

# 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 US 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, and 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 CO<sub>2</sub> 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, data logging, 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.