SOIL SCIENCE (SOILS)

SOILS 71: Environmental Sustainability

3 Credits

An introduction to environmental science, exploring sustainable human-environment interactions with examples from environmental soil science. SOILS 071 Environmental Sustainability (3) (GN;IL) This class provides an introduction to environmental sustainability for students with no background in environmental science or soils. The concept of sustainability provides a framework for understanding environmental problems by balancing the needs of current society with the long-term needs of future societies and the environment. Sustainability also provides a framework for linking international cultures because environmental problems and solutions often cross political and cultural boundaries. The goal of the course is to develop critical thinking skills related to sustainable environmental choices. As we explore the concept of sustainability, we will discover the role of soil in mediating human-environment interactions by determining natural plant and animal abundance, supporting agriculture, and buffering the environment against modern pollution. The five themes of the class are: 1) The science of nature and the nature of science, which introduces students to the scientific method and value systems that affect environmental choices, 2) Population and consumption, where we consider these challenges to global sustainability, 3) the Malthusian dilemma of how we can feed billions of people in the near future, 4) the conservation dilemma of how we can maintain a healthy environment (while feeding billions of people), and 5) Success stories in sustainable environmental science and policy. The class will include &quot;soils cases&quot; in which examples from environmental soil science are used to convey principles of sustainability, and &quot;sustainability walks&quot; to see examples of sustainable environmental choices near campus. Students will complete the class with: 1) a survey of the key issues in global environmental sustainability, 2) exposure to current scientific information related to these issues, 3) an enhanced ability to interpret environmental data, 4) an increased knowledge of the role of soils in maintaining environmental quality, 5) an increased understanding of how environmental problems and solutions are global phenomena, requiring cooperation among many international cultures, and 6) a significant depth of knowledge about what it takes to feed 6.5 billion people while maintaining a healthy environment.

International Cultures (IL)
General Education: Natural Sciences (GN)

SOILS 101: Introductory Soil Science

3 Credits

A study of soil properties and processes and relationships to land use, plant growth, environmental quality, and society. SOILS 101 Introductory Soil Science (3) (GN) This survey and foundational course introduces students to a broad range of subject matter from most sub-disciplines of soil science. We study a range of soil characteristics and seek to understand their relationship to soil function, land use, plant growth, environmental quality, and society/culture. This course introduces students to the variety and complexity of soils on a local, national, and international scale. We identify the physical, chemical, and biological properties and processes of soils and relate these to the way that societies use and abuse soils. Students acquire a working knowledge of the technical terminology of soil science and begin developing observational skills needed to describe and/or locate soil properties for specific locations and to interpret those properties for various uses. We learn to recognize and explain various land use and management decisions on agricultural productivity and sustainability, environmental and ecological health, and on community relationships. This course is required or on a list from which students select for many environmental and agricultural majors. It is specifically listed as a prerequisite for many other SOILS courses and for several soils-related courses taught at Penn State.

Bachelor of Arts: Natural Sciences
General Education: Natural Sciences (GN)

SOILS 102: Introductory Soil Science Laboratory

1 Credits

Laboratory exercise and field trips designed to develop student competency in soil description, analysis, and assessment. SOILS 102 Introductory Soil Science Laboratory (1) This laboratory course is designed for students who plan to work directly with soils, make land use and management decisions, or to be involved in projects requiring practical application of soil science principals. By conducting weekly laboratory and field exercises and writing reports on their work, students will deepen their understanding of, and learn to apply, the fundamental soil properties and processes introduced in SOILS 101. This laboratory course, in conjunction with the SOILS 101 lecture course, will provide foundational learning in soil science and prepare students for upper level soil science courses. This laboratory course is also designed to provide students with hands on experience in analytical procedures for soil assessment, testing, and interpretation, as well as field experience in observing, characterizing and describing soils.

Prerequisite: SOILS101

SOILS 296: Independent Studies

1-18 Credits/Maximum of 18

Creative projects, including research and design, which are supervised on an individual basis and which fall outside the scope of formal courses.

SOILS 299: Foreign Studies

1-12 Credits/Maximum of 12

Courses offered in foreign countries by individual or group instruction.

International Cultures (IL)

SOILS 401: Soil Composition and Physical Properties

3 Credits

Advanced study of mineralogical and physical properties of soils which affect soil-plant-water relationships.

Prerequisite: SOILS101
SOILS 402: Soil Nutrient Behavior and Management

3 Credits

Chemical and biological behavior of soil nutrients; management for plant availability and fate in the environment. Laboratory emphasizes soil testing and soil-plant relationships. SOILS 402 Soil Nutrient Behavior and Management (3) Soil Nutrient Behavior and Management is a senior/graduate level course that covers the chemical and biological processes that determine the behavior of essential plant nutrients in soils. As this understanding of basic nutrient behavior is developed in the course, it is applied directly to explain the basis for management of nutrients for optimum plant availability. This same nutrient behavior is linked to the fate of nutrients either applied as sources of plant nutrition or through disposal of nutrient containing materials on soils, which is a major environmental issue. Management practices necessary to minimize environmental impacts from nutrients are also covered. From this background students will be able to understand nutrient behavior and management recommendations and adapt management to a variety of soil-plant systems and situations both for plant growth and environmental protection. Real world examples of developing and adapting management systems are used to illustrate this process. The laboratory exposes the student to common soil testing procedures, methods for studying soil nutrient-plant interactions, and examples of practical application of management practices in the field. Evaluation will be based on 3 exams, laboratory reports, homework assignments.

Prerequisite: CHEM 112, SOILS101

Cross-Listed

SOILS 403: Soil Morphology Practicum

2 Credits/Maximum of 4

Students develop field skills to describe soil morphology, classify soils, and make land use interpretations. SOILS 403 Soil Morphology Practicum (2 per semester/maximum of 4) SOILS 403 is an eight week course that provides students with the opportunity to: make detailed soil morphological descriptions and interpretations; evaluate soil properties and their suitability for different land uses; and observe various soils throughout the Northeastern U.S. SOILS 403 synthesizes techniques used to describe soil morphology and site characteristics, classify soils, and make land use interpretations. The field skills taught are highly applicable to those pursuing careers in fields of environmental studies, engineering, waste disposal, horticulture, landscape architecture, agricultural, forestry, consulting, and by those describing soils for research. Students also have the opportunity to try out for the Penn State Undergraduate Collegiate Soil Judging Team each fall.

Prerequisite: SOILS101 or equivalent

SOILS 404: Urban Soils

3 Credits

This course introduces the student to natural and human-influenced soils. SOILS 404 Urban Soils (3) This course introduces the student to the management of soils in urban and suburban settings via comparisons in soil physical, chemical, and biological properties. The soil is also examined as the interface between the biotic and abiotic components of an urban site. Therefore, site management of soil during or following placement is examined in detail. Urban soil physical and chemical properties are discussed in terms of site stability. The interactions between stormwater management, erosion control, soil mechanics, and the soil’s ability to support vegetation are examined in the context of sustaining urban environments. The soil design process is presented: site assessment, biophysical analysis, profile construction, specification formulations, and conformance testing and inspection protocols. Professional practical examples such as mine reclamation, brown field restoration, and landscape construction are presented to illustrate the process. The student completes a series of exercises to gain experience in soil examination, soil/land use interpretation, site assessment, soil erosion calculations and a group assignment that evaluates soil issues on a reclamation or construction project.

Prerequisite: SOILS101

SOILS 405: Hydropedology

3 Credits

Soil and water interactions across scales, integrated studies of landscape- soil-water relationships, fundamental processes of water flow and chemical transport. SOILS (GEOSC) 405 Hydropedology (3) Hydropedology is the study of the fluxes, storages, pathways, residence times, and spatio-temporal organization of water in the root and deep vadose zones, and their relations to climate, ecosystem, land use, and contaminant fate. The aim is to characterize integrated physical, chemical, and biological processes of soil-water interactions across scales (including chemicals and energy transported by water flow). This course embraces interdisciplinary and multiscale studies of interactive pedological and hydrological processes in the earth’s surface and subsurface environments. The course will address the fundamental issues and practical applications of hydropedology (as a sister discipline of hydrogeology). This course emphasizes situations that have distinct characteristics of pedogenic features, structures, layers, and soil-landscape relationships in the real world. Students will gain an in-depth understanding of soil and water interactions across scales from point observations to watershed phenomena, and will gain skills in predicting flow pathways and water fluxes in the landscape. This course promotes active learning, critical thinking, and hands-on skills. Course format will consist of two lectures and one laboratory/field exercise each week. The course will utilize a network of local watersheds with different land uses for demonstrations and class projects. Grading will be based on weekly lab/field exercise (20%), class research project (40%), homework (10%), one midterm exam (15%), and one final exam (15%). Since hydropedology is linked to a wide array of environmental, ecological, geological, agricultural, and natural resource issues of societal importance, SOILS (GEOSC) 405 will support interdisciplinary training of students in Soil Science as well as in other disciplines of the College of Agricultural Sciences, especially Agricultural and Biological Engineering, Agronomy, and Forest Resources. Students in the College of Earth and Mineral Sciences, College of Engineering, Eberly College of Science, and the Intercollege Graduate Degree Program in Ecology also will find this course useful when undertaking research on the vadose zone, the hydrologic cycle, and the earth system.

Prerequisite: SOILS101

Cross-listed with: GEOSC 405

SOILS 412W: Soil Ecology

3 Credits

Introduction to soil organisms; includes interactions between organisms, their processes, and metabolism with a major focus on microorganisms.

Prerequisite: BIOL 011, BIOL 127, or BIOL 110
Prerequisite: Nutrient Management Planning.

Such as nutrient cycling as well as farm-level implementations such as principals and strategies. The course considers big picture concepts scientific and practical understanding of sound nutrient management to environmental quality. Students in this cross-listed course gain both nearby crop land. If not properly managed these nutrients represent a risk animal products, 60 to 70% of the nutrients are excreted and applied to livestock farms. While some nutrients leave the farm in the form of regionalization and concentration of animal production systems comes animal, plant and soil sciences to the issues and solutions in the area. Systems is a senior level course that applies the fundamentals of comprehensive review of nutrient flow in animal agricultural systems, 3 Credits

Lecture and laboratory course on the genesis of soils, their classification, mapping, and interpretation for land use. SOILS 416 Soil Genes is the sole reason for conservation planning. Eventually control was the sole reason for conservation planning. Eventually the conservation and sustainable use of resources. This involves the community. The course focuses on developing methods for soil, water, air, plants, animals, and humans (soil, water, air, plants, animals, and humans) impacting quality of life and sense of place. SOILS 422 provides the student with practical knowledge of community and natural resources conservation. The course covers symbiotic aspects of soil, water, air, plants, animals, and humans and their impact on the community. The course focuses on developing methods for the conservation and sustainable use of resources. This involves understanding the land ethic and developing a sense of place. Conservation awareness has grown in recent years. Originally, erosion control was the sole reason for conservation planning. Eventually...
water conservation also became a concern addressed by planning. We have now moved into an era of ecosystem-based planning, where soil health, water and air quality, sustainable communities, and much more are considered in conservation planning. This planning involves both natural and human resources. SOILS 422 covers understanding, designing, and developing best management practices (BMPs) for addressing resource conservation and maintaining sustainable farmland and communities. Calculating runoff and soil loss are researched and integrated into conservation planning as tools for establishing the need for BMPs. Resources and technologies are covered, such as soil surveys, geographic information systems (GIS), global positioning systems (GPS), and ground penetrating radar (GPR). Networking and partnerships are also covered to give the student a practical knowledge of the critical nature of teamwork. Additionally, workings and interactions between federal, state, and local organizations and agencies are explored. Landscape patterns, such as urban and suburban sprawl, mining, logging, and resource utilization are explored. Education is enhanced in the form of a community/sense of place project. This project utilizes classroom knowledge and incorporates student research into a practical plan for developing an appreciation and awareness for one’s community. Throughout the course the various aspects of soil, water, air, plants, animals and humans are woven together to emphasize the importance of all decisions on the ecosystem. After completing SOILS 422, the student will be equipped to make valuable and educated decisions to positively affect the community. Hands-on aspects of the course include various field trips to experience field conservation and community stability. At the end of the course the student will be able to evaluate effects of human activities on the landscape; make sustainable landuse decisions; determine the need for, and design best management practices; and develop a sense of place and describe individual roles and responsibilities in the community.

Prerequisite: SOILS 101

SOILS 450: Environmental Geographic Information Systems
3 Credits

Use of geographic information systems (GIS) and digital spatial databases to characterize landscapes for environmental assessment and management.

Prerequisite: SOILS 101

SOILS 489: Supervised Experience in College Teaching
1-3 Credits/Maximum of 3

Participate with instructors in teaching an undergraduate soil science course; assist with teaching and evaluation and with development of instructional materials.

Prerequisite: SOILS 101, approval of instructor

SOILS 490: Colloquium
1 Credits

Continuing written and oral presentations developed by students in consultation with the course instructor.

Prerequisite: seventh-semester standing
Cross-listed with: AGRO 490

SOILS 494: Undergrad Research
1-6 Credits/Maximum of 6

Prerequisite: permission of the SOILS program

SOILS 494H: Honors Thesis Research
1-6 Credits/Maximum of 6

Independent study directed by a faculty supervisor that culminates in the production of a SOILS honors thesis. The course involves research and other scholarly activities (such as writing) necessary for completion of an approved SOILS honors thesis.

Prerequisite: Enrollment in the Schreyer Honors College and permission of a SOILS honors adviser

Honors

SOILS 495: Internship
1-18 Credits/Maximum of 18

Supervised off-campus, nongroup instruction including field experiences, practica, or internships. Written and oral critique of activity required.

Prerequisite: prior approval of proposed assignment by instructor

Full-Time Equivalent Course

SOILS 496: Independent Studies
1-18 Credits/Maximum of 18

Creative projects, including research and design, which are supervised on an individual basis and which fall outside the scope of formal courses.

SOILS 499: Foreign Studies
1-12 Credits/Maximum of 12

Courses offered in foreign countries by individual or group instruction. International Cultures (IL)