ENVIRONMENTAL SOIL SCIENCE, CERTIFICATE

The Environmental Soil Science Certificate is a gateway to understanding the dynamics of Earth's thin living skin. Soil is where the atmosphere, lithosphere, and hydrosphere connect and is pivotal in shaping ecosystems' biodiversity, health, and resilience. Mastery of soil properties, processes, and distribution is necessary for addressing pressing environmental challenges, including food and energy security, water quality protection, climate change, and ecosystem health.

This certificate equips students with a holistic understanding of soil and its intersection with environmental issues. Rooted in a foundational soil science course, students delve into thematic areas, forming connections between soils and various environmental domains.

Designed as a launchpad, this certificate empowers students to pursue careers and certification in the field of soil science, opening doors for employment in the public and private sectors. Our dedicated advisors will guide students in selecting courses tailored to prepare them for their journey toward expertise in soil science and environmental stewardship.

HOW TO GET IN

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The Certificate in Environmental Soil Science is open to all undergraduate students. Students pursuing the program are encouraged to declare as early as possible so that they can best align the coursework with their interests and plan their field experience.

PREPARATORY COURSEWORK

No courses are required to declare the certificate; however, general chemistry is a prerequisite to complete required courses in the certificate.

Code	Title	Credits
CHEM 103	General Chemistry I	4
CHEM 109	Advanced General Chemistry	5
CHEM 115	Chemical Principles I	5

REQUIREMENTS

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Code	Title	Credits
Soil Science Foundation		4
Soil Science Themes		9
Allied Sciences		2-4
Total Credits		**16**

- The certificate requires a **minimum of 16 credits**.
- A minimum grade of C is required in all certificate coursework.
- Courses taken on a pass/fail (satisfactory/unsatisfactory) basis will not count toward the certificate.
- All certificate coursework must be completed in residence at the UW-Madison.

SOIL SCIENCE FOUNDATION

Complete the following courses for a total of **4 credits**:

Code	Title	Credits
SOIL SCI 301	General Soil Science	3
or SOIL SCI/ ENVIR ST/ GEOG 230	Soil: Ecosystem and Resource	
SOIL SCI 302	Meet Your Soil: Soil Analysis and Interpretation Laboratory	1
Total Credits		**4**

SOIL SCIENCE THEMES

Complete at least one course from three of the four thematic areas for a **minimum of 9 credits**. Courses may only count towards one thematic area. Additional courses from this section may be completed to meet the overall minimum credits for the certificate.

Soil Fertility & Chemistry

Code	Title	Credits
SOIL SCI 321	Soils and Environmental Chemistry	3
SOIL SCI/ AGRONOMY/ HORT 326	Plant Nutrition Management	3
SOIL SCI/BSE/ CIV ENGR 372	On-Site Waste Water Treatment and Dispersal	2
SOIL SCI 430	Environmental Soil Contamination	3
SOIL SCI/ F&W ECOL 451	Environmental Biogeochemistry	3
SOIL SCI 621	Soil Chemistry	3
SOIL SCI/ CIV ENGR/ M&ENVTOX 631	Toxicants in the Environment: Sources, Distribution, Fate, & Effects	3

Soil Physics & Development

Code	Title	Credits
SOIL SCI 327	Environmental Monitoring and Soil Characterization for Earth's Critical Zone	4
SOIL SCI/ GEOG 525	Soil Geomorphology	3
SOIL SCI/ GEOG 526	Human Transformations of Earth Surface Processes	3
SOIL SCI/ AGRONOMY/ ATM OCN 532	Environmental Biophysics	3
SOIL SCI 622	Soil Physics	3

Soil Biology & Ecology

Code	Title	Credits
SOIL SCI/ PL PATH 323	Soil Biology	3
SOIL SCI/ AGRONOMY/ BOTANY 370	Grassland Ecology	3
SOIL SCI/ MICROBIO 425	Environmental Microbiology	3

SOIL SCI/ F&W ECOL 451	Environmental Biogeochemistry	3
SOIL SCI/ CIV ENGR 623	Microbiology of Waterborne Pathogens and Indicator Organisms	3

Soils and the Environment

Code	Title	Credits
SOIL SCI 211	Soils and Climate Change	2
SOIL SCI 250	Introduction to Environmental Science	3
SOIL SCI/ ENVIR ST 324	Soils and Environmental Quality	3
SOIL SCI 327	Environmental Monitoring and Soil Characterization for Earth's Critical Zone	4
SOIL SCI 430	Environmental Soil Contamination	3
SOIL SCI 499	Soil Management	3
SOIL SCI/ F&W ECOL/ HORT 524	Urban Soil and Environment	3
SOIL SCI/ ENVIR ST 575	Assessment of Environmental Impact	3
SOIL SCI 585	Using R for Soil and Environmental Sciences	3

ALLIED SCIENCES

Complete one course from the following for a **minimum of 2 credits**:

Course List

Code	Title	Credits
A A E 101	Introduction to Agricultural and Applied Economics	4
A A E/ENVIR ST 244	The Environment and the Global Economy	4
A A E 352	Global Health: Economics, Natural Systems, and Policy	4
AGRONOMY 100	Principles and Practices in Crop Production	4
AGROECOL/ AGRONOMY/ C&E SOC/ENTOM/ ENVIR ST 103	Agroecology: An Introduction to the Ecology of Food and Agriculture	3
AGRONOMY/ BOTANY/ SOIL SCI 370	Grassland Ecology	3
AGRONOMY 377	Global Food Production and Health	3
BSE 301	Land Information Management	3
BSE/CIV ENGR/ SOIL SCI 372	On-Site Waste Water Treatment and Dispersal	2
BSE 473	Water Management Systems	3
C&E SOC/SOC 140	Introduction to Community and Environmental Sociology	4
C&E SOC/SOC 222	Food, Culture, and Society	3
C&E SOC/ F&W ECOL/ SOC 248	Environment, Natural Resources, and Society	3
C&E SOC/A A E/ SOC 340	Issues in Food Systems	3-4
ENTOM/ AGRONOMY/ NUTR SCI 203	Introduction to Global Health	3
ENTOM 570	Systems Thinking in Global Health	3
HORT 120	Survey of Horticulture	3
HORT 227	Propagation of Horticultural Plants	3
HORT/PL PATH 261	Sustainable Turfgrass Use and Management	2
HORT 370	World Vegetable Crops	3
LSC 212	Introduction to Scientific Communication	3
LSC 251	Science, Media and Society	3
LSC 430	Communicating Science with Narrative	3
PL PATH 311	Global Food Security	3

CERTIFICATE COMPLETION REQUIREMENT

This undergraduate certificate must be completed concurrently with the student's undergraduate degree. Students cannot delay degree completion to complete the certificate.

LEARNING OUTCOMES

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1. Discuss, debate, and communicate those aspects of soil science pertinent to their primary major, specialization, and career goals.
2. Describe how soil integrates into larger environmental issues using its properties, processes, and distribution from local to global scales and natural to anthropogenic environments.
3. Identify potential solutions to issues related to soil that promote the ecosystem services soil provides.
4. Communicate, in written or oral form, potential environmental impacts of land-use practices involving soil.

ADVISING AND CAREERS

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Each certificate student is assigned an advisor who works to understand student goals and help students shape their path through the certificate. Advisors also provide support for post-graduation plans such as jobs, fellowships, or graduate school.

There may be additional requirements for students seeking a Professional Soil Scientist certification beyond the Certificate requirements.
The certificate advisor can help you identify courses that will meet requirements for the Professional Soil Scientist Certification through The Soil Science Society of America.

CAREER OPPORTUNITIES

The Certificate in Environmental Soil Science provides an attractive addition to a science, engineering, or allied science major for students

interested in careers in environmental sciences, agricultural science, natural resources, and other related industries. Students in majors across campus can also use the certificate to diversify their skills and knowledge to be better informed citizens.

Questions about advising or careers may be directed to the certificate advisor listed in the contact box.

PEOPLE

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FACULTY

Dr. Francisco Arriaga

Applied Soil Physics, Soil and Water Management and Conservation: Conservation agriculture systems; development of conservation tillage practices that enhance soil quality, soil hydraulic properties, and plant water use through the adoption of cover crops and non-inversion tillage for traditional cropping systems.

Dr. Nicholas Balster

Soil Ecology, Plant Physiological Ecology, and Education: Energy and material cycling in natural and anthropogenic soils including forests, grasslands, and urban ecosystems; stable isotope ecology; environmental education; nutrition management of nursery soils; tree physiology, production and response; ecosystem response to global change; urban ecosystem processes; invasive plant ecology; biodiversity.

Dr. Phillip Barak

Soil Chemistry and Plant Nutrition: Nutrient cycling; nutrient recovery from wastewater; molecular visualization of soil minerals and molecules; soil acidification.

Dr. Zachary Freedman

Soil microbiology, ecology and sustainability: Effects of environmental change on biogeochemical cycles; community ecology and trophic dynamics; forest soil ecology; soil organic matter dynamics; sustainable agroecosystems; bio-based product crop production on marginal lands.

Dr. Alfred Hartemink

Pedology, Digital Soil Mapping: Pedology; soil carbon; digital soil mapping; tropical soils; history and philosophy of soil science.

Dr. Jingyi Huang

Soil Physics, Proximal and Remote Sensing, Soil Monitoring and Management, Digital Soil Mapping: Application of proximal and remote sensing technologies for understanding the movement of water, heat, gas, and solutes in soils across different spatial and temporal scales; application of physical and empirical models for monitoring, mapping, and managing soil changes due to natural processes and human activities.

Dr. Inna Popova

Environmental soil chemistry; understanding and mitigating the response of soil systems to the increased pressure of organic contaminants; application of biopesticides; development of novel separation and analyses methods for contaminants in environmental matrices.

Dr. Natasha Rayne

Soil Fertility and Nutrient Management: Manure placement, timing, and nitrogen credits; Organic soil amendments and nutrient cycling; Climate-smart and site-specific nitrogen management; Improvement of nitrogen use efficiency in cereal crop production.

Dr. Matthew Ruark

Soil Fertility and Nutrient Management: Soil fertility and management of grain biofuel, and vegetable crops; cover crop management; agricultural production and water quality; sustainability of dairy cropping systems; soil organic matter management.

Dr. Douglas Soldat

Turfgrass and Urban Soils: Turfgrass, urban soils, nutrient management, water resources, soil testing, landscape irrigation; soil contamination.

Dr. Thea Whitman

Soil Ecology, Microbiology, and Biogeochemistry: Soil microbial ecology; organic matter decomposition and carbon stabilization; global environmental change; stable isotopes; linking functional significance of microbial communities with ecosystem processes; fire effects on soil carbon and microbes; management and policy.

Dr. Xia Zhu-Barker

Soil Biogeochemistry, Land Management, and Environmental Sustainability: Nitrogen and carbon biogeochemical cycles; greenhouse gas and air pollutant emissions; nitrate leaching and runoff; innovative manure and nutrient utilization; composting; climate change mitigation and adaptation; ecosystem services and carbon markets; dairy environmental sustainability; novel methods in isotopic techniques; mechanistic exploration of soil-plant-microbe interactions; process-based modelling. The specific research topics include:

- Microbial and abiotic processes involved in the production and consumption of nitrogen and carbon gases (N_2O, NO_X, NH_3, CO_2, CH_4)
- Land management practices (e.g., compost, fertilizer, cover crops, irrigation, and tillage) that change soil health, nitrogen use efficiency, crop productivity, nitrogen losses, carbon turnover.
- Process oriented modelling of carbon/nitrogen turnover in agricultural ecosystems.
- Environmental changes on the sustainability and resilience of agricultural ecosystems especially dairy production systems.

WISCONSIN EXPERIENCE

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Students in the Certificate in Environmental Soil Science are involved in an array of opportunities across campus. Students are highly encouraged to complement their coursework with out-of-classroom experiences such as research (https://soils.wisc.edu/research-programs/), volunteering

(https://morgridge.wisc.edu/), internships (https://cals.wisc.edu/academics/undergraduate-students/outside-the-classroom/internships/), and study abroad (https://www.studyabroad.wisc.edu/).

Students in the certificate can participate in the UW-Madison Soil Judging Team.

CERTIFICATION/LICENSURE

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CERTIFIED PROFESSIONAL SOIL SCIENTIST

There may be additional requirements for students seeking a Professional Soil Scientist certification beyond the Certificate requirements. Work with your advisor to ensure that you complete courses that will meet requirements for the Professional Soil Scientist Certification through The Soil Science Society of America.

Please refer to https://www.soils.org/certifications/become-certified/ for current requirements.

RESOURCES AND SCHOLARSHIPS

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Financial support in the form of scholarships, part-time employment, paid internships, and work-study programs is available to qualified undergraduate students. Students with a primary major in the College of Agricultural and Life Sciences receive more than $1.25 million in scholarships annually. Additionally, the Department of Soil and Environmental Sciences is proud to offer numerous scholarships annually to students pursuing the Certificate in Environmental Soil Science.