ENL 699 Independent Study in English (A).
Designed individually through consultation between student and instructor to suit the student’s needs and interests and the special competence of the instructor. Additional requirements may be imposed by the department. 1-6 Cr. Every Semester.

DEPARTMENT OF ENVIRONMENTAL SCIENCE AND BIOLOGY

105 Lennon Hall
(585) 395-5975

Chairperson and Professor: James M. Haynes, PhD, University of Minnesota; Distinguished Service Professor: Joseph C. Makarewicz, PhD, Cornell University; Empire Innovation Professor of Wetland Science: Douglas A. Wilcox, PhD, Purdue University; Professor: Christopher J. Norment, PhD, University of Kansas; Assistant Professors: Mark D. Norris, PhD, University of Minnesota; Jacques Rinchard, PhD, University of Namur (Belgium); Instructional Support Technician: Hillary R. Mosher; Environmental Science Program Faculty: Whitney J. Autin, Associate Professor of Earth Sciences, PhD, Louisiana State University; Mark R. Noll, Associate Professor of Earth Sciences, PhD, University of Delaware; Paul L. Richards, Assistant Professor of Earth Sciences, PhD, Pennsylvania State University; James A. Zollweg, Associate Professor of Earth Sciences, PhD, Cornell University; Michael A. Brown, Assistant Professor of Chemistry, PhD, University of Memphis; Mark P. Heitz, Associate Professor of Chemistry, PhD, SUNY at Buffalo; Markus M. Hoffmann, Associate Professor of Chemistry, PhD, Washington University; Adjunct Faculty: David H. Kosowski (NYDEC retired); Theodore W. Lewis (Research Associate); Gary N. Neuderfer (NYDEC retired); Charles R. O’Neill (New York Sea Grant); and Norma A. Polizzi, JD, Adair Law Firm.

Environmental problems are among the most urgent issues facing our civilization. In order to manage Earth’s environment well, we must understand the processes that shape its surface; control the chemistry of the air, water and soil; and produce and maintain the biological and other resources upon which humans depend. We must also understand the interactions of animals, plants and other living organisms with their physical and chemical environments, or their ecology. The environmental science curriculum includes both a common core and an individual course of study that allows MS candidates to develop conceptual knowledge and technical skills to use the disciplines of ecology, chemistry and the earth sciences to understand and solve environmental problems. Thus, fields of study like “green” and water chemistry, watershed analysis, limnology, fisheries and wildlife science and management, conservation biology, ecosystem ecology and global change, wetlands, and aquaculture are encompassed in this degree program.

The MS in environmental science and biology is a demanding, thesis-based experience. The curriculum is designed to challenge students to think critically, independently and creatively, while providing the intellectual depth and breadth necessary to support the research formally developed in the thesis proposal. Graduates in the areas of biological and earth sciences and chemistry with a focus on environmental science have been very successful gaining admission to doctoral programs or finding professional employment in one of the environmental sciences.

Admission Requirements

Each student pursuing the MS is supervised by a faculty member in the Department of Environmental Science and Biology, or by an “associate” faculty member from the Departments of the
Earth Sciences or Chemistry. The thesis advisor monitors the student's academic progress and is responsible for directing the student's academic program, including the thesis proposal, oral comprehensive examination, thesis project, and thesis defense.

Whether or not the applicant can be accepted will depend on his or her credentials and intended area of specialization, and the ability of a faculty member to accept a new MS advisee. Before a student is admitted to the MS program in environmental science and biology, a faculty member must be willing to serve as the student's thesis advisor.

**The Curriculum**
The MS program in environmental science and biology is designed so that the student can complete all coursework in two years.

**First Fall Semester**
- *Experimental Design (ENV 614)* 3
- *Research Seminar (ENV 705)* 1
- 700/600/500 Level Elective 3-4
- 700/600/500 Level Elective 3-4

**Subtotal** 10-12

**First Spring Semester**
- *Research Seminar (ENV 705)* 1
- 700/600/500 Level Elective 3-4
- 700/600/500 Level Elective 3-4

**Subtotal** 7-9

**Second Fall Semester**
- 700/600/500 Level Elective 3-4
- 700/600/500 Level Elective 3-4

**Subtotal** 6-8

**Second Spring Semester**
- *Thesis Research (ENV 704)* 1
- 700/600/500 Level Elective 3-4

**Subtotal** 4-5

**Minimum credits required for graduation** 30

* Signifies a required course.

Must take at least one credit of ENV 704, Research Thesis, during the MS Program; may take up to six credits.

**Graduation Requirements**

1. Establish a Thesis Advisory Committee early in the first semester after matriculation.

2. Complete the graduate Plan of Study, as determined by the Thesis Advisory Committee in consultation with the candidate, by the end of the first semester after matriculation.


4. Successfully complete an Oral Comprehensive Examination, administered by the Thesis Advisory Committee, by the end of the third semester after matriculation. The results of the exam may be used by the Advisory Committee to adjust the candidate’s Plan of Study. In case of failure of the exam, ONE oral reexamination may be granted by the committee before the start of the fourth semester after matriculation.

5. Required core courses (6 credits)
   a. Graduate Research Seminar (ENV 705 – 2 credits, taken as one, 1-credit course per semester during the first four semesters after matriculation).
   b. Thesis (ENV 704 – at least one credit, maximum of six, taken in the second, third or fourth
c. Experimental Design (ENV 614 – 3 credits)
6. A minimum of 15 semester hours at the 600- and 700-level.
7. A minimum of 30 semester hours of graduate credit with a cumulative GPA of 3.0 or higher in all graduate courses taken at The College at Brockport.
9. Submission of five copies of the successfully defended thesis to the ESB department secretary.

ENVIRONMENTAL SCIENCE AND BIOLOGY COURSES

ENV 500 Plant Diversity (A). Prerequisite: One general biology and one 400-level ecology course. In-depth study of the diversity of plants from an evolutionary perspective to taxonomic and botanical characteristics. Laboratory and field work surveys plant structures and principles of plant classifications and identification from the cellular to organismal level. Projects include plant collection and preservation, plant propagation, plant reproduction, and review and presentation of botanical literature. 4 Cr. Odd Fall.

ENV 505 Plant Ecology (A). Prerequisite: One general biology and one 400-level ecology course. In-depth study of the relationships between plants as well as with the environment including physiological ecology and describing the plant environment; population ecology and interactions between plants and other organisms; and community ecology including plant diversity and temporal dynamics. Uses field exercises to explore local plant communities using experimental and quantitative techniques. Requires students to analyze and discuss current readings in plant ecology. 4 Cr. Even Fall.

ENV 513 Topics in Plant Biology (A). Prerequisite: ENV 400 or 405. In-depth discussion of recent scientific literature and experimental data in plant biology, ecology, and systematics. Requires students to critically analyze current scientific literature and write a research paper. 3 Cr.

ENV 519 Principles of Limnology (A). Prerequisite: ENV 303. In-depth study of the physical, chemical and biological properties of lakes and streams. Topics include top-down: bottom-up control of food webs, eutrophication, nutrient cycling, acid precipitation effects on lakes, paleolimnology, etc. Requires students to critically analyze classical and current limnological literature and write two research papers. ENV 521 is the complementary laboratory. 3 Cr. Fall

ENV 521 Limnology Lab (A). Prerequisite: ENV 303. In-depth study of the laboratory and field methods of limnology. Topics include sampling and identification of selected aquatic organisms, chemical analysis of water, and operation of physical and chemical sampling gear. Includes field exercises on lakes, using department vessels, and in streams. ENV 519 is the complementary lecture course. 2 Cr. Fall.

ENV 523 Biology of Pollution (A). Prerequisite: One general biology and one college chemistry course. In-depth study of the chemistry and biology of pollution. Places primary focus on water pollution problems and effects of pollutants on organisms at the molecular, cellular, physiological and behavioral levels, plus effects on populations, communities and ecosystems. Provides an overview of toxicity testing techniques and data analysis. 3 Cr. Odd Spring.

ENV 527 Animal Behavior (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of the science of animal behavior. Explores the behavior of animals in relation to adaptions and phylogenetic history. Topics include methods of studying behavior, the effects of genes and environment on behavior, relationships between neural and endocrine function and behavior, foraging strategies, mating strategies and systems, and social systems. 3 Cr. Even Fall.

ENV 530 Ornithology (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of birds. Explores their form, function, ecology and evolution. Topics includes anatomy, physiology, origins and biophysics of flight, migration and annual cycle, mating systems, and population and community ecology of birds. Includes lab and field study of anatomy and flight, identification techniques, census methods, and trapping and banding. 4 Cr. Even Spring
ENV 535 Northern Wetlands (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of wetlands of the northern United States – peatlands and Great Lakes coastal marshes. Addresses wetland development starting with underlying geology and hydrology, then proceeding to biogeochemistry and development of plant communities and faunal habitats. Assesses human impacts on these wetland types, along with potential means for preventing degradation and restoring wetland functions. 3 Cr. Even Spring

ENV 539 Conservation Biology (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of conservation biology. Examines current theories and data from evolutionary biology, ecology and genetics as they relate to the conservation of biological diversity. Topics include causes of extinction, habitat loss and fragmentation, design of nature reserves, landscape ecology, application of basic principles of population biology to species conservation, and restoration ecology. 3 Cr. Even Fall

ENV 540 Herpetology (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of reptiles and amphibians. Explores their form, function, ecology and evolution. Topics include anatomy, physiology, mating systems, population and community ecology of herpetofauna, and their conservation biology. Includes lab and field study of identification techniques and capture and census methods. 4 Cr. Odd Spring

ENV 544 Terrestrial Ecosystem Ecology (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of the major terrestrial ecosystems of the world and the stresses they face due to global environmental change such as rising atmospheric carbon dioxide levels, global warming, declining biodiversity, invasive species and elevated nitrogen deposition. Compares systems with respect to their major characteristics, including vegetation, energy flow, and nutrient cycling and inputs. 3 Cr. Even Spring

ENV 546 Wetland Ecology (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of wetland science, from wetland types, functions, values, hydrology, biogeochemistry, development, succession, and plant and animal communities. Laboratory exercises consist of field trips to local wetlands of different types, field sampling experiences, practice in wetland delineation, and lab experiments. Focuses on practical application of knowledge gained and concludes with problems related to wetland management and restoration. 4 Cr. Fall

ENV 548 Restoration Ecology (A). Prerequisites: One general biology and one 400-level ecology course. In-depth approach to restoration of terrestrial, wetland, and aquatic ecosystems to be addressed by focusing on regulatory constraints, site characterization/evaluation, conceiving and designing restoration projects that fit within the surrounding landscape, monitoring requirements, control of invasives, and adaptive management. Working in groups, students develop conceptual restoration projects of their own choosing in terrestrial, wetland, or aquatic ecosystems. Assigns case studies for further analysis of restoration options. 3 Cr. Odd Spring

ENV 552 Environmental Laws and Regulations (A). In-depth discussion of key federal and state environmental laws, how branches of government interact to enforce environmental laws and regulations, and the roles scientists and lawyers play in resolving environmental issues. 3 Cr. Fall

ENV 559 Mammalogy (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of mammals. Explores their form, function, ecology and evolution. Topics include origins, anatomy, physiology, diet and feeding strategies, population and community ecology, and social systems. Laboratory and field activities emphasize mammalian classification, habitat selection and population biology. 4 Cr. Odd Fall

ENV 562 Aquatic Toxicology. Prerequisites: One general biology and one 400-level ecology course. In-depth study of toxicity testing equipment, procedures and organisms. Students design toxicity tests, analyze test results and culture test organisms. 4 Cr. Even Spring

ENV 564 Aquaculture I (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of the principles and practices of intensive and extensive aquaculture. Topics include system design and operation; water quality maintenance; diet and nutrition; reproduction, selective breeding and genetics; disease identification and treatment; and the biology of cultured organisms. 4 Cr. Odd Fall

ENV 574 Aquaculture II (A). Prerequisite: ENV 303. In-depth study of the business aspects of aquaculture. Topics include aquaculture inputs, aquaculture production, farm management, processing, distribution, marketing, consumer behavior, pricing, government policy, modeling, international trade, transfer of technology, international cooperation, and environmental impacts. 4 Cr. Even Fall

ENV 576 Animal Ecophysiology (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of physiological adaptations of animals to their physical environment and the influence of these adaptations on animal distributions. Topics include temperature and energy metabolism, water and ion balance, oxygen availabili-
ty, sensory and reproductive adaptations. Examines biochemical, cellular and organism responses to these factors using an integrative and comparative approach. 3 Cr. Odd Fall

ENV 577 Field Biology. Prerequisites: One general biology and one 400-level ecology course. Explores flora and fauna of various habitats in Western New York. Topics include structure and function of communities, species identification, qualitative and quantitative assessment of communities and ecosystems, and general conservation theory and practice. 4 Cr. Odd Summer

ENV 583 Aquatic Invertebrates. Prerequisites: One general biology and one 400-level ecology course. In-depth study of aquatic invertebrates and their importance in stream and lake ecosystems. Topics include invertebrate biology and ecology, classification and identification (insects, crustaceans, mites, annelids, mollusks, etc.), use of dichotomous keys and sampling equipment, and preparation techniques. Prepares students to predict habitat or water quality conditions based on the invertebrate fauna present. 4 Cr. Odd Spring

ENV 584 Fish Ecology (A). Prerequisites: One general biology and one 400-level ecology course. In-depth study of fish and fisheries. Topics include fish anatomy and physiology in relation to fish behavior and ecology, classification to the ordinal level, population dynamics (reproduction, growth, mortality, environment) and fishery management. ENV 590 is the complementary laboratory. 3 Cr. Even Spring

ENV 588 Environmental Impact Analysis (A). Prerequisite: ENV 303. Students prepare an environmental impact statement (EIS) for a realistic local development project. Topics include the National Environmental Policy Act, the NY State Environmental Quality Review Act, relevant regulations and permit requirements (federal, state, local), and analysis of environmental impacts and alternatives. Depending on the number of credits and session offered, may include field work. 4-6 Cr. Summer

ENV 590 Fishery Techniques and Fish Identification (A). Prerequisite: ENV 303. In-depth study of laboratory and field techniques used by fisheries scientists. Hands-on activities include fish collection methods (electrofishing, nets) fish anatomy, fish identification and quantitative analysis of fisheries data. ENV 584 is the complementary lecture course. 2 Cr. Odd Fall

ENV 614 Experimental Design and Data Interpretation (A). Prerequisite: MTH 121 or higher. In-depth study of experimental design, hypothesis formulation and testing, data manipulation and analysis, and interpretation of biological data. Topics include descriptive statistics, exploratory data analysis, and parametric and non-parametric two- and multi-sample tests using analysis of variance, regression and other techniques. 3 Cr. Fall

ENV 616 Multivariate Statistics (A). Prerequisites: ENV 614. Overview of common multivariate methods used for analysis of complex data and evaluation of scientific literature in ecological and environmental research. Topics include multivariate regression techniques, cluster analysis, principal components analysis, canonical and correspondence analyses, multivariate analysis of variance, and discriminant function analysis. Emphasis on applications, not theory. 3 Cr. Spring

ENV 621 Water Chemistry (A). Prerequisites: Two college chemistry courses. In-depth study of the theory and operation of analytical environmental chemistry instruments. Hands-on activities include flame and graphite furnace atomic absorption spectrophotometry, enzyme-linked immunosorbent assays (ELISA), gas chromatography by micro-ECD, and autoanalyser techniques for nutrients. Covers extraction techniques for tissue (soxhletic) and water (C-18 empore filters) analysis. Each student develops a water quality profile for a body of water. 4 Cr. Spring

ENV 692 Graduate Internship (A). Designed for the student who wishes to gain experience working with an environmental organization in the public or private sector (e.g. industry, government, environmental organizations). Can be taken only once for credit. 3 Cr. Every Semester

ENV 695 Topics in Environmental Science (A). Designed for the student who wishes to gain experience in a special field of study. Details reflect student demand, needs, topics of interest and instructor availability. 3-4 Cr. By Arrangement

ENV 699 Independent Study in Environmental Science (A). Designed individually through consultation between student and instructor to suit the student’s needs and interests and the special competence of the instructor. Additional requirements may be imposed by the instructor. 1-3 Cr. By Arrangement

ENV 704 Research Thesis (A). Individual investigation of an original research problem to be submitted in a format acceptable to satisfy the requirements for the master's degree as determined by department rules and regulations. 1-6 Cr. Every Semester

ENV 705 Research Seminar (A). Develops critical thinking skills through weekly discussion of key scientific literature on topics in environmental science, ecology, or plant and animal biology. Taken as two semester-long, one-credit seminars during the first two semesters of the graduate program. 1 Cr. Every Semester
The courses on the following pages, offered by other departments, may be taken by ESB graduate students with approval of their thesis committees.

**BIO 515 Molecular Biology (A).** Prerequisite: Instructor’s permission. Covers the biosynthesis and function of macromolecules, especially nucleic acids. Includes topics in regulation, molecular virology, transposition and transformation, as well as recombinant DNA methods. 3 Cr.

**BIO 526 Recombinant DNA (A).** Prerequisite: Instructor’s permission. Considers theory and techniques in the recombinant DNA field. Includes topics such as cloning vectors, restriction analysis, PCR methods, and expression of cloned genes in both prokaryotes and eukaryotes. Also considers examples and implications of recombinant DNA methodology in plants and agriculture, as well as in medicine, human genetics and disease. 3 Cr. Fall

**BIO 567 Biochemistry I (A).** Prerequisite: Instructor’s permission. Covers proteins, lipids, carbohydrates, nucleic acids and other biomolecules with an emphasis on buffers, structures, experimental methods, main energy production pathways and biosynthesis. Requires application of concepts and information to experimental data and deduction of structures, functional roles and mechanisms. 3 Cr. Fall

**BIO 568 Biochemistry II (A).** Prerequisite: Instructor’s permission. Emphasizes topics such as metabolic pathways, human nutrition, chromosomes and genes, protein biosynthesis, cell walls, immunoglobulins, muscle contraction, cell motility, membrane transport, and excitable membranes and sensory systems. Investigates the experimental evidence for the structure and functions of biomolecules. 3 Cr. Fall

**ESC 512 Hydrology with Lab (A).** Prerequisite: Instructor’s permission. Explores the water cycle, including precipitation, runoff, streams and lakes, groundwater, snow and other hydrologic topics. Covers water storage and processes, analytical skills dealing with hydrologic events, and the utilization and conservation of water resources in terms of its distribution, quality and flow. 4 Cr.

**ESC 518 Watershed Sciences (A).** Prerequisite: Instructor’s permission. Explores the art and science of evaluating water, air and land resources in a watershed to provide scientific information for management policy decisions. Covers utilization of maps and other physical resources information, sampling, data processing and analysis. 3 Cr.

**ESC 521 Air Pollution Meteorology (A).** Prerequisite: Instructor’s permission. For students, engineers and professional people training to measure air pollution levels or measure and evaluate meteorological parameters which affect the diffusion and concentration of pollutants in the atmosphere. Provides knowledge of the effects of meteorology in air pollution. Covers factors related to site selection, control programs and interpretation of surveys. Also studies diffusion using mathematical models. 3 Cr.

**ESC 531 GIS Applications in Earth and Environmental Science (A).** Prerequisite: Instructor’s permission. Introduces students to spatial analysis theories, techniques, and issues associated with ecological and environmental applications. Provides hands-on training in the use of spatial tools while addressing a real problem. Allows students to experience linking GIS analyses to field assessments and monitoring activities. 3 Cr.

**ESC 555 Soils Science (A).** Prerequisite: Instructor’s permission. Explores the formation, properties and characterization of soils, especially those of New York state; measurement of physical and chemical properties in field and classroom; and management, conservation and applications of Soil Survey. 3 Cr.

**ESC 557 Marine Geology-Bahamas (A).** Prerequisite: Instructor’s permission. Involves preparation in the fall semester for a 2-week January intercession field experience in coral reef biology and geology on San Salvador island in the Bahamas. Covers identification, behavior and ecology of marine organisms in five habitats associated with coral reefs. Teaches students to prepare a scientific field notebook and to design, conduct and write a paper on a personal research project. 3 Cr.

**GEL 557 Geochemistry (A).** Course fee. Prerequisite: Instructor’s permission. Applies basic chemical principles of thermodynamics, kinetics and equilibrium to the investigation of common geologic problems ranging from the crystallization of silicate melts to surface reactions on soil minerals. Focuses on application of good laboratory practices to wet chemical and instrumental techniques involving geologic materials. 4 Cr.

**GEL 562 Groundwater (A).** Prerequisite: Instructor’s permission. Studies groundwater, its occurrence, movement and use, and its place in the hydrologic cycle. Examines the origin of aquifers, use and effects of wells, and water quality and groundwater problems. Laboratory focuses on practical application of principles to solving hydrogeologic problems. 4 Cr.
Department of Health Science

(585) 395-2643

Chairperson and Associate Professor: Douglas Scheidt, PhD, University of Buffalo, State University of New York; Associate Dean of The School of Education and Human Services and Professor: Eileen L. Daniel, DEd, University of Oregon; Professor: Thomas Golaszewski, EdD, University of Buffalo, State University of New York; Associate Professors: Joseph E. Balog, PhD, University of Maryland; Linda F. Balog, PhD, University of Maryland; Priya Banerjee, PhD, Southern Illinois University-Carbondale; Gary J. Metz, MPA, The College at Brockport, State University of New York; Celia Watt, PhD, University of Texas-Austin; Assistant Professors: Jennifer R. Boyle, PhD, University of Maryland; Patti A. Follansbee, PhD, Southern Illinois University-Carbondale; Gregg M. Kirchofer, PhD University of Toledo.

Degree Program

MSEd Health Education

The Department of Health Science offers the MSEd Health Education program for the preparation of professional health educators. Professional preparation for the field of health education focuses on skills for the promotion of health, and strategies for enhancing and encouraging change toward positive health behaviors. Students may pursue one of the following options:

1. Community Health Education

   The MSEd offers opportunities for advanced study related to the planning, implementation and evaluation of health-education programs in a variety of community settings, including public health departments, voluntary health associations, medical and mental-health care organizations, work-site settings and health advocacy organizations. Completion of this degree prepares the candidate to be eligible to become credentialed as a Certified Health Education Specialist (CHES), as set forth by the National Commission for Health Education Credentialing.

2. New York State Professional Certification to Teach Health (K-12)

   The MSEd also meets the academic requirements established by the New York State Department of Education for professional certification as a health teacher.

   Background

   In New York state, the field of teacher education is in the midst of an era of unprecedented change. Effective February 2, 2004, the educational requirements for teaching certifications changed, as did the certificate titles themselves.

   What was called a provisional certificate is now titled an initial certificate. Similarly, what