

SOIL IN THE ENVIRONMENT

ERS 484 / GEOG 404

Course Syllabus: September 2013

COURSE INFORMATION

Instructor:	Maren Oelbermann, Ph.D.
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Office Hours:	TBD
Lecture Times:	Thursday 8:30 am to 11:20 am
Location:	EV1, Room 132
Prerequisite:	EnvS 200

COURSE DESCRIPTION

This course examines the role of soil the environment and its importance as a natural resource in agricultural and forest productivity and the effects on soil due to mismanagement. This course is divided into three sections. The first section introduces fundamental concepts of soil looking in detail at soil composition, formation, and soil physical, chemical and biological characteristics. The second section of this course will discuss soil degradation and management approaches used to rehabilitate acidic soil, salinization/sodicity and soil erosion. The third section will focus on soil pollution, and the role of soil in maintaining environmental integrity. [This course is available on Learn.](#)

COURSE GOALS

- To introduce the composition and characteristics of soil and the importance of soil in the environment
- To introduce the major factors affecting soil resources and approaches to rehabilitation of soil

COURSE OBJECTIVES

By the end of the semester, students should be able to:

- Understand the fundamental characteristics (physical, chemical, biological) of soil, and soil degradation
- Outline solutions to rehabilitate degraded soil
- Understand soil pollution and the importance of soil in maintaining ecosystem integrity

COURSE EVALUATION

Midterm:

- In-class midterm held on Thursday, October 24th, 2013 (8:30 am to 10 am)
- Worth 30% of the final mark
- Midterm includes lectures 1, 2, 3, 4, and 5, and all associated readings with these lectures

Final Exam:

- The Final Exam is worth 40% of the final mark.
- The exam will be scheduled during the final examination period in December 2012.

- Only in exceptional circumstances, and with official documentation, will a missed midterm or final exam be granted to be written at a later date.

Assignment:

- The assignment is worth 30% of the final mark. Assignment outline is posted on Learn.
- The assignment must be submitted on Thursday, November 15th, 2013 by 11:59 pm in the Learn Dropbox
- Late assignments will be *penalized 4 marks per day*. The final day of submitting the assignment is November 18th, 2013 at 11:59 pm. Any assignments submitted after this time will automatically receive a grade of zero (0).

COURSE TEXTBOOK

The textbook for this course is required and can be purchased in the UW Bookstore:

"Elements of the Nature and Properties of Soils"
by N.C. Brady and R.R. Weil, 3rd Edition, 2010.

COURSE SUBJECT MATERIAL

MODULE 1: Fundamental Soil Characteristics

LECTURE 1:

Introduction

- Introduction to ERS 484/GEOG 404: Soil in the Environment
- Course Syllabus
- Course Expectations

The Soil Around Us: Composition and Importance (Chapter 1)

- What is Soil?
- The Functions of Soil
- Components of Soil: Mineral and Organic
- The Soil Profile
- Soil: A Precious Resource
- Soil: Degradation, Misuse and Quality

LECTURE 2:

Soil Sampling Methods (not in textbook)

- Methods of Soil Sampling: Agriculture, Forestry and Ecosystems
- Soil Sample Preparation
- Soil Sample Analysis

Soil Architecture and Physical Properties (Chapters 4 and 7)

- Soil Texture (size distribution of soil particles) and Soil Textural Classes
- Soil Structure and Soil Aggregates
- Soil Bulk Density
- Soil Porosity and Permeability
- Soil Air
- Soil Color
- Soil Temperature

LECTURE 3:

Soil Chemical Properties (Chapter 8)

- The Soil Colloid: Properties and Types
- Clay: Silicate clay structure, Clay Types and Mineralogical Organization, Role of Clay
- Soil Humus
- Cation and Anion Exchange
- Soil pH: Its Role in Cation/Anion Exchange

LECTURE 4:

Soil Water: Characteristics and Behavior (Chapters 5 and 6)

- Water Chemistry
- Soil Water Content
- Soil Water Potential, Availability and Flow
- Soil Water Infiltration and Percolation
- Water Uptake by Plants
- Water Use Efficiency
- Reducing Water Loss

Plant Nutrients: Nitrogen, Phosphorus and Potassium (Chapter 12)

- Essential Macronutrients for Plant Productivity
- Mechanisms of Nutrient Uptake
- Soil Nitrogen
- Soil Sulfur
- Soil Phosphorus
- Soil Potassium

LECTURE 5:

Soil Biological Properties and Soil Organic Matter (Chapters 10 and 11)

- Diversity of Organisms in Soil
- Soil Organisms (macro-, meso- and micro-fauna)
- Factors Affecting Soil Microorganism Growth and Ecological Relationships
- Soil Organisms and Plant Communities: The Good and Bad
- Soil Organic Matter (and the Carbon Cycle)
- The Process of Decomposition and Factors Controlling Decomposition
- Formation of Humus
- Soil Organic Matter and Climate Change
- The Importance of Long-Term Research: Example from Rothamsted, England

LECTURE 6:

Soil Formation and Soil Classification [Chapters 2 and 3 (pages 58 to 68 only)]

- Formation of Soil from Parent Material: Weathering of Soil Minerals
- Soil Formation: The Factors that Influence the Formation of Soil
- Landforms and Soil Development
- Soil Horizons
- Factors Used in Soil Classification
- Canadian System of Soil Classification (not in textbook)
- FAO and U.S.A. System of Soil Classification (not in textbook)

MODULE 2: Degraded Soils and their Management

LECTURES 7:

Acidic Soils (Chapter 9: pages 270 to 298)

- Processes of Soil Acidity and Alkalinity
- The Role of Aluminum in Soil Acidity
- Sources of Soil Acidity
- Buffering of pH in Soils
- Biological Effects on Soil pH
- Human Influenced Soil pH
- Amending Soil pH and Maintaining Soil Productivity

Soil Tillage Systems (not in textbook)

- Why Till the Soil?
- Tillage Terminology
- Alternatives to Conventional Tillage Systems
- Tillage and Environmental Sustainability

LECTURE 8:

Soil Salinization and Sodicty (Chapter 9: pages 301 to 318)

- Characteristics and Problems of Dry Regions Soils
- Development of Salt-affected Soils
- Measuring Salinity and Sodicty
- Classes of Salt-affected Soils
- Growth of Plants on Salt-affected Soils
- Physical Degradation of Soil by Sodic-Chemical Conditions
- Recognizing Salty and Sodic Soils
- Restoration of Saline and Sodic Soils

LECTURE 9:

Soil Erosion (Chapter 14)

- The Extent of the Problem
- Erosion by Water, Universal Soil Loss Equation
- Water Erosion Control
- Erosion by Wind
- Wind Erosion Control

MODULE 3: Soil Pollution and Environmental Integrity

LECTURE 10:

Soil Pollution (Chapter 15)

- Threats to the Environment
- Organic Wastes
- Pesticides
- Heavy Metals and Natural Toxins
- Particulates and Gases

Soil and Environmental Integrity (not in textbook)

- Environmental Law and Soil
- Best Management Practices (BMP)
- Water and Soil Quality
- Remediation of Contaminated Soil

LECTURE 11

Overflow Lecture

Final Exam Review

STUDENT CONDUCT AND APPROPRIATE BEHAVIOUR

I encourage students to study together, however each student is expected to individually fulfill the requirements of the assignment, presentation, and exams. It is the responsibility of each student to be aware of what constitutes responsible behaviour in class, what constitutes plagiarism, and your rights and responsibilities with respect to these issues.

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. www.uwaterloo.ca/academicintegrity/. Students who are unsure what constitutes an academic offence are requested to visit the on-line tutorial at: <http://www.lib.uwaterloo.ca/ait/>

Note for students with disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt, please contact your Undergraduate Advisor for details.

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties, check Guidelines for Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm

Appeals: A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 - (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals). See: www.adm.uwaterloo.ca/infosec/Policies/policy72.htm

Consequences of Academic Offences:

ENV students are strongly encouraged to review the material provided by the university's Academic Integrity office (see: <http://uwaterloo.ca/academicintegrity/Students/index.html>).