Department: SOIL

Course No.: 2120

Credits: 3

Title: Environmental Soil Science

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Content Area: CA3 Science and Technology

Catalog Copy: SOIL 2120. Environmental Soil Science (251) (Formerly offered as PLSC 251.) Three credits. Three class periods. Prerequisite: CHEM 1122 or 1124Q or 1127Q or 1137Q or or 1147Q. Not open for credit to students who have passed PLSC 250. Schulthess

Introduction to the physical, chemical and biological properties of soils. The relationship between soils and the growth of higher plants. Impact of soils on environmental quality. CA-3

Course Information:

In our role as a land and sea grant institution, The University of Connecticut's 2009-2014 Strategic Plan's summary of aspirations and values states that "we seek to promote the state's economic development and social well-being by advancing new science, improving the cultural fabric, protecting the natural environment, and enhancing the quality of healthcare." In its section Goal 1, Undergraduate Education, it further notes that successful resolution of environmental sustainability requires not only scientific principles, but also a global perspective. This Soils course is very much in line with these aspirations and goals.

Soils impact everybody's life. It is global in nature, and it affects all other natural environments. Soil carbon sequestration influences climate change. All known chemicals (including agricultural, pharmaceutical, and petroleum products) spend a significant amount of time in soils. This, in turn, impacts water quality. The production of food is strongly dependent on soil quality, and food production, in turn, directly affects local economies. Soil erosion is an important mechanism for the transport of pollutants, and it also directly degrades our top soil. Without good soil structure many of our agricultural fields would be fields of mud when wet or very hard surfaces when dry.

Teaching our undergraduates about soils and soil stewardship increases their understanding of the natural environment, the importance of sustainability, the impact it has on our everyday lives, and the interdependency of the various natural environments. Soil formation is influenced by climate, topography, biota, parent materials and time. That is, as the students learn about soils, they also learn about its dependency on climate, the role of geological events (such as, volcanic eruptions, glaciation, and flooding), the impact of location of soil types and quality, and the ecology of the environment. Accordingly, this course is a gateway toward many of the other environmental courses taught in our

university, particularly where soils are a central component of natural and human-influenced processes.

Students today only know soils based on what they see on its surface. For most, the rest of what lies below is “dirt” and they fail to see that complex horizons are present within inches below their feet. This ignorance of such an important natural body can have many detrimental consequences in a student’s future activities that involve soils, which can include construction projects (engineers) and the economic development of nations (economists). Even if the students do not need to work with soils professionally, they will all probably always interact with soils throughout their lives. Their decisions on the use of recreational vehicles in sensitive areas will be better informed. Their decisions on how to manage their gardens and lawns will be based on good soil stewardship lessons learned here. And most importantly, management of soils and soil quality directly affects food security. With this soils course, our undergraduate students will have a better grasp of critical environmental and ecological issues, and they will particularly be aware that all of the natural bodies of planet Earth are all interconnected, from the air they breath, to the water they drink, to the food they eat, and to the ground they stand on. Soil quality impacts their lives, and how they live their lives, in turn, greatly impacts soil quality.

Because of soil’s relationship to the environmental life on this planet, a GER designation would be entirely appropriate. More undergraduate students would be drawn into this course with information on a critical subject area that will affect their lives on an everyday basis.

Meets Goals of Gen Ed 40a. Course Description:
This course covers four major areas: (1) nature and description of soils, (2) soil physics, (3) soil chemistry, and (4) environmental impact of soils. Soils are mostly underground and are therefore not fully visible from above. Only the soil surface is visible. Accordingly, this course teaches the students how to “see” through this surface layer so as to understand the nature of the environment below ground. To accomplish this, there is a great deal of basic sciences taught in this course (chemistry, physics and biology) as well as other applied sciences (climatology, geology and ecology). The course’s goal is to have the students understand how the various parts of nature (such as climate, biota, topography, parent materials, and time) are all involved in the formation and maintenance of healthy soils. The course’s goal is also to instill awareness of anthropogenic activities on soil quality, and soil quality on anthropogenic activities.

40b. Course Requirements:
There are four 100-point written exams in this course, each covering the four major areas described above. Each section has an accompanying chapter to be read about the topics covered. Several short written quizzes are given, averaging about two per week, each worth one to three points each. Problem sets are also offered, averaging two or three per semester, and these are on numerical calculations of soil properties. There are also four short reports required where the students synthesize material learned in context with current environmental problems.

40c. List of themes, issues, and topics to be covered:
The first topic covered is on the nature and description of soils. This topic covers most of the more

difficult soils vocabulary presented. Previous classes on this topic consistently elicited awe and surprise from students about the complex nature of the world just inches beneath their feet. This topic explains to the students how soils are described and classified. The classification system is based on various soil properties that can be objectively observed and measured.

The second topic covers the physical properties of soils and how water moves vertically through the soil profiles or horizontally in groundwater. This includes discussions on water quality, homeland security, and water conservation.

The third topic covers the chemical properties of soils. This is closely tied to soil fertility and soil quality. It is also tied to soil degradation and production of saline-sodic soils and various soils in marginal agricultural lands around in the United States and around the world. Various satellite images and soils photos from around the world are included in these discussions.

The final topic coalesces the environmental impact on soils with the earlier topics. This includes discussions on soil organic matter, particularly on the role of biota, temperature, and climate change on the production and decomposition of soil organic matter, as well as its impact on atmospheric carbon dioxide levels and soil carbon sequestration. This topic also covers soil erosion and its impact on food production. Also covered are soil pollution and its impact on human health as well as the health and quality of various other natural environments downstream.

CA3 Criteria:

Students in this course will meet the following criteria:

Students will be introduced to a broad, coherent body of knowledge and contemporary scientific or technical methods:
The students will learn various basic physical and chemical parameters of soils. These are important in understanding water movement in soils and soil chemical properties, which also affect biological processes. It is also important in soil taxonomy and description of the soil horizons, which guides proper management of soils.

This course will promote an understanding of the nature of modern scientific inquiry, the process of investigation, and the interplay of data, hypotheses, and principles in the development and application of scientific knowledge:
Students will learn about the process of investigation and the interplay of data through lessons on how soils are described, analyzed and classified. Lessons on soil classification focus primarily on hypotheses construction for a given location based on various soil formation factors. This is followed by data on a limited set of field samples because it is generally impractical to excavate entire fields for this purpose. Accordingly, the scaling up of the scientific data collected in a few field samples is studied.

This course will introduce students to unresolved questions in some area of science or technology and

discuss how progress might be made to answer these questions:
This course often describes situations where no known solution is free of negative consequences, but yet choices must be made with the current technology. These include use of chemicals to control weeds (which is highly dependent on biotechnology as well as field management practices), and use of fertilizers without causing pollution (which can be influenced by slow release technological developments, as well as precision application technologies). This course also discusses the use of invasive soil sampling techniques, which generally disturb the soil's structure, and looks at the type of tools that might be used instead (such as ground penetrating radar, moisture measuring tools, and several others).

This course will promote interest, competence, and commitment to continued learning about contemporary science and technology and their impact upon the world and human society:
Soils impact everybody's life. From drinking water quality to the recycling of organic waste products. From the fast draining recreational fields to the protected wetlands. From the productivity of agricultural fields to the dust bowl of the 1930s (and many other current dust storms around the world). From the use of fertilizers and agricultural chemicals to the disposal of pharmaceutical and industrial chemicals (of which they nearly all always end up in soils for extended periods of time). From septic tanks to landfills. The wealth of a nation is closely tied to the quality of its soils. The difference between war and peace is closely tied to soil quality and the availability of food and water.
Accordingly, soil stewardship is an important repeated theme in this course. Students learn how soils impact us, as well as how our activities impact soils. Students learn about the various natural cycles that involve soils, and they also learn about the erosion of soils and the fragile nature of soils (particularly top soil). They also learn that once a soil is lost, which is easy to do, it is not easily recovered.