ENVIRONMENTAL SCIENCE AND TECHNOLOGY MAJOR

The Environmental Science and Technology major prepares students for graduate study and careers focusing on understanding the natural and built environments and resolving environmental problems and concerns for the benefit of humans and ecosystems. Specifically, the program encompasses impacts of human society on the natural environment, the effects of environmental conditions on humans and ecosystems, science-based management of ecosystems, watershed and soil-related processes related to environmental quality, and designing solutions to sustainably improve environmental quality of air, water, soil, and biological communities. The ENST major is a science- and math-based curriculum leading to a B.S. degree in Environmental Science and Technology with concentrations in Ecological Technology Design, Ecosystem Health, Soil and Watershed Science, or Natural Resources Management. These concentrations share a foundation in science and mathematics, offer specialization through required concentration core courses, and provide flexibility in course selection in concentration depth and technical elective categories. The concentrations are designed to provide students with a fundamental understanding of environmental systems and issues and the multidisciplinary quantitative design and analytical tools necessary to solve complex environmental problems.

For future updates and exciting changes, please visit our website at enst.umd.edu (http://enst.umd.edu/).

Concentrations:

Ecological Technological Design

The ENST concentration in Ecological Technology Design prepares students for integrating natural systems with the built environment to solve environmental problems while achieving economic, ecological and social sustainability. The science and applications of using natural systems, processes and organisms to address environmental issues has evolved during the last few decades to a mature level whereby there are strong employment opportunities for graduates that are cross-educated in ecology and technology. Examples of eco-technological applications include restoration of urban and rural streams, creation of wastewater treatment wetlands, design of raingardens and bioretention systems for low-impact stormwater management, design of eco-industrial parks, life cycle assessment of products for improved environmental performance, bioremediation and phytoremediation of contaminated groundwater, ecological systems for by-product recovery, and filtration of contaminated air with bioreactors. The curriculum consists of a broad set of background courses in environmental science, electives in applications of Ecological Technology Design, and upper-level courses that synthesize the major. Hands-on design experience is included in required internship and practicum courses.

Ecosystem Health

The ecosystem health concentration is a broad and increasingly important field with wide ranging applications in the environmental science and public health fields. The field encompasses environmental factors and ecosystem functions that affect human health and the effects of human activities on the ecosystem products and services we depend on. Example topics within the field include ecological risk analysis, environmental toxicology, environmental impact assessment, chemical fate and transport, human health risk assessment, industrial hygiene, air quality, environmental microbiology, food safety and security, biodiversity and human health, and children’s environmental health. The Ecosystem Health concentration within the Department of Environmental Science and Technology offers a science-based curriculum that includes advanced studies in ecosystem health and environmental protection and the impacts of environmental degradation on human health.

Natural Resources Management

The goal of the Natural Resources Management Concentration is to teach students concepts of the environmentally sound use and management of natural resources. Ecosystems and human societies are linked in complex cycles and relationships between vegetation and wildlife, forests and cities, conservation and development. By learning to participate effectively within these cycles, we will help sustain a harmonious relationship between the environment and human activities. This concentration provides students with the knowledge and skills they need to work in such positions as wildlife biologists, environmental consultants, wetland scientists, forest managers, fisheries biologists, aquatic biologists, and nature interpreters.

Soil and Watershed Science

The Soil and Watershed Science concentration enables students to understand the complex ways in which aquatic and terrestrial ecosystems are influenced by soil properties and processes and land management decisions. The soil performs such critical ecological functions as supplying and purifying water, recycling wastes, nurturing plants, modifying the atmosphere by emitting or sequestering gases and particulates, providing habitat for the most diverse biological communities on Earth, and serving as a medium for human engineering projects.

The concentration in Soil and Watershed Science in ENST provides students with one of the top soil science programs in the nation. The curriculum prepares graduates for work in variety of careers addressing natural resource and environmental issues and provides a rigorous science background for those planning to pursue post-graduate degrees in environmental sciences, soil science, watershed processes, and related fields. Students graduating from this program will make valuable contributions to society as they pursue challenging careers critical to the protection of the environment. In addition to pursuing advanced degrees, graduates may work in both the private and public sectors performing such services as soil mapping, wetland delineation, land conservation planning, forestry, waste management, farm advising, international development, and consulting in environmental, construction, and landscape architecture areas. Graduates from the Soil and Watershed Science concentration will be qualified to take the national exam to become a Certified Professional Soil Scientist (CPSS).

Program Learning Outcomes

1. Science and Technology Application. Students will demonstrate the ability to apply natural science principles and technology methods (particularly in ENST), and be able to express scientific questions and findings in the context of relevant socio-environmental dimensions
2. Quantitative Reasoning. Students will demonstrate the ability to apply basic mathematical and quantitative reasoning in the context of relevant socio-environmental dimensions
3. Written and Oral Communication. Students will be able to communicate clearly, concisely, and effectively in writing and speech to scientific, management, policy, or general audiences
4. Information Literacy. Students will demonstrate information literacy skills that they can successfully apply in and outside their disciplines
5. Technology Fluency. Students will be able to apply technologies to their research and academic efforts in the context of their specific disciplines.

Requirements
This program requires a total of 120 credit for a Bachelor of Science, including the general education program course credits, required major credits; Technology and Ecosystem elective credits, and free elective credits. All courses counted toward the major must be completed with a C- or better. An overall GPA of 2.0 in major courses is required for graduation.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>ENST Core for all Areas of Concentration</td>
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<tr>
<td>BSCI170 &amp; BSCI171</td>
<td>Principles of Molecular &amp; Cellular Biology and Principles of Molecular &amp; Cellular Biology Laboratory</td>
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<tr>
<td>MATH120</td>
<td>Elementary Calculus I</td>
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<tr>
<td>BSCI160 &amp; BSCI161</td>
<td>Principles of Ecology and Evolution and Principles of Ecology and Evolution Lab</td>
<td>4</td>
</tr>
<tr>
<td>CHEM131 &amp; CHEM132</td>
<td>Chemistry I - Fundamentals of General Chemistry and General Chemistry I Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>ENST200</td>
<td>Fundamentals of Soil Science</td>
<td>4</td>
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<tr>
<td>ENST233</td>
<td>Introduction to Environmental Health</td>
<td>4</td>
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<tr>
<td>CHEM231 &amp; CHEM232</td>
<td>Organic Chemistry I and Organic Chemistry Laboratory I</td>
<td>4</td>
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<tr>
<td>PHYS121</td>
<td>Fundamentals of Physics I</td>
<td>4</td>
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<tr>
<td>GEOG306 or BIOM301</td>
<td>Introduction to Quantitative Methods for the Geographical Environmental Sciences or Introduction to Biometrics</td>
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<tr>
<td>ENST360</td>
<td>Ecosystem Ecology</td>
<td>4</td>
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<tr>
<td>ENST389</td>
<td>Internship</td>
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</table>

Concentration (See list below) 34-35

Senior Integrative Experience - Choose one course from list below 3
- ENST388 Honors Thesis Research
- ENST470 (Ideas into Impact)
- ENST486 (Senior Professional Internship)
- ENST489 Research Experience

Total Credits 78-79

Concentrations:

Ecological Technology Design

Course | Title | Credits |
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<tbody>
<tr>
<td>ENST481</td>
<td>Ecological Design</td>
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<tr>
<td>MATH121</td>
<td>Elementary Calculus II</td>
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</table>

Concentration Depth - Ecology (2 Courses) 6
- ENST410 Ecosystem Services: An Integrated Analysis
- ENST422 Soil Microbial Ecology
- ENST450 Wetland Ecology
- ENST453 Watershed Science: Water Balance, Open Channel Flow, and Near Surface Hydrology
- GEOL453 Ecosystem Restoration

Concentration Depth - Design (4 Courses) 11
- ENST281 Computer Aided Design in Ecology
- ENST282 Ecological Innovation and Entrepreneurship
- ENST405 Energy and Environment
- ENST415 Renewable Energy
- ENST443 Industrial Ecology
- ENST485 Water Management in Urban Environment
- ENST456 (Spatial Analysis and Ecological Sampling) or GEOG372 Remote Sensing or GEOG373 Geographic Information Systems or INAG237 Surveying and GPS Applications in Agriculture

Ecosystem Health

Course | Title | Credits |
<table>
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<tr>
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<tbody>
<tr>
<td>ENST461</td>
<td>Urban Wildlife Management</td>
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</tr>
<tr>
<td>GEOG331</td>
<td>Introduction to Human Dimensions of Global Change</td>
<td></td>
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<tr>
<td>LARC452</td>
<td>Green Infrastructure and Community Greening</td>
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<tr>
<td>PLSC480</td>
<td>Urban Ecology</td>
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Sustainable Technology:
- ENST432 Environmental Microbiology
- ENST441 Sustainable Agriculture
- GEOL453 Ecosystem Restoration
- INAG250 Fundamentals of Agricultural Mechanics
- PLSC425 Green Roofs and Urban Sustainability

Wetlands:
- ENST430 Wetland Soils
- ENST450 Wetland Ecology
- ENST452 Wetland Restoration
- GEOL452 Watershed and Wetland Hydrology

Ecology and Ecosystem Management:
- BSCI467 Freshwater Biology
- ENST373 Natural History of the Chesapeake Bay
- ENST460 Principles of Wildlife Management
- PLSC471 Forest Ecology

Total Credits 36

Ecosystem Health Technical Electives 112

Urban Ecosystems and Human Dimensions:
- ENST461 Urban Wildlife Management
- GEOG331 Introduction to Human Dimensions of Global Change

LARC452 Green Infrastructure and Community Greening
PLSC480 Urban Ecology
Sustainable Technology:
- ENST422 Sustainable Agriculture
- GEOL453 Ecosystem Restoration
- INAG250 Fundamentals of Agricultural Mechanics
- PLSC425 Green Roofs and Urban Sustainability

Wetlands:
- ENST430 Wetland Soils
- ENST450 Wetland Ecology
- ENST452 Wetland Restoration
- GEOL452 Watershed and Wetland Hydrology

Ecology and Ecosystem Management:
- BSCI467 Freshwater Biology
- ENST373 Natural History of the Chesapeake Bay
- ENST460 Principles of Wildlife Management
- PLSC471 Forest Ecology

Total Credits 36
Environmental Health:
ENST403  Invasive Species Ecology  
ENST423  Soil-Water Pollution  
ENST434  Toxic Contaminants: Sources, Fate, and Effects  
ENST436  Emerging Environmental Threats  
ENST445  Ecological Risk Assessment  
Ecological Processes:
ENST405  Energy and Environment  
GEOG372  Remote Sensing  
GEOG415  Land Use, Climate Change, and Sustainability  
GEOL452  Watershed and Wetland Hydrology  
LARC450  Environmental Resources  
Ecological Processes:
BSCI467  Freshwater Biology  
ENST422  Soil Microbial Ecology  
ENST450  Wetland Ecology  
ENST460  Principles of Wildlife Management  
PLSC400  Plant Physiology  
Human Health:
BSCI424  Pathogenic Microbiology  
BSCI425  Advanced Cell Biology Lab Practices  
BSCI437  General Virology  
BSCI440  Mammalian Physiology  
Cultural or Social Dimensions:
ENST410  Ecosystem Services: An Integrated Analysis  
GEOG331  Introduction to Human Dimensions of Global Change  
GEOG431  Culture and Natural Resource Management  
PLCY301  Sustainability  
SOCY406  Globalization  

Total Credits 35

Natural Resources Management

Course  Title  Credits

Concentration Core
BSCI222  Principles of Genetics  4  
ENST214  Introduction to Fish and Wildlife Sciences  3  
ENST487  Environmental Conflicts and Decision Making  2  

Concentration Depth (4 Courses) 12
ENST456  (Spatial Analysis and Ecological Sampling)  
or GEOG372  Remote Sensing  
or GEOG373  Geographic Information Systems  
or INAG237  Surveying and GPS Applications in Agriculture  
ENST450  Wetland Ecology  
or ENST453  Watershed Science: Water Balance, Open Channel Flow, and Near Surface Hydrology  
AREC240  Introduction to Economics and the Environment  
or AREC241  Environment, Economics and Policy  
or ENST410  Ecosystem Services: An Integrated Analysis  
ENST424  Field Study in Soil Morphology  
or ENST430  Wetland Soils  
or ENST441  Sustainable Agriculture  
or ENST462  Field Techniques in Wildlife Management  
or GEOG418  Field and Laboratory Techniques in Environmental Science  

Natural Resources Management Technical Electives 10
Wildlife:
ENST460  Principles of Wildlife Management  2  
ENST461  Urban Wildlife Management  2  
BSCI334  Mammalogy  
& BSCI335  and Mammalogy Laboratory  2  
ENSP102  Introduction to Environmental Policy  2  
PLSC254  Woody Plants for Mid-Atlantic Landscape II  
ENSP330  Introduction to Environmental Law  2  
or GVPT273  Introduction to Environmental Politics  

Fisheries:
ENST314  Fisheries Management and Sustainability  3  
COMM250  Introduction to Communication Inquiry  3  
COMM382  Essentials of Intercultural Communication  3  
GEOG331  Introduction to Human Dimensions of Global Change  3  
GEOG416  Conceptualizing and Modeling Human-Environmental Interactions  3  
ENSP102  Introduction to Environmental Policy  3  
ENSP330  Introduction to Environmental Law  3  
GVPT273  Introduction to Environmental Politics  3  

Wetlands:
ENST430  Wetland Soils  4  
ENST450  Wetland Ecology  4  
ENST452  Wetland Restoration  4  
GEOL452  Watershed and Wetland Hydrology  4  
PLSC489  Special Topics in Plant Science (PLSC489D Plant Taxonomy)  4  
or PLSC254  Woody Plants for Mid-Atlantic Landscape II  

Forestry:
PLSC253  Woody Plants for Mid-Atlantic Landscapes I  
PLSC254  Woody Plants for Mid-Atlantic Landscape II  
PLSC400  Plant Physiology  
PLSC471  Forest Ecology  

Total Credits 33

Soil and Watershed Science

Course  Title  Credits

Concentration Core
GEO100  Physical Geology  4  
GEO110  Physical Geology Laboratory  
ENST456  (Spatial Analysis and Ecological Sampling)  0-3  
or GEOG372  Remote Sensing  
or GEOG373  Geographic Information Systems  
or INAG237  Surveying and GPS Applications in Agriculture  

Concentration Depth - Soil Sciences 7
ENST411  Principles of Soil Fertility  
ENST414  Soil Morphology, Genesis and Classification  5  
ENST417  Soil Physics and Hydrology  7  
ENST421  Soil Chemistry  5  

Total Credits 35
### Environmental Science and Technology Major

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<td>Soil Microbial Ecology</td>
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**Concentration Depth - Field Experiences**

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<tr>
<td>ENST301</td>
<td>Field Soil Morphology I</td>
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<tr>
<td>ENST302</td>
<td>Field Soil Morphology II</td>
</tr>
<tr>
<td>ENST303</td>
<td>Field Soil Morphology III</td>
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<tr>
<td>ENST309</td>
<td>Advanced Field Soil Morphology</td>
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<tr>
<td>ENST424</td>
<td>Field Study in Soil Morphology</td>
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<td>ENST430</td>
<td>Wetland Soils</td>
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**Concentration Depth - Systems**

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<tr>
<td>AREC365</td>
<td>World Hunger, Population, and Food Supplies</td>
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<tr>
<td>ENST410</td>
<td>Ecosystem Services: An Integrated Analysis</td>
</tr>
<tr>
<td>ENST432</td>
<td>Environmental Microbiology</td>
</tr>
<tr>
<td>PLSC400</td>
<td>Plant Physiology</td>
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**Soil and Watershed Science Technical Electives**

<table>
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<tr>
<td>AREC365</td>
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<td>GEOG372</td>
<td>Remote Sensing</td>
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<tr>
<td>PLSC303</td>
<td>Global Food Systems</td>
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<td>PLSC405</td>
<td>Agroecology</td>
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<tr>
<td>BSCI223</td>
<td>General Microbiology</td>
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<tr>
<td>BSCI337</td>
<td>Biology of Insects</td>
</tr>
<tr>
<td>BSCI467</td>
<td>Freshwater Biology</td>
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<tr>
<td>ENST410</td>
<td>Ecosystem Services: An Integrated Analysis</td>
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<tr>
<td>GEOL322</td>
<td>Mineralogy</td>
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<tr>
<td>GEOL340</td>
<td>Geomorphology</td>
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<tr>
<td>GEOL341</td>
<td>Structural Geology</td>
</tr>
<tr>
<td>GEOL342</td>
<td>Sedimentation and Stratigraphy</td>
</tr>
<tr>
<td>GEOL444</td>
<td>Low Temperature Geochemistry</td>
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**Watersheds:**

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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>ENST334</td>
<td>Environmental Toxicology</td>
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<tr>
<td>ENST423</td>
<td>Soil-Water Pollution</td>
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<tr>
<td>ENST453</td>
<td>Watershed Science: Water Balance, Open Channel Flow, and Near Surface Hydrology</td>
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<tr>
<td>GEOL451</td>
<td>Groundwater</td>
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<tr>
<td>GEOL452</td>
<td>Watershed and Wetland Hydrology</td>
</tr>
<tr>
<td>GEOL453</td>
<td>Ecosystem Restoration</td>
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</tbody>
</table>

**Total Credits** 32-35

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1. Any combination of electives can be taken. Courses appear in blocks of related topics to assist students in tailoring their program to particular interests within the concentration. Under some circumstances, other 300 or 400 level electives can be substituted with advisor’s approval.

2. Required for Professional Certification as an Associate Wildlife Biologist by The Wildlife Society.

3. Required for Professional Certification as an Associate Fisheries Professional by American Fisheries Society.

4. Required for Professional Certification as a Wetland Professional in Training (WPIT) by The Society of Wetland Scientists Professional Certification Program (SWSPCP).

5. Required for Soil Certification Exam.

### Four Year Plan

Click here for roadmaps for four-year plans in the College of Agricultural and Natural Resources.

Additional information on developing a four-year academic plan can be found on the following pages:

- [4yearplans.umd.edu](http://4yearplans.umd.edu)
- The Student Academic Success-Degree Completion Policy (https://academiccatalog.umd.edu/undergraduate/registration-academic-requirements-regulations/academic-advising/) section of this catalog