

# THE CURRICULUM

The MS program in Environmental Science and Biology is designed so that the candidate can complete all coursework in two years of full-time study (Table 1). Required and elective courses are listed in Table 2 and their college catalog descriptions follow Table 2.

**Table 1.** A typical two-year course schedule for an MS candidate in Environmental Science and Biology.

<b>First Fall Semester</b>	<b>Credits</b>
*Experimental Design (ENV 614)	3
*Graduate Research Seminar (ENV 705)	1
700/600/500 Level Elective	3-4
700/600/500 Level Elective	3-4
<b>Subtotal</b>	<b>10-12</b>

<b>First Spring Semester</b>	
*Thesis Research (ENV 704)	2
*Graduate Research Seminar (ENV 705)	1
700/600/500 Level Elective	3-4
<b>Subtotal</b>	<b>6-7</b>

<b>Second Fall Semester</b>	
*Thesis Research (ENV 704)	2
*Graduate Research Seminar (ENV 705)	1
700/600/500 Level Elective	3-4
<b>Subtotal</b>	<b>6-7</b>

<b>Second Spring Semester</b>	
*Thesis Research (ENV 704)	2
*Graduate Research Seminar (ENV 705)	1
700/600/500 Level Elective	3-4
<b>Subtotal</b>	<b>6-7</b>

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**Minimum credits required for graduation 30**

*\*Signifies a required course.*

**Table 2.** Required and elective courses available to candidates for the MS in Environmental Science and Biology.

<b>Courses</b>	<b>Title (credits) (semester offered)</b>
<b>700 Level Courses</b>	
<sup>1</sup> ENV 704	Research Thesis (2 * 3 semesters) (F, S)
<sup>1</sup> ENV 705	Graduate Seminar (1 * 4 semesters) (F, S)
<sup>2</sup> LST 722	Great Lakes Issues (3)
<b>600 Level Courses</b>	
<sup>1</sup> ENV 614	Experimental Design (3) (F)
ENV 621	Water Chemistry (4) (S)
<sup>2</sup> ENV 692	Graduate Internship (3) (F, S, Sm)
<sup>2</sup> ENV 695	Topics in Environmental Science (F, S)
<sup>2</sup> ENV 699	Independent Study (3) (F, S, Sm)
<sup>2</sup> NAS 663	Field Natural History (3) (Sm)
PAD 679	Grant Writing and Management (3) (S)
PAD 680	Public Policy (3) (F)
<b>500 Level Courses</b>	
ENV 500	Plant Diversity (4) (EoF)
ENV 505	Plant Ecology (4) (EoF)
ENV 506	Wildlife Ecology (4) (EoF)
<sup>2</sup> ENV 513	Topics in Plant Biology (3)
ENV 519	Principles of Limnology (3) (F)
ENV 521	Limnology Laboratory (2) (F)
ENV 523	Biology of Pollution (3) (EoS)
ENV 530	Ornithology (4) (EoS)
ENV 539	Conservation Biology (3) (S)
ENV 540	Herpetology (4) (EoS)
ENV 544	Terrestrial Ecosystem Ecology (EoS)
ENV 552	Environmental Laws and Regulations (3) (F, S)
ENV 559	Mammalogy (4) (EoF)

ENV 562	Aquatic Toxicology (EoS)
ENV 564	Aquaculture I (EoF)
ENV 574	Aquaculture II (EoF)
ENV 576	Animal Ecophysiology (EoF)
ENV 577	Field Biology (3) (EoS <sup>m</sup> O)
ENV 583	Aquatic Invertebrates (4) (EoS)
ENV 584	Fish Ecology (3) (EoS)
ENV 588	Environmental Impact Analysis (4) (EoS <sup>m</sup> E)
ENV 590	Fishery Techniques/Fish Identification (2) (F)
ESC 512	Hydrology (4) (F)
ESC 518	Watershed Sciences (3) (EoS)
ESC 521	Air Pollution Meteorology (3) (EoF)
ESC 531	Geographic Information Systems (3) (S)
ESC 555	Soils Science (F)
ESC 557	Tropical Marine Geology/Biology (3) (F)
GEL 557	Geochemistry (4) (EoS)
GEL 562	Groundwater (4) (EoS)
BIO 515	Molecular Biology (3) (F)
BIO 526	Recombinant DNA (3) (S)
BIO/CHM 567	Biochemistry I (4) (F)
BIO/CHM 568	Biochemistry II (4) (S)

<sup>1</sup>Signifies a required course. <sup>2</sup>Taught as needed by students.

Other courses are offered at least once every two years.

F = Fall, S = Spring, Sm = Summer, Eo = Every other.

## CATALOG DESCRIPTIONS OF 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. Even 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. Field exercises explore local plant communities using experimental and quantitative techniques. Students analyze and discuss current readings in plant ecology. 4 Cr. *Odd Fall.*

**ENV 506 Wildlife Ecology (A).** *Prerequisite: One general biology and one 400-level ecology course.* In-depth study of wildlife ecology. Lecture topics include population ecology, behavior, nutrition, disease, habitat management, predator prey systems, economics, and the human dimensions of wildlife management. Laboratories and field work include radio telemetry, census methods, aging white-tailed deer, and computer modeling. 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. Students critically analyze current scientific literature and write a research paper. 3 Cr.

**ENV 519 Principles of Limnology (A).** *Prerequisite: ENV 303.* Promotes in-depth understanding 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. Students critically analyze classical and current limnological literature and write two research papers. Recommended for students interested in oceanography and marine biology. Required for students in the aquatic ecology track of the environmental science major. ENV 521 is the complementary laboratory. 3 Cr. *Fall.*

**ENV 521 Limnology Laboratory (A).** *Prerequisite: ENV 303.* In-depth study of 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 streams. Recommended for students interested in oceanography and marine biology. Required for students in the aquatic ecology track of the environmental science major. ENV 519 is the complementary lecture course. 2 Cr. *Fall.*

**ENV 523 Biology of Pollution (A).** *Prerequisite: One college biology and one college chemistry course in-depth study of chemistry and biology of pollution.* 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. Toxicity testing techniques and data analysis are explored. 3 Cr. *Odd Spring.*

**ENV 530 Ornithology (A).** *Prerequisite: 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 539 Conservation Biology (A).** *Prerequisite: 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).** *Prerequisite: 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 herpefauna, 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).** *Prerequisite: 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 and contrasts systems with respect to their major characteristics, including vegetation, energy flow, and nutrient cycling and inputs. 3 Cr. *Even 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. Every Semester.*

**ENV 559 Mammalogy (A).** *Prerequisite: 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.** *Prerequisite: One general biology and one 400-level ecology course.* In-depth study of toxicity testing equipment, procedures and organisms. Students design toxicity tests and culture test organisms. *4 Cr. Even Spring.*

**ENV 564 Aquaculture I (A).** *Prerequisite ENV 303:* 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).** *Prerequisite ENV 303:* 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 availability, sensory and reproductive adaptations. Biochemical, cellular and organism responses to these factors will be examined using an integrative and comparative approach. *3 Cr. Odd Fall.*

**ENV 577 Field Biology.** *Prerequisite: 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 conserva-

tion theory and practice. 4 Cr. Summer.

**ENV 583 Aquatic Invertebrates.** *Prerequisite: 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).** *Prerequisite: 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 (recruitment, growth, mortality, environment) and fishery management. ENV 490 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. 1-6 Cr. Summer.

**ENV 590 Fishery Techniques and 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 122 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. Even Fall.

**ENV 621 Water Chemistry (A).** *Prerequisite: Two college chemistry courses.* In-depth study of the theory and operation of analytical environmental chemistry in-

struments. 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 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 department. *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. Two credits per semester in the second through fourth semesters of matriculation for a total of six credits. *2 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 four semester-long, one-credit seminars during the first two years of the graduate program. *1 Cr. Every Semester.*

## **RELEVANT GRADUATE COURSES TAUGHT BY OTHER SUNY BROCKPORT DEPARTMENTS**

**LST 722 Topics in the Natural Sciences: Great Lakes Issues.** Students develop a comprehensive understanding of the physical, chemical, biological, ecological, economic, political and social factors that influence the Great Lakes ecosystem. Emphasizes the underlying science of and solutions for Great Lakes environmental

problems. 3 Cr. Offered Occasionally.

**NAS 663 Field Natural History.** Prerequisites: One general biology and one 400-level ecology course. Studies the principles of ecology and conservation in actual field locations. Uses taxonomic principles and field recognition of common species to develop an understanding of natural relationships. Students develop individual projects related to their interests. 3 Cr. Offered Occasionally.

**PAD 679 Grant Writing and Management.** Provides students with a “hands-on” experience of developing and writing competitive grant proposals for non-profit and governmental agencies in order to increase their effectiveness in planning for, submitting, obtaining and managing grants. Enables students to create a competitive grant proposal, identify the strengths and shortcomings of grant funding for program and agency purposes, identify sources of grant funding, and analyze the strengths and shortcomings of agency support for grant writing. 3 Cr. Every Semester.

**PAD 680 Public Policy** Introduces students to the study of public policy and the practice of policy analysis. Examines the various methods of identifying and structuring public policy problems and issues, formulating and analyzing alternative responses, recommending policy actions for decision making, and designing and evaluating implementation plans and the means to monitor and evaluate the resulting policy outcomes. Focuses attention on understanding public policy and conducting analysis in a political/ administrative environment in order to develop an understanding and capacity to use systematic analytic tools and concepts to improve the quality of decision making in the public sector. 3 Cr. Every Semester.

**ESC 512 Hydrology.** Prerequisites: ESC 350, MTH 201 or 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. Every Other Fall.

**ESC 518 Watershed Sciences.** Prerequisites: ESC 350 and 412 or GEL 62 or 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. *Every Other Spring*.

**ESC 521 Air Pollution Meteorology.** *Prerequisites: ESC 211 and 350.* Studies the way the atmosphere transports and diffuses pollutants. Lays a groundwork through a study of fundamental meteorology, including stability, turbulence, wind and local circulations. Also studies diffusion through mathematical models of both point sources and area sources. 3 Cr. *Every Other Spring*.

**ESC 531 Environmental Applications of Geographic Information Systems.** *Prerequisite: ESC 230 or equivalent experience or instructor's permission.* Explores spatial analysis theories and techniques and issues associated with ecological and environmental applications. Provides hands-on training in the use of spatial tools while addressing a real problem. The student will experience linking GIS analyses to field assessments and monitoring activities. 3 Cr. *Spring*.

**ESC 555 Soils Science (A).** *Prerequisites: GEL 201, CHM 205, ESC 350 and ESC 391 or 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. *Every Other Spring*.

**ESC 557 Tropical Marine Geology/Biology.** *Prerequisite: ESC 200 or ENV 319 or instructor's permission.* Explores the geology, biology and ecology of tropical marine ecosystems. Includes an intensive, 2-week field experience on San Salvador island in the Bahamas during the winter intersession. Students prepare a detailed scientific field notebook, design of an independent research project, and write a formal report on the project. 3 Cr. *Fall*.

**GEL 557/CHM 557 Geochemistry.** *Prerequisites: ESC 350, GEL 201, and CHM 205 and 206.* 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. *Every Other Spring*.

**GEL 562 Groundwater.** *Prerequisites: ESC 350 and GEL 201 or its equivalent.* Studies groundwater, its occurrence, movement and use, and its place in the hydrologic cycle. Examines the origin and analysis of aquifers, use and effects of wells, and water quality and groundwater problems. 4 Cr. *Every Other Spring*.

**BIO 515 Molecular Biology** *Prerequisites: BIO 301, BIO 302 and CHM 305, or 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. Every Other Spring.

**BIO 526 Recombinant DNA.** 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. Every Other Spring. *Prerequisites: BIO 302 and CHM 305, or instructor's permission.*

**CHM/BIO 567 Biochemistry I.** *Prerequisite: CHM 306.* 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.

**CHM/BIO 568 Biochemistry II.** *Prerequisite: CHM 467.* 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. Spring.