ENVIRONMENTAL SCIENCE AND TECHNOLOGY MAJOR

Program Director: Paul Leisnham, Ph.D.

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 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 ecological technology design applications include restoration of urban and rural streams, creation of wastewater treatment wetlands, design of rain gardens 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.
6. Diversity, Equity, Inclusion and Respect (DEIR). Students will be able to apply their scientific and technological research and academic efforts in the context of diversity, equity, inclusion, and respect.

**REQUIREMENTS**

This program requires a total of 120 credits 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>
<td></td>
<td></td>
</tr>
<tr>
<td>BSCI170 &amp; BSCI171</td>
<td>Principles of Molecular &amp; Cellular Biology and Principles of Molecular &amp; Cellular Biology Laboratory</td>
<td>4</td>
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<tr>
<td>MATH120</td>
<td>Elementary Calculus I</td>
<td>3</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>
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<tr>
<td>ENST200</td>
<td>Fundamentals of Soil Science</td>
<td>4</td>
</tr>
<tr>
<td>ENST233</td>
<td>Introduction to Environmental Health</td>
<td>4</td>
</tr>
<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>
</tr>
<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>
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<tr>
<td>ENST389</td>
<td>Internship</td>
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<tr>
<td>Concentration (See list below)</td>
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<tr>
<td>Senior Integrative Experience - Choose one course from list below</td>
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<tr>
<td>ENST388</td>
<td>Honors Thesis Research</td>
<td></td>
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<tr>
<td>ENST470</td>
<td>Ideas into impact</td>
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<tr>
<td>ENST486</td>
<td>Senior Professional Experience</td>
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<tr>
<td>ENST472</td>
<td>Capstone</td>
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<td>Total Credits</td>
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**Concentrations:**

**Ecological Technology Design**

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<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>ENST481 &amp; BSCI207</td>
<td>Ecological Design &amp; Principles of Biology III - Organismal Biology</td>
<td>4</td>
</tr>
<tr>
<td>MATH121</td>
<td>Elementary Calculus II</td>
<td>3</td>
</tr>
</tbody>
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**Concentration Depth - Ecology (2 Courses) | 6**

| ENST410 | Ecosystem Services: An Integrated Analysis | |
| ENST422 | Soil Microbial Ecology | |

**Ecosystem Health**

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<thead>
<tr>
<th>Course</th>
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<tr>
<td>ENST333</td>
<td>Ecosystem Health and Protection</td>
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<tr>
<td>ENST334</td>
<td>Environmental Toxicology</td>
<td>3</td>
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<tr>
<td>ENST436</td>
<td>Emerging Environmental Threats</td>
<td>3</td>
</tr>
<tr>
<td>BSCI207 &amp; BSCI222</td>
<td>Principles of Biology III - Organismal Biology &amp; Principles of Genetics</td>
<td>3</td>
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<tr>
<td>MATH121</td>
<td>Elementary Calculus II</td>
<td>3</td>
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</table>

**Concentration Depth (2 Courses) | 6**

| ENST403 | Invasive Species Ecology | |
| ENST423 | Soil-Water Pollution | |
ENST432  Environmental Microbiology
ENST445  Ecological Risk Assessment

**Ecosystem Health Technical Electives** 1  12

- 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

- Environmental Science and Management:
  - ENST405  Energy and Environment
  - GEOG415  Land Use, Climate Change, and Sustainability
  - GEOL452  Watershed and Wetland Hydrology
  - ENST432  Environmental Microbiology
  - LARC450  Environmental Resources

- Ecological Processes:
  - ENST422  Soil Microbial Ecology
  - ENST450  Wetland Ecology
  - ENST460  Principles of Wildlife Management
  - PLSC400  Plant Physiology
  - BSCI467  Freshwater Biology

- Human Health:
  - BSCI424  Pathogenic Microbiology
  - BSCI425  Advanced Cell Biology Lab Practices
  - BSCI437  General Virology
  - BSCI450  Mammalian Systems Physiology

- Chemistry Depth:
  - CHEM241  Organic Chemistry II
  - CHEM242  Organic Chemistry Laboratory II

- 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
  - SOCY405  Scarcity and Modern Society

**Total Credits** 34

### Natural Resources Management

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
<td><strong>Concentration Core</strong></td>
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<tr>
<td>BSCI222</td>
<td>Principles of Genetics</td>
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</tr>
<tr>
<td>ENST214</td>
<td>Introduction to Fish and Wildlife Sciences</td>
<td>3</td>
</tr>
<tr>
<td>ENST487</td>
<td>Environmental Conflicts and Decision Making</td>
<td>2</td>
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<tr>
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<th>Title</th>
<th>Credits</th>
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<tr>
<td><strong>Concentration Depth (4 Courses)</strong></td>
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</tbody>
</table>
| ENST456  | Spatial Analysis and Ecological Sampling  
  or GEOG272  Introduction to Earth Observation Science  
  or GEOG373  Geographic Information Systems  
  or INAG237  GPS & Drone Applications in Surveying  
  or ENST453  Watershed Science: Water Balance, Open Channel Flow, and Near Surface Hydrology | |

**Total Credits** 33

### Soil and Watershed Science

<table>
<thead>
<tr>
<th>Course</th>
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<th>Credits</th>
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<tbody>
<tr>
<td><strong>Concentration Core</strong></td>
<td></td>
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<tr>
<td>GEOL100</td>
<td>Physical Geology</td>
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</table>
  & GEOL110  | Physical Geology Laboratory | |
| ENST456  | Spatial Analysis and Ecological Sampling  
  or GEOG272  Introduction to Earth Observation Science | 3 |
Environmental Science and Technology Major

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>or GEOG373</td>
<td>Geographic Information Systems</td>
</tr>
<tr>
<td>or INAG237</td>
<td>GPS &amp; Drone Applications in Surveying</td>
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</tbody>
</table>

**Concentration Depth - Soil Sciences** 7
- ENST411 Principles of Soil Fertility
- ENST414 Soil Morphology, Genesis and Classification 5
- ENST417 Soil Hydrology and Physics 5
- ENST421 Soil Chemistry 5
- ENST422 Soil Microbial Ecology 5

**Concentration Depth - Field Experiences** 3
- ENST301 Field Soil Morphology I
- ENST302 Field Soil Morphology II
- ENST303 Field Soil Morphology III
- ENST309 Advanced Field Soil Morphology
- ENST424 Field Study in Soil Morphology
- ENST430 Wetland Soils
- ENST441 Sustainable Agriculture
- ENST450 Wetland Ecology

**Concentration Depth - Systems** 6
- AREC365 World Hunger, Population, and Food Supplies
- ENST410 Ecosystem Services: An Integrated Analysis
- ENST432 Environmental Microbiology
- PLSC400 Plant Physiology

**Soil and Watershed Science Technical Electives** 12
- Agriculture and Sustainable Land Use:
  - AREC365 World Hunger, Population, and Food Supplies
  - PLSC303 Global Food Systems
  - PLSC405 Agroecology
- Social Ecology:
  - BSCI223 General Microbiology
  - BSCI337 Biology of Insects
  - BSCI467 Freshwater Biology
  - ENST410 Ecosystem Services: An Integrated Analysis
- Geosciences:
  - GEOL322 Mineralogy
  - GEOL340 Geomorphology
  - GEOL341 Structural Geology
  - GEOL342 Sedimentation and Stratigraphy
  - GEOL444 Low Temperature Geochemistry
- Watersheds:
  - ENST334 Environmental Toxicology
  - ENST423 Soil-Water Pollution
  - ENST453 Watershed Science: Water Balance, Open Channel Flow, and Near Surface Hydrology
  - GEOL451 Groundwater
  - GEOL452 Watershed and Wetland Hydrology
  - GEOL453 Ecosystem Restoration

**Total Credits** 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 (https://agnr.umd.edu/academics/advising/four-year-plans/) 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:
- [http://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/#success)](https://academiccatalog.umd.edu/undergraduate/registration-academic-requirements-regulations/academic-advising/#success) section of this catalog