

SOIL SCIENCE, PH.D.



The UW–Madison Department of Soil Science is one of the oldest, largest, and most prominent soil science departments in the United States. It is globally renowned for its excellence in soil research and education. The department’s mission is to provide instruction, research, and extension leadership in soil chemistry, physics, biology, and pedology to economic and sustainable land use. Programs are designed to improve basic understanding and practical management of soil resources in natural, agricultural, and urban ecosystems, and to serve local, state, national, and global interests. The department implements the Wisconsin Idea to the extended community and provides all generations with an appreciation of soil as a key natural resource and thorough understanding of the scientific basis of the environment and agriculture.

Soil science entails understanding soils and applying the principles of physics, chemistry, mathematics, and biology to the sustainable management of soil and the environment. Soil science deals with the effects of climate change and its interaction with the soil, with scarcity of water resources, and the increase of food production to feed 9 billion people. The link between soils and biodiversity as well as the effects of soils on biofuel production is widely researched in the Department of Soil Science.

The department is committed to integrated programs of instruction, research, extension, and outreach that address societal goals of responsible stewardship of soil and water resources.

The importance of soils in crop production, environmental issues, turf and grounds management, soil conservation, global climate change, carbon sequestration, rural and urban planning, and waste disposal are integrated into the department's course offerings and research programs. Graduate study in soil science provides the basic and applied scientific training needed for teaching, research, and other professional work in the agricultural, earth, and environmental sciences. The department office provides information concerning career placement and available vacancies.

Graduates from the department occupy leading positions in industry, government, education, and research in agriculture, natural resources and environmental science throughout the world. Of the more than 1,000 alumni of the department's graduate program, many are deans, directors, chairs, faculty, and staff at universities in the U.S. and other countries, or in leading positions in government, regulatory agencies, research institutions, agribusinesses, chemical industries, and recreational and conservation organizations.

The number of graduate students enrolled in the program over the past 10 years has averaged 20 per year, with about half pursuing master's degrees and half pursuing doctorates. International students generally comprise about 30% of the total. Department faculty also direct additional graduate students in multidisciplinary research in soils-related programs.

Faculty Research

Research in the department focuses on an improved understanding of the soil, as well as on interactions between soil and the people of Wisconsin. The faculty have extensive and long-term experience and knowledge about the soils of Wisconsin, their genesis, properties and management. The department has an exciting suite of research activities ranging from the molecular level to the global. Research focuses on topical themes like climate change and soil changes to land use effects of biofuel production to DNA fingerprinting of soil life.

Many field-research projects on soil and water problems are conducted in cooperation with state and federal agencies, agribusinesses, municipalities, and private farmers. The department cooperates closely with the Wisconsin Geological and Natural History Survey, Molecular and Environmental Toxicology Center, and the USDA Natural Resource Conservation Service in

conducting soil surveys and addressing problems of groundwater shortages and contamination. Relationships between soils and forests are studied at tree nurseries and in state, private, and commercial forests throughout the state in cooperation with the Wisconsin Department of Natural Resources and the pulp and paper industry.

Through a long commitment of our staff to international agriculture, the department has assisted in the creation of agricultural colleges in several developing countries and has attracted outstanding international graduate students. Current research involvement includes Brazil, Chile, China, Trinidad-Tobago, Spain, Australia, Argentina, and Antarctica.

Many department faculty have been recognized nationally and globally for their contributions to soil science. Three of only four soil scientists appointed to the National Academy of Sciences are from the UW–Madison Department of Soil Science. Several faculty members have received local and national academic, professional-society, trade-association, and industrial prizes and awards for teaching, research, and extension education and serve on important state, national, and international committees. Many faculty members have been recognized for their contributions by election to honorary fellowship in the Soil Science Society of America, the American Society of Agronomy, and allied professional societies.

Our faculty are heavily involved in cooperative interdisciplinary research undertakings with scientists and organizations within and beyond the university, such as UW–Madison's Gaylord Nelson Institute for Environmental Studies, Molecular and Environmental Toxicology Center, Environmental Chemistry and Technology Program, and other science departments, state agencies, environmental consulting and service companies, agribusinesses, and trade organizations.

RESEARCH FACILITIES

Research in the department can be conducted in the field, in the laboratory, behind the desktop, but is commonly conducted in a combination. The department is equipped with all necessary laboratory, computing, and field facilities for graduate training and research. State-of-the-art scientific instrumentation includes soil moisture tension apparatus; flame-emission and atomic-absorption spectrophotometers and gamma-ray spectrometers; neutron activation analysis

equipment; an inductively coupled plasma (ICP)-emission spectrometer and an ICP-mass spectrometer; thin-layer, high-performance liquid, gas, and ion chromatographs; low-mass isotope ratio mass spectrometer; micro-respirometers; micro-titer-plate counters; infrared and ultraviolet spectrophotometers; phase-contrast, polarizing and epifluorescence microscopy and photomicrography equipment; eddy correlation systems for heat, moisture, and CO₂ fluxes; ground-penetrating radar; high-resolution digital imaging; dynamic light scattering and particle electrophoresis equipment; flow field flow fractionation; and accelerated solvent extractor. Field equipment includes a truck-mounted hydraulic soil probe with well-drilling capabilities; a plot-field harvest combine; various production field equipment (planters, tillage equipment, rainfall simulator); differential-global position system; and particle counter.

Excellent data-collection, datalogging, computing, and networking facilities are available for basic research and graduate training. In addition to computing facilities maintained by individual researchers for their students, the department makes available to its graduate students a computer graphics facility for the production of sophisticated graphic output.

Specialized facilities are available for research in molecular biology, modern environmental microbiology, in vitro toxicology and bioassays, and contaminated-site remediation. Soils graduate students and faculty have shared access to major advanced physicochemical, x-ray, and electron microscopy analytical equipment through the Materials Science Center, National Magnetic Resonance Facility at Madison, National Synchrotron Light Source at Brookhaven National Laboratories, and other UW–Madison science and engineering departments. Facilities, vehicles, machinery, and instrumentation are available for conducting field experiments at ten strategically located UW Agricultural Research Stations and the O.J. Noer Turfgrass Research and Education Facility. Fieldwork for agricultural production and environmental protection is supported by daily information from the CALS agricultural weather-station network as well as soils, crops, land-use, and natural resources analysis using land information systems and geographic information systems.

A foundation in the basic sciences is essential for graduate study in soil science. The program requires all students to have successfully completed the pre-requisite or equivalent coursework listed below. Admission with deficiencies is possible but is likely to delay completion of graduate studies.

Pre-requisite Coursework

The following courses are generally completed in an undergraduate program; however, if these requirements have not been met, they will need to be satisfied during the Ph.D. program.

MATH 221 & MATH 222	 Calculus and Analytic Geometry 1 and  Calculus and Analytic Geometry 2	9
STAT 301	 Introduction to Statistical Methods	3
CHEM 109 & CHEM 327	 Advanced General Chemistry and Fundamentals of Analytical Science	9
or CHEM 103/104	General Chemistry I	
PHYSICS 103	 General Physics	4
BIOLOGY/BOTANY/ZOOLOGY 151	Introductory Biology	3
or BOTANY/BIOLOGY/ZOOLOGY 152	 Introductory Biology	
or BOTANY 500	 Plant Physiology	
or BOTANY/F&W ECOL/ZOOLOGY 460	 General Ecology	
or BIOCHEM 501	Introduction to Biochemistry	
or BIOCHEM 507	General Biochemistry I	

Application Materials

The following materials must be submitted when applying to the program: an online application, official transcripts, Graduate Record Exam (GRE) scores, and three references. TOEFL scores are required for applicants whose native language is not English. Because graduate requirements presuppose extensive science coursework, continuing undergraduate students are encouraged to select undergraduate courses carefully if they are considering advanced degrees in soil science.

Application deadlines

Applications for summer session should be submitted by **April 15**, fall semester by **June 15**, and spring semester by **November 15**.

Graduate School Admissions

Graduate admissions is a two-step process between academic degree programs and the Graduate School. Applicants must meet requirements of both the program(s) and the Graduate School. Once you have researched the graduate program(s) you are interested in, [apply online](#).

Graduate School Resources

Resources to help you afford graduate study might include assistantships, fellowships, traineeships, and financial aid. [Further funding information](#) is available from the Graduate School. Be sure to check with your program for individual policies and processes related to funding.

Program Resources

Financial support is usually available to qualified students in the form of research assistantships, mostly funded from research grants; final decision for granting a research assistantship rests with the professor(s) supervising the research. Any assistantship for at least one-third time qualifies a student for remission of tuition (though students may be responsible for other administrative fees). The department does not offer teaching assistantships. A number of Graduate School fellowships are available to new students with outstanding records. The deadline for application for these competitive fellowships is early January of each year. The department selects the most qualified applicants and forwards their dossiers to a campus-wide selection committee. Support for graduate assistantships is available through two Wisconsin Distinguished Fellowships (the W.R. Kussow/Wisconsin Turfgrass Association and the Leo M. Walsh/Wisconsin Fertilizer and Chemical Association), the C.B. Tanner Agricultural Physics Award Fund, and the Charles and Alice Ream Soil and Water Protection Research Fund. In addition, there are two awards given annually to outstanding incoming graduate students, the O.N. Allen Graduate Fellowship for Agriculture and the Kelling Soil Fertility Award.

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Minimum Graduate School Requirements

Review the Graduate School minimum [academic progress and degree requirements](#), in addition to the program requirements listed below.

Major Requirements

MODE OF INSTRUCTION

Face to Face	Evening/Weekend	Online	Hybrid	Accelerated
Yes	No	No	No	No

Mode of Instruction Definitions

Evening/Weekend: These programs are offered in an evening and/or weekend format to accommodate working schedules. Enjoy the advantages of on-campus courses and personal connections, while keeping your day job. For more information about the meeting schedule of a specific program, contact the program.

Online: These programs are offered primarily online. Many available online programs can be completed almost entirely online with all online programs offering at least 50 percent or more of the program work online. Some online programs have an on-campus component that is often designed to accommodate working schedules. Take advantage of the convenience of online learning while participating in a rich, interactive learning environment. For more information about the online nature of a specific program, contact the program.

Hybrid: These programs have innovative curricula that combine on-campus and online formats. Most hybrid programs are completed on-campus with a partial or completely online semester. For more information about the hybrid schedule of a specific program, contact the program.

Accelerated: These on-campus programs are offered in an accelerated format that allows you to complete your program in a condensed time-frame. Enjoy the advantages of on-campus courses with minimal disruption to your career. For more information about the accelerated nature of a specific program, contact the program.

CURRICULAR REQUIREMENTS

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Minimum Credit Requirement	51 credits
Minimum Residence Credit Requirement	32 credits
Minimum Graduate Coursework Requirement	Half of degree coursework (26 credits out of 51 total credits) must be completed graduate-level coursework; courses with the Graduate Level Coursework attribute are identified and searchable in the university's Course Guide (http://my.wisc.edu/CourseGuideRedirect/BrowseByTitle).
Overall Graduate GPA Requirement	3.00 GPA required.
Other Grade Requirements	Required courses in soil science must be completed with a grade of B or better (BC and C may not be offset by AB and A). For all other courses, the requirement is an average record of B or better in all work taken as a graduate student.
Assessments and Examinations	<p>Candidates must complete the Ph.D. prospectus, which consists of the prospectus seminar and the written prospectus.</p> <p>Candidates are required to take a preliminary examination.</p> <p>Candidates for the Ph.D. degree are subject to a final oral examination on their dissertation and the general fields of the major and minor studies. Candidates must present an open seminar on their Ph.D. research findings, followed by oral defense of the dissertation in front of the doctoral committee.</p> <p>Deposit of the doctoral dissertation is required.</p>
Language Requirements	No language requirements.

Doctoral
Minor/Breadth
Requirements

All doctoral students are required to complete a minor. Ph.D. candidates in soil science must supplement their major study with a minimum of 10 credits in graduate courses in another field. These courses must be selected according to a coherent plan under Option A or Option B as follows:

Option A–External: A student must offer at least 10 credits from a degree program outside the soil science major. Selection of this option requires approval of the minor department.

Option B–Distributed: A distributed minor for a student studying for a Ph.D. in soil science shall consist of a minimum of 10 credits of graduate-level courses in one or more departments. Selection of this option requires approval of the certification committee.

A minor program must be approved by the minor department (Option A) or by the Department of Soil Science Certification Committee (Option B) no later than the end of the second semester of Ph.D. graduate work (not including summer sessions). A copy of the completed minor agreement form is needed to obtain the warrant for the preliminary exam.

Required COURSES

SOIL SCI 301	General Soil Science	4
SOIL SCI 325	Soils and Landscapes	3
SOIL SCI/AGRONOMY/ATM OCN 532	Environmental Biophysics	3
or SOIL SCI 622	Soil Physics	
SOIL SCI 621	Soil Chemistry	3
or SOIL SCI/BOTANY/HORT 626	Mineral Nutrition of Plants	
SOIL SCI/MICROBIO 523	Soil Microbiology and Biochemistry	3
SOIL SCI 728	Graduate Seminar 1	1
SOIL SCI 799	Practicum in Soil Science Teaching 2	1-3
SOIL SCI 990	Research 3	1-
		12

A minimum of 8 credits, non-research at the 500 or higher level, which includes two credits of graduate seminar. 8

- 1 All Ph.D. candidates must present at least two seminars in [SOIL SCI 728](#) Graduate Seminar for a letter grade \geq B or equivalent during Ph.D. program. One of the seminars must be on the student's prospectus. Each candidate must enroll in [SOIL SCI 728](#) Graduate Seminar every fall and spring semester; exceptions require the approval of the department chair.
- 2 All candidates pursuing a Soil Science Ph.D. shall complete a minimum of 1 credit of [SOIL SCI 799](#) Practicum in Soil Science Teaching. A written plan for satisfying this requirement shall be prepared by the student in conjunction with the advisor and approved by the Certification Committee. The type and level of effort required to earn one or more degree credits in [SOIL SCI 799](#) Practicum in Soil Science Teaching shall be in accordance with the guidelines and standards set forth by the CALS Curriculum Committee and approved by the UW Divisional Committees in the Spring Semester 1981.
- 3 Ph.D. candidates are required to enroll in at least 1 credit of [SOIL SCI 990](#) Research every semester.

Graduate School Policies

The [Graduate School's Academic Policies and Procedures](#) provide essential information regarding general university policies. Program authority to set degree policies beyond the minimum required by the Graduate School lies with the degree program faculty. Policies set by the academic degree program can be found below.

Major-Specific Policies

Graduate Program Handbook

A Graduate Program Handbook containing all of the program's policies and requirements is forthcoming from the program.

Prior Coursework

Graduate Work from Other Institutions

With program approval, students are allowed to count no more than 12 credits of graduate coursework taken during graduate study at other institutions. Coursework earned ten or more years prior to admission to a doctoral degree is not allowed to satisfy requirements.

UW–Madison Undergraduate

With program approval, students are allowed to count no more than 7 credits of graduate coursework numbered 300 or above from a UW–Madison undergraduate degree. The coursework may also count toward the 50% graduate coursework requirement if the courses are numbered 700 or above. Coursework earned ten or more years prior to admission to a doctoral degree is not allowed to satisfy requirements.

UW–Madison University Special

With program approval, students are allowed to count no more than 15 credits of coursework numbered 300 or above taken as a UW–Madison University Special student. The coursework may also count toward the 50% graduate coursework requirement if the courses are numbered 700 or above. Coursework earned ten or more years prior to admission to a doctoral degree is not allowed to satisfy requirements.

Probation

The Graduate School regularly reviews the record of any student who earned grades of BC, C, D, F, or Incomplete in a graduate course (300 or above), or grade of U in research credits. This review could result in academic probation with a hold on future enrollment or in being suspended from the Graduate School.

ADVISOR / COMMITTEE

The doctoral committee is a committee of five or more faculty members chosen by the major professor and the student, subject to approval by the certification committee. A minimum of three must be drawn from the soil science faculty. Representation of the minor department (see *graduate minor requirements*, below) is at the option of the minor

department, but the Department of Soil Science recommends that the minor professor be on the committee. A minimum of three must be designated as readers.

It is the responsibility of the student and the major professor to form a doctoral committee and schedule a meeting before the end of the second semester (not including summer sessions) of Ph.D. graduate work. The doctoral committee will prepare a draft "degree clock" for the student specifying all significant Ph.D. milestones (certification of Ph.D. coursework, approval of minor, presentation of prospectus, preliminary examination, and final examination) during their initial meeting.

A student who does not meet deadline requirements in the departmental Ph.D. requirements document will not be allowed to register in the subsequent semester until a written plan for meeting the requirements has been approved by the major advisor and the department certification committee.

A proposed program for a Ph.D. candidate satisfying the minimum course requirements must be approved by the certification committee before the end of the first semester of Ph.D. graduate work.

CREDITS PER TERM ALLOWED

15 credits

Time Constraints

Prospectus: The written prospectus and the prospectus seminar must be completed by the end of the third semester (not including summer sessions).

Preliminary exam: Students who obtain their M.S. degree in the department and who continue in the department for their doctorate must take the preliminary examination by the end of the fourth semester (not including summer sessions) of Ph.D. graduate work. Candidates who are approved to retake a failed examination must have passed by the end of the fifth semester.

Candidates for the Ph.D. degree who obtained an M.S. or M.A. degree elsewhere, must take the Preliminary Examination by the end of the fourth semester (not including summer sessions) of Ph.D. graduate work. Candidates who are approved to retake a failed examination must have passed by the end of the fifth semester.

Candidates who do not adhere to this deadline must show justification for the delay to the department certification committee.

Final oral exam and deposit of dissertation: A candidate for a doctoral degree who fails to take the final oral examination and deposit the dissertation within five years after passing the preliminary examination may be required to take another preliminary examination and to be admitted to candidacy a second time.

Other

Financial support is available to qualified M.S. and Ph.D. students in the form of research assistantships. Most assistantships are funded through research grants, and the final decision rests with the professor(s) supervising the research. A research assistantship for at least one-third time qualifies a student for remission of all tuition. The department does not offer teaching assistantships. Graduate School fellowships are also available.

Graduate School Resources

Take advantage of the Graduate School's [professional development resources](#) to build skills, thrive academically, and launch your career.

Program Resources

UW–Madison offers a wealth of resources intended to enrich your graduate studies and enhance your professional skills. Starting your very first year on campus, it is expected that you will take full advantage of the career and professional development resources that best fit your needs and support your goals. Since our alumni thrive not only in academia but also in industry, corporate, government and non-profit arenas, we strive to be in-tune, holistic, and innovative in our approach to meeting the diverse professional development needs of our students. By actively

participating in these professional development opportunities, you will build the skills needed to succeed academically at UW–Madison and to thrive professionally in your chosen career.

1. Articulates research problems, potentials, and limits with respect to theory and practice in soil science.
2. Formulates ideas, concepts, designs, and/or techniques beyond the boundaries of soil science knowledge.
3. Articulates testable hypotheses and conducts research that makes a substantive contribution to soil science.
4. Communicates clearly in ways appropriate to the field, in oral and written forms, for scholarly and general public audiences.
5. Fosters ethical and professional conduct, adhering to accepted standards such as that of the Soil Science Society of America.

FACULTY

Assistant Professor 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.

Associate Professor 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.

Professor Phillip Barak

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

Professor William Bleam

Surface and Colloid Chemistry: Physical chemistry of soil colloids and sorption processes, chemistry of humic substances, factors controlling biological availability of contaminants to microorganisms, magnetic resonance and synchrotron studies of adsorption and precipitation.

Professor Alfred Hartemink

Pedology, Digital Soil Mapping: Application of fundamental soil science to real-world problems; digital soil mapping; history and philosophy of soil science; pedology, soil survey, and soil information systems.

Professor William Hickey

Soil Microbiology and Biochemistry: Soil microbiology, biodegradation, environmental toxicants, molecular physiology, functional genomics, microbial nanostructure, biotechnology.

Professor Carrie Laboski

Soil Fertility and Nutrient Management: Sustaining agricultural production and environmental quality; elucidate the biogeochemistry and subsequent best management practices for N, P, and K fertilizers and animal manures; soil fertility related to lime, secondary, and micronutrients; evaluation of soil and plant diagnostic tests; development of tools to assist producers, ag. professionals, and regulatory agencies to sustain economically sound production of grain and forage crops.

Professor Sharon Long

Applied Environmental and Public Health Microbiology: Microbial source tracking indicators in watershed management; improving detection and quantification, environmental ecology of indicator organisms and infectious diseases, microbial community structure and function in contaminated systems, microbial safety of wastewater sludge and biosolids, biotreatability assessment.

Professor Joel Pedersen

Environmental Chemistry/Biochemistry: Behavior of organic contaminants, macromolecules, and engineered nanoparticles in natural and engineered environments.

Associate Professor 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.

Professor Douglas Soldat

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

Professor Stephen Ventura

Geographic Information Systems (Joint w/Nelson Institute for Environmental Studies): Geographic information systems (GIS), biofuels and production on marginal lands, public participation GIS, urban agriculture, land-scape process modeling, soil survey and soil information systems, land and resource tenure, GIS and land use planning.

Assistant Professor 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.

Contact Information

Soil Science

College of Agricultural and Life Sciences

soils.wisc.edu

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