Division of Environmental Science

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Bachelor of Science in Environmental Science

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Mission and Objectives Statement

The faculty members who deliver the program in environmental science perform teaching, research and public service activities to promote environmental practices to improve the lives of people within New York state and around the world.
The **objectives** of the program in environmental science are to prepare students who:

- Will engage in environmental work while employed by government agencies and industry or in private consulting jobs that specialize in public works and the inventory, management, design, use, restoration and protection of natural and cultural resources,
- Are prepared to enter advanced academic studies involved with any of the many aspects of environmental science, and
- Will continue to develop the knowledge and skills needed to adapt to changing technological, environmental and business conditions to the benefit of society, employer and self.

Program **outcomes** for the undergraduate (B.S.) program in environmental science are to produce graduates who:

- Are knowledgeable of examples of global, regional and local environmental problems and issues,
- Are competent to perform in a graduate education or entry-level work environment,
- Have a sufficient knowledge base and tools to function effectively,
- Have the ability to conceptualize environmental problems in terms of unifying principles,
- Are capable of utilizing a systems approach to problem solving, and
- Can communicate their ideas and expectations effectively.

Additionally, the undergraduate program in environmental science aims to produce graduates who exhibit the following attributes:

- Knowledge in understanding basic principles and creativity in problem solving,
- Skills in originality and methods of problem solving,
- Attitude that includes ethics, self-discipline, perseverance,
- Ability to function effectively in a multidisciplinary team/environment,
- Understanding of the need for lifelong learning.

Undergraduate Program Requirements

The undergraduate curriculum in environmental science consists of two broad categories of courses. The general education component provides students with knowledge and skills that are useful and important for all educated persons. The professional courses provide students with direct preparation for a career.

Students may be admitted directly as first-year freshmen at ESF or through a variety of transfer options. Regardless of which way students enter ESF, they must complete both the general and professional education requirements.

Lower Division Course Requirements (50-51 credits)

Courses			Credits	
APM APM	105 106	Survey of Calculus and Its Applications I Survey of Calculus and Its Applications II		4 4
GNE	160	Computing Methods		3
EWP	190	Writing and the Environment	G	3
EWP	290	Writing, Humanities and the Environment	G	3
EWP	405	Writing for Science Professionals		3
EFB	120	The Global Environment & the Evolution of Human Society		3
EFB	101/102	General Biology I and Laboratory	G	4
EFB	103/104	General Biology II and Laboratory		4

ESC	132	Orientation Seminar: Environmental Science		1
FCH	150/151	General Chemistry I and Laboratory		4
FCH	152/153	General Chemistry II and Laboratory		4
FOR	207	Introduction to Economics	G	3
PHY	211/221	General Physics I and Laboratory		4
PHY	212/222	General Physics II and Laboratory		4

Lower Division Electives (12 credits)

Free electives		6
General Education: American History	G	3
General Education: Western Civilization	G	3

Professional Courses (16 credits)

APM	391	Introduction to Probability and Statistics	3
EFB	320	General Ecology	4
ESF	200	Information Literacy	1
ESF	300	Introduction to Geospatial Technology	3
ESC	494	Capstone Seminar	1
ESC	498	Research Problems in Environmental Science	4

Environmental Science Core (9-11 credits)

Students must complete one course from each of the following environmental science core areas. Note: Courses used to complete the advanced chemistry, biology, or mathematics requirements; environmental science core requirements; or option requirements may NOT be used to satisfy more than one of these requirements.

The Physical Environment	3-4
The Living Environment	3-4
The Social Environment	3

The Physical Environment

ERE	223	Statics and Dynamics	4
ERE	351	Basic Engineering Thermodynamics	2
FCH	210	Elements of Organic Chemistry	4
FCH	221/222	Organic Chemistry I/Organic Chemistry I Laboratory	4
FCH	360	Physical Chemistry	3
FOR	338	Meteorology	3
FOR	340	Watershed Hydrology	3
FOR	345	Introduction to Soils	3
EST	231	Environmental Geology	3

The Living Environment

EFB	303	Introductory Environmental Microbiology	4
EFB	326	Diversity of Plants	3
EFB	336	Dendrology	3
EFB	351	Forest Entomology	3
EFB	355	Invertebrate Zoology	4
EFB	385	Comparative Vertebrate Anatomy	4

EFB	440	Mycology	3
EFB	462	Animal Physiology: Environmental and Ecological	3
EFB	483	Mammal Diversity	3
EFB	485	Herpetology	3
EFB	486	Ichthyology	3
EFB	327	Adirondack Flora	3
EFB	342	Fungal Diversity and Ecology	3
EFB	345	Forest Health	3
EFB	384	Field Herpetology	3
EFB	388	Ecology of Adirondack Fishes	3

The Social Environment

EWP	390	Introduction to Literature of Nature	3
EFB/ EST	220	Urban Ecology	3
EST	361	History of the American Environmental Movement	3
EST	390	Social Processes and the Environment	3
FOR	312	Sociology of Natural Resources	3
FOR	465	Natural Resources Policy	3
EFB	337	Field Ethnobotany	3

Advanced Courses in Chemistry, Biology or Mathematics (9-12 credits)

An advanced course is one that has at least one prerequisite or is numbered 300 or above. Note: Courses used to complete the advanced courses in chemistry, biology or mathematics requirement may NOT be used to complete the environmental science core or option requirements.

Advanced Course in science or mathematics	3-4
Advanced Course in science or mathematics	3-4
Advanced Course in science or mathematics	3-4

Environmental Science Option (15-16 credits)

Students must complete at least one of the following options. Courses used to complete the advanced chemistry, biology, or mathematics requirements; environmental science core requirements; or option requirements may NOT be used to satisfy more than one of these requirements.

Environmental Information and Mapping	15
Watershed Science	15
Health and the Environment	17-18
Earth and Atmospheric Systems Science	15
Environmental Analysis	16
Renewable Energy	17

Environmental Information and Mapping

ERE	371	Surveying for Engineers	4
ERE	365	Principles of Remote Sensing	4
GEO	381	Cartographic Design	4
ERE	551	GIS for Engineers	3
		OR	
ENS	519	Spatial Ecology	3

Watershed Science

EFB	415	Ecological Biogeochemistry	3
FOR	340	Watershed Hydrology	3
FOR	345	Introduction to Soils	3
FOR	441	Watershed Ecology and Management	3
EFB	423	Marine Ecology	3
		OR	
EFB	424	Limnology	3
		OR	
EFB	486	Ichthyology	3
		OR	
EFB	487	Fisheries Science and Management	3
		OR	
ERE	440	Water Pollution Engineering	3
		OR	
FOR	338	Meteorology	3
		OR	
GEO	316	River Environments	3

Health and the Environment

EFB	303	Introductory Environmental Microbiology	4
EFB	307	Principles of Genetics	3
EFB	308	Principles of Genetics Laboratory	1
EFB	325	Cell Physiology	3
EFB	400	Toxic Health Hazards	3
EFB	385	Comparative Vertebrate Anatomy	4
		OR	
EFB	462	Animal Physiology: Environmental and Ecological	3

Earth and Atmospheric Systems Science

EFB	415	Ecological Biogeochemistry	3
EFB	524	Limnology	3
		OR	
FCH	510	Environmental Chemistry I	3
FOR	338	Meteorology	3
FCH	399	Introduction to Atmospheric Sciences	3
FCH	496	Special Topics: Oceanography	3

Environmental Analysis

EFB	303	Introductory Environmental Microbiology	4
FCH	380	Analytical Chemistry I: Gravimetric, Titrimetric and Potentiometric Analysis	3
FCH	381	Analytical Chemistry II: Spectroscopic, Chromatographic and Electroanalysis Techniques	3
FOR	338	Meteorology	3
		OR	
FOR	340	Watershed Hydrology	3
		OR	
FOR	345	Introduction to Soils	3
GEO	388	Geographic Information and Society	3
		OR	
ERE	365	Principles of Remote Sensing	3

Environmental Engineering Science

ERE	440	Water Pollution Engineering	3
ERE	441	Air Pollution Engineering	3

ERE	506	Hazardous Waste Management	3
PSE	370	Principles of Mass and Energy Balance	3
PSE	473	Mass Transfer	3

Renewable Energy

BPE	441	Biomass Energy	3
ESC	325	Energy Systems	3
ESC	335	Renewable Energy Systems	3
ESC	422	Energy Markets and Regulations	3
ESC	450	Capstone Planning	1
A minimum of 3 credits from the following:			
EFB	516	Ecosystems	3
EFB	518	Systems Ecology	4
ERE	351	Basic Engineering Thermodynamics	2
ERE	519	Green Entrepreneurship	3
FCH	360	Physical Chemistry I	3
FOR	415	Forest Consulting and Wood Procurement	3
PSE	361	Engineering Thermodynamics	3
PSE	370	Principles of Mass and Energy Balance	3
EST	427	Environment and Energy Auditing	3
CME	305	Sustainable Energy Systems for Buildings	3

Elective

Elective courses must be approved by an academic advisor. They should be related in some way to the student's area of study and are an opportunity to customize the academic experience. Free electives may be filled with any course with no approval necessary. Note: Courses used to complete the advanced courses in chemistry, biology or mathematics requirement may NOT be used to complete the environmental science core or option requirements.

Total minimum credits for the degree 125 credits.

Prehealth Advising

The curriculum for the bachelor of science degree with an environmental science option in health and the environment prepares students for advanced degrees in health professions with a suitable plan of study. To prepare for health professions, students may access Syracuse University's broad array of relevant courses and the advising, counseling and resources of the Health Professions Advisory Program.

UNDERGRADUATE MINORS

Students who meet the admission requirements may enroll in any of the undergraduate minors offered at ESF.

Graduate Program in Environmental Science (GPES)

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www.esf.edu/environmentalscience/graduate

The graduate program in environmental science (GPES) offers M.S., M.P.S. and Ph.D. degrees. GPES was created in the early 1970s as a unique response to the emerging institutional and analytical challenges of developing environmental problems. The program, which draws upon faculty from throughout the College, emphasizes a multidisciplinary social and natural science approach to environmental understanding and stewardship. It maintains a strong academic orientation, facilitating student and faculty engagement of fundamental environmental challenges such as resource utilization, the uses and limits of scientific prediction, risk and sustainability.

The mission of GPES is to provide interdisciplinary education, research and public service to prepare students to comprehensively address environmental concerns and problems, investigate practical solutions to them and to foster effective environmental stewardship. The program provides for the following:

- Multidisciplinary approach: recognition of the necessity to approach environmental problems with input from several disciplines and professions,

- Holistic perspective: awareness of and deference to the interdependence of elements within broadly defined ecosystems, including physical, biological, social and economic systems,
- Topical grounding: competency to understand and apply the principles of a particular subject of environmental inquiry in sufficient depth to interact with other disciplines and professional fields,
- Realistic experience: internships, focused projects, theses and seminars provide for direct interaction of legal, economic, political and social systems which underlie decision making.

The program's internal structure incorporates a common core that provides a broad policy-oriented foundation for the focused areas of study. Students applying to GPES must select which area of study they intend to pursue.

Requirements

The academic requirements of the graduate program in environmental science are designed to provide graduates with a sound preparation to meet the rapidly evolving challenges of the field as leading scholars and professionals. Programmatic requirements constitute a framework which includes a comprehensive core foundation emphasizing theory, issues and methods; extended knowledge within an area of study; and a synthesis experience.

Entering students should be adequately prepared to engage graduate level work in the program. The following undergraduate courses are pre- or co-requisites for all master's students: statistics, ecology and microeconomics or environmental economics. Courses in political science are strongly recommended.

In addition, students should have an academic background and/or work experience related to the selected area of study. Wherever possible, deficiencies should be made up prior to matriculation.

Master of Science

The master of science degree is designed as a two-year experience.

Core Requirements

A core of applied social science courses (credit-hour requirements vary with area of study) is required. In addition, a total of six credit hours is required in research methods. Course options which satisfy these requirements are designated by the area of study faculty.

Area of Study Requirements

A minimum of 15 credit hours (excluding ENS 899) is required in the area of study, as determined by the major professor and area of study faculty. Area of study subcommittees maintain advising lists of courses pre-approved to satisfy the 15-credit area of study requirement. The student's major professor or steering committee may designate additional courses. Five study areas are available to M.S. students: environmental policy and democratic processes, environmental and community land planning, environmental systems and risk management, water and wetland resource studies, and environmental communication and participatory processes.

Thesis Requirements

A minimum of six credit hours of research is required resulting in a document that clearly demonstrates graduate-level accomplishments of the student, followed by a defense examination. Students must have an approved thesis proposal.

Master of Professional Studies

The master of professional studies degree is a 39-credit-hour experience aimed at professional applications of environmental knowledge.

Core Requirements

A total of 21 credit hours is required. These must include applied social scienc courses in environmental policy and regulation, and democratic processes. In addition, a total of six credit hours is required in environmental science and six credit hours is required in methods courses emphasizing applications of technical knowledge.

Area of Study Requirements

A minimum of 12 credit hours of coursework is required in the chosen area of study, as determined by the major professor and study area faculty. Students select a study area at the time of application for admission to the program. Five study areas are available to M.P.S. students: environmental policy and democratic processes, environmental and community land planning, environmental systems and risk management, water and wetland resource studies, and environmental communication and participatory processes.

Synthesis Requirements

Students select either an internship for three to six credit hours or prepare a synthesis paper for three credit hours. All students must present a capstone seminar in their final semester. No terminal comprehensive examination is required.

Applicants with a minimum of three years of post-baccalaureate, full-time professional experience directly related to the intended area of study may apply for six credit hours of advanced standing in the program, reducing their degree requirements to 33 credit hours. Partial credit for experience cannot be awarded. When awarded for prior work experience, the six credit hours are applied toward the synthesis requirement.

Doctor of Philosophy

The Ph.D. program provides a unique opportunity to develop environmental policy-related research within a strong college community of environmental analysts and to draw upon the expertise of scholars at Syracuse University. Entering students are required to complete the equivalent of the GPES master's core either from prior graduate study or coursework taken within the first year of residency. Environmental and natural resources policy applicants are expected to have completed a master's research thesis.

Areas of Study

Environmental Communication and Participatory Processes (M.S., M.P.S., Ph.D.)
Participating Faculty: FOLTA, KUEHN, MEISNER, MORAN, SELFA

This study area addresses the communicative dynamics of the formation of attitudes. It includes decision making, public policy, public participation, campaign development, organizational effectiveness, and conflict prevention and resolution, which all hinge on the ability of participants to communicate and use information effectively, strategically and ethically. GPES students with this option will be prepared to enter diverse arenas of industry, non-government organizations and government structures well equipped to facilitate and participate in effective interactions among individual citizens, non-government organizations, publics, agencies, bureaucracies, scientists and others. They will have the skills and knowledge that will allow them to choose the more appropriate and effective process structures and strategies to reach objectives.

Environmental and Community Land Planning (M.S., M.P.S., Ph.D.)
Participating Faculty: BEIER, BRYANT, CARTER, DALEY, DIEMONT, DOBLE, DOELLE, M. HALL, HAWKS, MORAN, SELFA, TOLAND

Environmental and community land planning is concerned with orderly, efficient, equitable and aesthetic development of land with special concern for the state of the natural environment, the physical character of communities, and decision making at state, county and local levels of government. Planning balances competing demands on land and environment brought about by expanding urban and rural development, and enhancing viable natural and cultural resources is an important planning perspective. Another perspective involves the guiding of private and public development processes within a pluralistic political environment in order to promote sustainable communities while at the same time respecting fiscal, environmental and legal constraints.

The program is designed for students with social science, natural science, engineering or design backgrounds who are interested in an interdisciplinary and integrative program. Some students have majors in interdisciplinary programs in urban studies or environmental studies. Students develop an understanding and knowledge of development processes, natural systems and governmental planning and regulation. They develop a capacity to analyze environmental and community land planning problems and to form imaginative solutions. Skills obtained include preparation of land and environmental databases, plans, policies and implementation programs.

Environmental Systems and Risk Management (M.S., M.P.S., Ph.D.)
Participating Faculty: BEIER, DALEY, DIEMONT, DOELLE, ENDRENY, C. HALL, M. HALL,
KROLL, LIMBURG, LUZADIS, MAO, MORAN, MORSI-HUSSEIN, NAKATSUGAWA, NOMURA, NORDENSTAM, TAO, TEECE, VIDON, VOLK, YANAI

The environmental systems and risk management study area focuses on problems in environmental and natural resource policy in which scientific and technical issues are of central importance. The program is designed for graduate students with a science or engineering background. Current research includes urban ecology, spatial model construction, use of renewable materials in structures and processes, biomass energy production, ecosystems modeling, environmental risk assessment, use of technical information by regulatory agencies, land use forecasting for public policy decision making and sustainable resource and allocation. The environmental systems and risk management area of study provides a unique opportunity to study interdisciplinary problems. Specific coursework in environmental systems and risk management is supplemented by traditional disciplinary coursework in engineering or the natural sciences and policy analysis.

Environmental Policy and Democratic Processes (M.S., M.P.S.)
Participating Faculty: LUZADIS, MANNO, MEISNER, MORAN, NORDENSTAM, SELFA, SMARDON, SONNENFELD

The environmental policy and democratic processes study area addresses problems of environmental decision making at a time of rapid institutional and social change. How our society can best meet the growing challenges of environmental stewardship through mandated and voluntary public participation in decision making is the central question. This concern is increasingly important to many segments of modern society, and we intend that students acquiring knowledge in this study area will be prepared to contribute positively to these processes in career pursuits.

The focus of this study area is on developing new understanding of public participation in environmental decision making, against the backdrop of environmental policy making and program implementation. Particular attention is given to (a) the variety of organizations involved in participation, which generally are the institutions and agencies of government, citizen-based non-governmental organizations and the business or industrial sector; (b) the availability and utility of environmental information for these groups; and (c) the participation and integration of all informed stakeholders into environmental decision making. This tripartite scheme of organizations, information and participation frames student programs of study and suggests important directions for student and faculty research efforts.

The study area advances understanding of these questions of participatory democracy for environmental decision making through research and instruction and is particularly suited to inquisitive students with degrees in environmental studies, political science, geography, engineering and other fields that provide interdisciplinary backgrounds in natural and social science.

Water and Wetland Resource Studies (M.S., M.P.S., Ph.D.)
Participating Faculty: BOYER, DALEY, DOELLE, ENDRENY, KROLL, LEOPOLD, LIMBURG, MANNO, MITCHELL, MORAN, SELFA, SMARDON, STELLA, TAO, VIDON

The water and wetland resources area of study develops an understanding of technical, social and institutional aspects of water resources management, mitigation and restoration. Individual students may emphasize scientific or social subject areas but all students study in both areas. Scientific aspects include the basic physical, chemical and biological interactions occurring in water resources systems. The social aspects are concerned with planning, regulation, law and institutions and management of water and wetland resources.

Recommended coursework includes:

- physical sciences: civil engineering, geology, geomorphology, hydrology, meteorology, environmental engineering, soils, water chemistry, hydrogeology, hydrogeochemistry and geographic information systems;
- biological sciences: ecology, entomology, fisheries biology, forestry, microbiology, water quality and limnology; and
- social sciences: administration, economics, government, history, law, ethics, philosophy and policy.

Environmental and Natural Resources Policy (Ph.D.) www.esf.edu/enrp
Participating Faculty: BEIER, LUZADIS, MALMSHEIMER, MANNO, MORAN, NEWMAN, NORDENSTAM, SELFA, SMARDON, SONNENFELD, WAGNER

The environmental and natural resources policy Ph.D. program is a collaborative program offered by both the Graduate Program in Environmental Science and the Department of Forest and Natural Resources Management. This study area investigates how societies formulate and implement decisions regarding environmental and natural resources. Doctoral students integrate the biophysical sciences and policy-related social sciences to solve important problems in environmental and natural resources policy with applications throughout the world. The program offers an opportunity to work with outstanding faculty members on applied and theoretical studies.

Faculty members conduct studies at international, national, state and local levels on sustainability, implementation and administration of environmental, natural resources, and forest management programs and economic and institutional influences and impacts of government and non-government policies. The applications include environmental, natural resources and forest policy and administration; and environmental, natural resources, forest and ecological economics.

The environmental and natural resources policy (ENRP) doctoral program is a highly individualized program with coursework and research determined in consultation with the student, major professor and steering committee. Some coursework requirements may be met by transferring graduate credits as approved by the steering committee. Students may also fulfill coursework requirements by completing courses offered by the Maxwell School of Citizenship and Public Affairs at Syracuse University. Specific degree requirements are described in the Handbook for Environmental and Natural Resources Policy Ph.D., available in 320 Bray Hall, 107 Marshall Hall, and on the ENRP Web site.

Students are expected to complete requirements resulting in a coherent body of theory, a depth of understanding in a specified area of biophysical science, appropriate research methods, and advanced policy analysis and understanding.

The following four core competencies must be satisfied prior to the doctoral candidacy examination. A minimum of 12 credits is required in each area.

Natural science: graduate courses (500 level or higher) in a definable area of biophysical science;

Policy-related social science: 600-level or higher courses including at least one government course and one economics course;

Research methods: 600-level or higher courses including a general research methods course (required), qualitative methods, quantitative statistical methods, GIS, or spatial statistics;

Advanced environmental and natural resources policy: 600-level or higher courses including policy analysis and program evaluation (required).

Graduates have careers as university professors and advanced policy or program analysts. They often become leaders in government, legislatures, corporations, not-for-profit organizations, advocacy groups and academic institutions, consulting firms and village associations throughout the world.