ENVIRONMENTAL SCIENCES (PhD, MS)

ENVIRONMENTAL, COASTAL, AND OCEAN SCIENCES PhD TRACK, ENVIRONMENTAL BIOLOGY PhD TRACK, GREEN CHEMISTRY PhD TRACK, MOLECULAR, CELLULAR, AND ORGANISMAL BIOLOGY PhD TRACK, ENVIRONMENTAL SCIENCES MS

Faculty

Robert E Bowen, PhD, *University of Southern California* • Environmental Policy and Management

Robert F Chen, PhD, *University of California, San Diego* • Organic Geochemistry/Marine Organic Chemistry • Environmental Education

Joseph J Cooney (Emeritus), PhD, *Syracuse University* • Microbial Physiology and Ecology

Weston Dripps, PhD, *University of Wisconsin* • Hydrogeology

John A Duff, JD, *Suffolk University Law School* • Law and Marine Affairs

Eugene D Gallagher, PhD, *University of Washington* • Benthic Ecology • Environmental Statistics • Marine Community Structure

George B Gardner, PhD, *University of Washington* • Physical Oceanography (Part-time)

Harlyn Halvorson (Emeritus), PhD, *University of Illinois* • Microbiology

John F Looney, Jr, EdD, *Boston University* • Estuaries • Science Education

Sarah D Oktay, PhD, *Texas A&M University* • Chemical Oceanography (Part-time)

Curtis R Olsen, PhD, *Columbia University* • Environmental Biogeochemistry

William E Robinson, PhD, *Northeastern University* • Aquatic Toxicology

Michael P Shiaris (Biology Department), PhD, *University of Tennessee* • Microbial Ecology • Environmental Microbiology

David G Terkla, PhD, *University of California, Berkeley* • Environmental and Resource Economics

Yong Q Tian, PhD, *University Waikato* • GIS • Computer Modeling

Juanita L Urban-Rich, PhD, *University of Maryland* • Zooplankton Ecology

Gordon T Wallace, PhD, *University of Rhode Island* • Aquatic and Atmospheric Chemistry

Xuchen Wang, PhD, *State University of New York at Stony Brook* • Geochemistry and Carbon Isotope Geochemistry

Meng Zhou, PhD, *State University of New York at Stony Brook* • Physical Oceanography • Population and Behavior Dynamics

Programs and Facilities

The Doctoral Program in Environmental Science is composed of four multidisciplinary PhD tracks that are housed in the Departments of Environmental, Earth and Ocean Sciences (EEOS), Biology, and Chemistry at the University of Massachusetts Boston. The University's Master's Program in Environmental Science is housed in the Department of Environmental, Earth and Ocean Sciences (EEOS). The EEOS graduate program is unique in that it brings together faculty with expertise in biology, chemistry, physics, geology, economics, management, planning, law, and policy into a single academic department to effectively address environmental, coastal and ocean science issues, solve management problems, and advance scientific understanding and education at the interfaces of disciplines. The EEOS vision is to develop the nation's leading interdisciplinary research and educational program that integrates the natural and social sciences to generate and apply new knowledge for understanding and managing the impacts of anthropogenic perturbation on linked watershed and coastal marine systems. Both the doctoral and master's degree programs in Environmental Science train individuals for leadership roles as environmental scientists in the public and private sectors. Students prepare for careers in industry, government agencies, health-related fields, and university teaching and research. The program offers advanced course work, research, and other training in a broad spectrum of environmental problems in both the laboratory and the field.

The EEOS master's program in Environmental Science offers concentrations in applied marine ecology, aquatic chemistry, aquatic toxicology, environmental microbiology, environmental policy and law, and physical oceanography. Students in the master's program may choose either a thesis or a non-thesis option.

The UMass Boston campus is located on Boston Harbor within easy commuting distance of the residential areas of metropolitan Boston. Near the campus are island systems, protected bays, exposed open ocean areas, and Georges Bank. The University's field stations in Gloucester and on Nantucket Island provide access to additional marine, aquatic, wetland, and terrestrial ecosystems. Research facilities include modern, well-equipped laboratories, support facilities, the resources of the Healey Library's science collection, computing facilities, and specialized equipment reflecting the research interests of the faculty.

Degree Requirements

The PhD in Environmental Sciences/ Environmental, Coastal, and Ocean Sciences (ECOS) Track

Please see the general statement of degree requirements for doctoral programs in the "Regulations, Procedures, and Degree Requirements" section of this publication.

For the PhD in Environmental Sciences/ECOS Track, sixty credits are required. These credits are earned through a combination of course work and research. Formal course work includes a required core curriculum and a specialty area. Core courses include a course in statistics, two courses in the area of environmental law/policy/administration/management/economics, and any two of the following three courses: Biological Oceanographic Processes (ECOS 630); Chemistry of Natural Waters (ECOS 640); Physical Oceanography (ECOS 650). In addition, thirty hours of course work are generally necessary to provide a thorough grounding in the student's area of specialization as well as satisfy the interdisciplinary program of study requirements. At present, these areas of concentration include the chemistry of aquatic systems, zooplankton ecology, benthic ecology, environmental microbiology, environmental physiology/toxicology, environmental policy and administration, environmental education, and estuarine physics.

Each student's program of study and dissertation research is guided by a graduate committee. The student must select a major professor (or two major professors), who will serve as chair (or co-chairs) of this committee by the end of his or her second semester. The major professor and the student together select at least two additional ECOS faculty members to complete the graduate committee.

By the end of the third semester, the student meets with the committee to formulate his or her program of study. This plan will include the specification of areas for which the student will be responsible on the comprehensive examination; a written dissertation proposal; and, if considered necessary by the committee, a scientific communication, computer language, or foreign language requirement.

No later than the sixth semester, the graduate committee administers the comprehensive written and oral examination, which tests intellectual maturity and competence both in the broad area of environmental sciences and in the student's area of specialization. In order to advance to the oral portion of the examina-

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tion, the student must perform satisfactorily on the written portion. A student who fails the comprehensive examination may, at the committee's discretion, be permitted a second and final examination.

The student who successfully completes the comprehensive examination becomes a candidate for the PhD degree, and is thus required to present and defend a scholarly dissertation based on original research. The student's dissertation committee consists of at least four members, one of whom will be from outside the faculty of the ECOS Track. The student's major professor will chair the committee.

Dissertation research may be done in the laboratory or in the field, or may be carried out in part during residency with an appropriate private business or governmental agency.

If the presentation and successful defense of the dissertation do not take place within five years of admission to candidacy, the candidate must repeat the comprehensive examination. Please see the general statement on time limits and leaves of absence.

The adequacy of each student's progress toward the degree will be assessed at least once a year. Until the student's graduate committee is formed, this assessment is made by the graduate program director in consultation with the faculty. The student's committee, when selected, assumes the responsibility for the ongoing assessment of the student's progress.

Criteria for adequate progress include performance in courses and seminar presentations (starting in the second year, each student presents one departmental seminar per year); and substantive progress in selecting/conducting doctoral dissertation research. Students are expected to maintain a B average in courses and, normally, two grades of C or one grade of F will result in dismissal from the program. The student must have a B (3.0) average, or better, at the time of the comprehensive examination.

The PhD in Environmental Sciences/Environmental Biology Track

Please see the general statement of degree requirements for doctoral programs in the "Regulations, Procedures, and Degree Requirements" section of this publication. Complete information on the Environmental Biology track may be found in the "Biology" section of this publication.

The PhD in Environmental Sciences/Green Chemistry Track

Please see the general statement of degree requirements for doctoral programs in the "Regulations, Procedures, and Degree Requirements" section of this publication. Complete information on the Green Chemistry track may be found in the "Chemistry" section of this publication.

The PhD in Environmental Sciences/Molecular, Cellular, and Organismal Biology Track

Please see the general statement of degree requirements for doctoral programs in the "Regulations, Procedures, and Degree Requirements" section of this publication. Complete information on the Molecular, Cellular, and Organismal Biology (MCOB) track may be found in the "Biology" section of this publication.

The MS in Environmental Sciences

Please see the general statement of degree requirements for master's degree programs in the "Regulations, Procedures, and Degree Requirements" section of this publication. The MS program requires 30 credit hours. All students take a core course in environmental policy, any two of the following three courses: Biological Oceanographic Processes (ECOS 630); Chemistry of Natural Waters (ECOS 640); Physical Oceanography (ECOS 650); and additional courses specific to their individual areas of concentration.

By the end of his or her first semester in the program, the student selects a major professor. No later than the second semester, the major professor and student choose one (non-thesis) or two (thesis) additional members to form the graduate committee which is responsible for insuring that he or she fulfills the requirements of the program and those of the Office of Graduate Studies.

Students choosing to write a thesis enroll in ECOS 699 (Thesis Research). Students choosing the non-thesis option enroll in ECOS 698 (Projects in Environmental Sciences).

Students choosing the thesis option must present and defend a thesis based on their research. Students selecting the non-thesis option must present the results of their project to the committee.

Criteria for adequate progress include performance in courses and seminar presentations (starting in the second year, each student presents one departmental seminar per year). Students are expected to maintain a B average in courses and, normally, two grades of C or one grade of F will result in dismissal from the program.

Admission Requirements

Please see the general statement of admission requirements for all graduate studies programs in the "Admissions" section of this publication.

The graduate admissions committees for all programs and tracks recommend admissions on the basis of the completed application, official transcripts, Graduate Record Examination scores (aptitude tests only), and letters of recommendation. It is strongly recommended that applicants required to take the TOEFL exam attain scores of at least 600.

A BS or BA degree is required for admission, with a major in the natural, physical, or social sciences, or in mathematics. Candidates who have completed a master's degree are particularly welcome in the doctoral program.

Completion of at least one year each of college level mathematics (including calculus), biology, chemistry, physics and social sciences will generally be considered as minimum prerequisites for admission to study at the master's or doctoral level. Applicants should consult with prospective advisors, as there may be additional prerequisites for specific specialty areas. Students are also advised to review the subject matter of the prerequisite courses before they begin the program.

At the discretion of the graduate admissions committee, and depending on the area of concentration an applicant chooses, academic deficiencies at the undergraduate level may need to be remedied before the applicant is admitted to either the master's or the doctoral program. After admission, the student's advisory or dissertation committee may also require that academic deficiencies be remedied. The stated interest of a prospective student must coincide to an acceptable degree with the faculty specialties represented within the program. Generally, prospective students should identify potential faculty advisors in their application.

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To assure applicants of full and timely consideration, completed applications should normally be received by January 21 for the fall semester and by October 15 for the spring semester; however, applications received after those dates may be considered. Notification of admission is made as soon as possible. In general, students who have been admitted will be notified of assistantship awards shortly thereafter.

Course Information

Graduate courses in the Environmental Sciences Program are open to regularly matriculated students in the program, and to others with permission of individual course instructors.

In addition to the courses listed below as offered by the program, students in environmental sciences may take graduate courses and certain undergraduate courses in biology, chemistry, economics, mathematics, and physics as part of their program of study.

Courses

ECOS 525
Environmental Science Content Institute

This course is designed to use environmental sciences as an integrating context for teachers of middle school science. Field experiences in and activities drawn from the Neponset River Watershed will enhance the teaching of middle school earth science, life science, and physical science curricula. A conceptual framework for environmental sciences will connect field experiences to Massachusetts state curriculum frameworks.
3 Credits

ECOS 601
Introduction to Applied Statistics

This course provides graduate students in the sciences with an intensive introduction to applied statistics. Topics include descriptive statistics, probability, non-parametric methods, estimation methods, hypothesis testing, correlation and linear regression, simulation, and robustness considerations. Calculations will be done using handheld calculators and the Minitab Statistical Computer Software. (Course offered in the fall only.)
Prerequisite: Permission of instructor.
3 Lect Hrs, 3 Credits

ECOS 605
Teaching Environmental Science and Technology

Environmental Science offers engaging, integrated, contextual learning opportunities for students from K to gray. This course is intended to explore the effective use of environmental science to teach science at all levels, while a practical focus on general science at the middle school level will guide activities and examples. While attention will be paid to how people learn, curriculum frameworks, and practical limitations in K-12 classrooms, the focus of this course will be environmental science content, including: Biogeochemical Cycles, Energy Flow and Transformation, Ecosystems, Biodiversity and Evolution, Spatial and Temporal Reference Frames, Earth System Science, Ways of Knowing, and Human Interactions.
3 Lect Hrs, 3 Credits

ECOS 611
Applied Statistics

This course is designed to prepare the student to design and analyze experiments and field studies using ANOVA (Analysis of Variance) and regression techniques. Calculations are performed using handheld calculators and the SAS Statistical Computer Software. (Course offered in the spring only.)
Prerequisites: ECOS 601 or equivalent, or permission of instructor.
3 Lect Hrs, 3 Credits

ECOS 612
Multivariate Statistics

Introduction to multivariate statistical methods. Topics include regression analysis and various classification techniques. Theoretical foundations are discussed, but the emphasis is on applications. Students make use of a computer statistics package.
Prerequisite: ECOS 611 or equivalent, or permission of instructor.
3 Lect Hrs plus independent work at the computer console, 3 Credits

ECOS 616
Environmental Policy and Administration

Study of how solutions to environmental problems are implemented. Techniques of policy-making and administration in both public and private organizations are studied. Government and industrial administrators are brought to campus to provide insight into real-world problems and solutions. (Course offered in the fall only.)
3 Lect Hrs, 3 Credits
Mr Bowen

ECOS 621
Plankton Dynamics

The focus of the course will be on the dynamic processes and interactions between water column plankton (e.g., phytoplankton, zooplankton, bacteria, and protists) with regard to nutrient and energy exchange. The course will examine how changes in the water chemistry can affect biological processes and community composition and the impacts this has on marine resources and society. There will be a small field component to this course where students are exposed to and allowed to see the different plankton organisms along with being shown the basic methods for studying the different water-column plankton.
3 Lect Hrs, 3 Credits

ECOS 622
Introduction to Zooplankton Ecology

Zooplankton can be called the cows of the sea. These animals range in size from 2 µm to .1 mm and are the food supply for many commercially important fish, whales, and other large animals. This course will examine the different classes and functional groups of marine zooplankton, with an emphasis on copepods and tunicates. Zooplankton morphology, physiology, ecology, and geographical distributions will be discussed in detail and related to larger environmental issues, e.g., global warming, eutrophication.
3 Lect Hrs, 3 Credits
Ms Urban-Rich

ECOS 623
Introduction to Geographic Information Systems

This course teaches the concepts, principles, approaches, techniques, and technologies of geographic information systems (GIS).The specific topics include essential elements of a GIS, hardware requirements and system integration, technologies and techniques for acquiring spatial data, spatial data models, data structures, data formats, database models, spatial analysis and modeling, cartographic design, implementation of a GIS, and environmental and socioeconomic applications. Hands-on exercises on ArcView are assigned each week. A term project on the use of a GIS in solving a specific environmental or socio-economic problem is required.
Prerequisite: Permission of instructor.
2 1/2 Lect Hrs, 2 1/2 Lab Hrs, 4 Credits

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ECOS 625
Principles and Applications of Remote Sensing
In this course, students learn the physical principles of remote sensing and become familiar with the capabilities and limitations of current and future remote-sensing systems. They also learn the techniques commonly used for interpreting aerial photographs, satellite remote-sensing data, and thermal and radar imagery, and gain practical lab experience in image interpretation. They are exposed to a wide variety of applications in environmental mapping and monitoring, natural resource management, urban and regional planning, and global change research.
Prerequisite: ECOS 611 or permission of instructor.
2 1/2 Lect Hrs, 2 1/2 Lab Hrs, 4 Credits

ECOS 627
Environmental Modeling in Raster GIS
This course has two major components. The first component focuses on GIS raster data models, their structure and function, and in particular their use in a modeling context. The second component focuses on the use of modern structures design techniques for forming a basis for the correct design and implementation of geographic information systems applications.
3 Lect Hrs, 3 Credits

ECOS 630
Biological Oceanographic Processes
The processes which govern the population dynamics of phytoplankton, zooplankton, and benthos will be studied in the context of ecological simulation modeling. Calculus recommended, but not required. (Course offered in the fall only.)
3 Lect Hrs, 3 Credits
Mr Gallagher

ECOS 635
Environmental Toxicology
The course will impart basic principles of environmental toxicology, focusing on toxicological assessment, types and mechanisms of toxicological response, the properties and effects of specific groups of toxicants released into the environment (e.g., PAH, PCB, pesticides, metals, dioxins/dibenzoofurans), and an overview of current issues facing the rather broad field of environmental toxicology. Toxicological responses will be discussed at all levels of biological organization, from the molecular/biochemical, cellular, and organismal up through the population, community, and ecosystem. Biochemical toxicology will be particularly emphasized with respect to toxicant absorption, internal partitioning/transport, metabolism/detoxification, sequestering, targeting, and elimination.
3 Lect Hrs, 3 Credits
Mr Robinson

ECOS 640
The Chemistry of Natural Waters
A basic description of the chemistry of natural and especially marine waters designed to lay the foundation for more advanced course work. Emphasis will be on the chemical composition of natural waters and the identification of the important chemical, physical, and biological processes controlling their composition. A case study, emphasizing the multidisciplinary nature of these processes, will be given at the end of the course.
3 Lect Hrs, 3 Credits
Mr Wallace

ECOS 645
Analytical Techniques in Environmental Science
This course serves as a practical introduction to analytical methods and instrumentation available to the environmental scientist. Topics include 1) sampling of air, water, and sediment and in situ instrumentation (e.g. CTD and sensors); 2) extraction and separation techniques, such as ultracentrifugation and ultrafiltration, and electrophoresis; 3) thin layer, gas, and liquid chromatography; 4) mass spectrometry; and 5) UV-Vis, fluorescence, NMR, and ESR spectroscopy. Emphasis is given to recent analytical developments and to instrumentation available to Environmental Science Program students. (Course offered in the fall every other year.)
Prerequisite: Permission of instructor.
Mr Chen

ECOS 650
Physical Oceanography
This course introduces the physical processes active in the ocean environment, including coastal and estuarine regions, and investigates the connection between those processes and observed physical characteristics of the ocean. (Course offered in the fall only.)
Prerequisites: Physics or calculus, or permission of instructor.
3 Lect Hrs, 3 Credits
Mr Gardner

ECOS 655
Estuarine and Coastal Physical Processes
Topics include mathematical theories of tides, tidal currents, shallow water waves, mixing, stratification, estuarine circulation, baroclinic currents, frontal dynamics, and baroclinic instability. This course will focus on basic concepts of physical processes in estuaries and coastal oceans. Students should have a solid working skill of algebra and solid understanding of calculus. A working knowledge of ordinary and partial differential equations is a plus, but is not required.
Prerequisites: Calculus and physics, or permission of instructor.
3 Lect Hrs, 3 Credits
Mr Zhou

ECOS L658 (BIOL L658)
Environmental Physiology
A discussion course exploring in detail the mechanisms by which organisms adapt to their environment, and highlighting the interplay among cellular function, physiological function, and the ecology of the organism. (Course offered in the spring every other year.)
Prerequisites: BIOL 211 or 213, and 371; or permission of instructor.
3 Lect Hrs, 3 Credits
Mr Robinson

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ECOS 670
Environmental Economics
This course is designed for those students in the program who have a minimal background in economics. It focuses on the use of economic analysis as a tool for helping to resolve environmental policy problems. Discussion includes such topics as benefit-cost analysis, the taxation and regulation of polluters, and the analysis of current government policies directed at the regulation and reduction of air, water, and solid waste pollution. (Course offered in the spring every other year.)
Prerequisite: College calculus or permission of instructor.
3 Lect Hrs, 3 Credits
Mr Terkla

ECOS 675
Marine Resource Economics
This course is designed for graduate students in environmental sciences with an interest in economics. It explores the use of economic analysis in helping to solve natural resource problems of the coastal zone and ocean. In particular, it focuses on such topics as fisheries management, resource scarcity, the concept of economic efficiency, measuring the benefits of natural resources, on-shore coastal development, and depletable, recyclable, and non-recyclable resources. (Course offered in the spring every other year.)
Prerequisite: Permission of instructor.
3 Lect Hrs, 3 Credits
Mr Terkla

ECOS 680
Coastal and Ocean Law
An examination of the laws to preserve, develop, and manage coastal ocean resources and space. Judicial decisions interpreting and applying these laws are a major focus, although attention is also given to the coastal and ocean policies embodied in them and the process by which these policies have been established.
Prerequisite: Permission of instructor.
3 Lect Hrs, 3 Credits
Mr Duff

ECOS 685
Legal Foundations for Ecosystem Management
This course examines current US environmental and natural resource management laws from the perspectives of modern "ecosystem management." Because these laws were enacted in the late 1960s and 1970s, they typically do not reflect the findings of the ecological sciences with respect to the need to preserve critical ecological processes or the need to manage the natural environment at appropriate spatial and temporal scales. Students participate in discussions of readings in the ecosystem management literature, select and critically review an environmental or natural management program from an ecosystem management perspective, and present their findings to the seminar.
Prerequisite: Admission to program or permission of instructor.
3 Lect/Disc Hrs, 3 Credits
Mr Duff

ECOS 691
Current Literature in Environmental Sciences
A series of one-credit seminar courses focusing on subfields of environmental science, designed to help students develop the habit of keeping up with recent developments through reading scientific journals. The seminars also provide a forum for discussion of significant new findings in the field as well as discussion and critique of the students' own research.
Prerequisite: Permission of instructor.
1 1/2 Lect/Disc Hrs, 1 Credit

ECOS 692
WISP Seminar
This seminar is designed to prepare WISP (Watershed-Integrated Sciences Partnership between UMass Boston and three local school districts) Fellows for intensive summer workshops (Teacher Training and Environmental Science Content Institute), to initiate an exploration of science education practices, and to expose Fellows to middle school classroom teaching. The seminar is intended to provide consistency and a passing on of experiental knowledge from one cohort of Fellows (outgoing) to the next (incoming). The 1-credit seminar is required for participation of UMass Boston graduate students in the GK-12 program as Fellows.
1 Lect Hr, 1 Credit
Mr Chen

ECOS 697
Special Topics in Environmental Sciences
This course provides an opportunity for presentation of particularly timely lecture/laboratory/field material which does not fall under the purview of any other course.
Prerequisite: Permission of instructor.
Hrs by arrangement, 1-4 Credits

ECOS 698
Projects in Environmental Sciences
A practicum resulting in a substantial written report based on library, laboratory, or field research which involves an original project. Up to 6 credits from this course may be applied to the MS degree, over more than one semester. Please note: This course is required for all master's-level students taking the non-thesis option; it is not open to doctoral students. Students may not take both ECOS 698 and 699.
Prerequisite: Completion of 9 graduate credits in the Environmental Sciences MS Program, or permission of Graduate Program Director.
Hrs by arrangement, 1-6 Credits

ECOS 699
Thesis Research
Research conducted under faculty supervision which leads to the presentation of a master's thesis. Up to 10 credits from this course may be applied to the MS degree, over more than one semester. Please note: This course is required for all master's-level students taking the thesis option; it is not open to doctoral students. Students may not take both ECOS 698 and 699.
Prerequisite: Completion of 9 graduate credits in the Environmental Sciences MS Program, or permission of instructor.
Hrs by arrangement, 1-10 Credits

ECOS 710
Environmental Biogeochemistry
This course identifies and defines the influence of biota on the geochemical cycling of inorganic and organic substances through the atmosphere, hydrosphere, and lithosphere. Particular emphasis is given to contemporary research in the biogeochemistry of carbon, sulfur, selected metals, and organic compounds of natural and anthropogenic origin. Calculus and biochemistry are recommended, but not required. (Course offered in the spring every other year.)
Prerequisites: CHEM 253 and 254 or equivalent; or permission of instructor.
3 Lect Hrs, 3 Credits
Mr Chen

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ECOS 715
Isotope Geochemistry
This course explores the use of stable and radioactive isotopes in delineating biogeochemical and geochemical processes in the environment. Emphasis is given to recent advances in the field. Specific topics to be addressed include geochronology, paleothermometry, use of isotopes as tracers, and analytical methods. A team project exercise combining field and laboratory work and presentation of results is required. (Course offered in the fall every other year.)
Prerequisites: ECOS 630, 640, and 650; or permission of instructor.
3 Lect Hrs, 3 Credits
Mr Wallace

ECOS 716
Scientific and Technical Information and the Policy Process
This course considers the role of scientific and technical information in the policy-making process. Questions of the impact of information on policy evaluation, the role of scientists, and research agenda setting are all discussed. (Course offered in the spring only.)
3 Lect Hrs, 3 Credits
Mr Bowen

ECOS 718
Environmental Law and Policy: Federal Agencies, Courts, and Congress
This course surveys three major areas of federal involvement in environmental law and policy. The first is federal environmental and resource management programs and laws, such as the Clean Water, Ocean Dumping, Superfund, Resource Conservation and Recovery, Coastal Zone Management, and Fishery Conservation and Management Acts. The second is the role of the federal agencies and courts in implementing and overseeing federal laws; and the third is the legislative functions of the US Congress in debating, enacting, and monitoring national policy. Emphasis is placed on coastal and marine environmental problems and issues.
Prerequisite: Permission of instructor.
3 Lect Hrs, 3 Credits
Mr Duff

ECOS 720
Benthic Boundary Layer Process
An interdisciplinary view of the benthos in freshwater, estuarine, and marine ecosystems. Special attention is paid to the interactions between physical, chemical, and geological processes and benthic populations. Calculus, ECOS 630, ECOS 640 recommended. (Course offered in the spring every other year.)
3 Lect Hrs, 3 Credits
Mr Gallagher

ECOS 726
Coastal Zone Management
This course introduces and evaluates the legal, political, and social factors that most directly affect the management of coastal area resources. Both conceptual and case-oriented literature are reviewed, in order to familiarize the student with the evolution and practice of coastal zone management generally in the U.S., and particularly in the Commonwealth of Massachusetts.
3 Lect Hrs, 3 Credits
Mr Bowen

ECOS 750
Organic Geochemistry
This course examines the production and cycling of organic matter at the earth's surface. Starting with the photosynthetic fixation of CO_2 and the biosynthesis of a diverse array of molecules, the course traces the path of reduced carbon through the biogeosphere to incorporation in sedimentary deposits. Specific topics to be addressed include photosynthesis, biosynthesis, chemical evolution, the organic carbon cycle, diagenesis, and catagenesis: the formation of fossil fuels, and the biogeochemistry of organic compounds of environmental concern. Students are introduced to selected analytical methods used in organic geochemistry. (Course offered in the fall every other year.)
Prerequisite: ECOS 640 or ECOS 710, or permission of instructor.
4 Lect Hrs, 3 Credits
Mr Chen

ECOS 760
Aquatic Toxicology
The course will provide advanced study in aquatic toxicology, focusing on current topics and issues facing the broad field of aquatic toxicology, including toxicological assessment, approaches to modeling toxicant absorption, water and sediment criteria, and the diverse mechanisms employed by aquatic organism to deal with a variety of chemical toxicants. The interdisciplinary nature of the field, particularly the interactions among various natural and social sciences, will be stressed.
3 Lect Hrs, 3 Credits
Mr Robinson

ECOS 780
Seminar in Environmental Chemistry
Lectures and discussion focused on contemporary issues in environmental chemistry. (Course offered in the fall every other year.)
Prerequisites: ECOS 640 and/or permission of instructor.
3 Lect Hrs, 3 Credits
Mr Wallace, Mr Chen

ECOS 788
Current Issues in Toxicology
Topical and controversial issues in toxicology are the focus of this lecture/seminar course. Participants explore such concerns as dental mercury amalgam, Alar, radon, Agent Orange, electromagnetic fields, and environmental tobacco smoke. Each topic is assessed with respect to health effects and health risk, cellular mechanisms of toxicological action, route of uptake, persistence in the environment, public concern, and regulatory action. Current data on health effects are scrutinized to determine whether public concerns and regulatory actions are indeed justified. (Course offered in the spring every other year.)
Prerequisites: ECOS 660, BIOL 371 and 372, and permission of instructor.
3 Lect/Disc Hrs, 3 Credits
Mr Robinson

ECOS 791
Seminar in Environmental Sciences
Presentations and discussions of current topics in environmental sciences by students and visiting lecturers. Registration required each semester.
1 Disc Hr, 1 Credit

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ECOS 796
Independent Study in Environmental Science
Independent laboratory and/or library studies under the direction of a faculty member.
Prerequisite: Permission of instructor and program director.
Hrs by arrangement, 1-3 Credits

ECOS 798
Internship in Environmental Sciences
Individual student placements at a private sector or government institution in order to provide training and professional experiences not available on campus. Each placement is jointly supervised by an individual at the host agency or company and by a faculty member.
Prerequisite: Completion of 18 graduate credits.
Hrs by arrangement, 1-9 Credits

ECOS 899
Dissertation Research
Research, conducted under faculty supervision, which leads to the presentation of a doctoral dissertation.
Hrs by arrangement, 1-10 Credits

GERONTOLOGY (PhD, MS, GRADUATE CERTIFICATE)

MANAGEMENT OF AGING SERVICES TRACK (MS)

Faculty

Ellen Birchander, MS,*Tufts University*, MSW, *Boston College* • Experimental Psychology (Part-time)

Ellen A Bruce, JD, *Northeastern University* • Law

Jeffrey A Burr, PhD, *University of Texas at Austin* • Sociology

Francis G Caro, PhD, *University of Minnesota* • Sociology

Yung-Ping Chen, PhD, *University of Washington* • Economics

Lillian Glickman, PhD, *Brandeis University* • Public Policy (Part-time)

Jan E Mutchler, PhD, *University of Texas at Austin* • Sociology

Frank Porell, PhD, *Carnegie-Mellon University* • Urban and Public Affairs

Nina M Silverstein, PhD, *Brandeis University* • Social Welfare

Marian Spencer, RN, MS, *Boston University* • Social Welfare

Barbara F Turner, PhD, *University of Chicago* • Human Development

Robert Weiss (Emeritus), PhD, *University of Michigan* • Sociology

The PhD Program

UMass Boston's PhD Program in Gerontology is located in the McCormack Graduate School for Policy Studies. The PhD Program is designed to prepare students for leadership roles as teachers, researchers, planners, and policy makers in this field of growing importance for both the private and the public sectors. The program's approach reflects the urban mission of the University of Massachusetts Boston. Special attention is given to the needs of the low-income elderly, and to issues of racial and cultural diversity.

The PhD Program in Gerontology qualifies a select group of skilled researchers and policy analysts to extend the frontiers of this growing field through research, teaching, or policy development; and to prepare themselves for leadership roles in our aging society. Advanced work in gerontology is interdisciplinary, bridging theories, concepts, and research methods drawn from several social sciences.

The curriculum of UMass Boston's PhD Program in Gerontology is designed to give graduates command of a broad body of specialized knowledge in aging and social policy, as well as the capacity to develop methodologically sound procedures to expand that base of knowledge and understanding. The program can be completed in four years: five semesters of full-time course work, one semester of combined course and dissertation work, and two semesters of full-time dissertation work.

The program's location on campus adjoins UMass Boston's Gerontology Institute. The Gerontology Institute, established by the Massachusetts Legislature, constitutes a major resource for the doctoral program. The Institute's mission is to focus attention on the economic, social, and political issues that confront the aging population. Institute activities include policy research and analysis as well as publication of the *Journal of Aging & Social Policy.* The Institute emphasizes the demography of aging, income security, health care, long-term care, and productive economic and social roles for the elderly. Older people themselves are often involved in the design and execution of Institute activities. Students in the program gain experience by participating in the Institute's research and policy projects.

Degree Requirements

Please see the general statement of degree requirements for doctoral programs in the "Admissions" section of this publication.

Degree requirements for the Gerontology PhD Program include course work, an empirical research paper, qualifying paper examination, and a doctoral dissertation.

Course Work

Students in the Gerontology PhD program must accumulate 69 credits, through taking courses as listed below:

A. Four foundation courses, which emphasize different disciplinary approaches to aging:

   GERON 621 (Social Aspects of Aging)

   GERON 626 (Economic Issues in Aging Populations)

   GERON 628 (Psychology of Aging)

   GERON 724 (Ethnic and Racial Diversity in Aging Societies)

   (Total: 12 credits)