

# SOIL ECOSYSTEM DYNAMICS

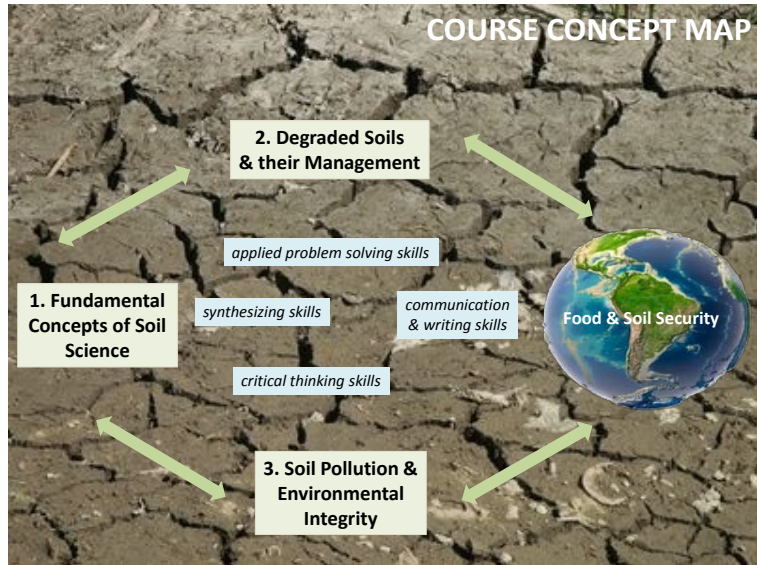
## ERS 684 (Grad Course)

### Course Outline: September 2018

*"The soil does not stay the same, but like anything alive, is always changing and telling its own story. Soil is the substance of transformation" –C. Williams*

#### COURSE OVERVIEW

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 GOAL & INTENDED LEARNING OUTCOMES

##### Goal:

- To introduce the fundamental concepts of soil sampling, soil physical, chemical and biological characteristics; and to introduce the major factors affecting soil degradation and using sustainable management practices and rehabilitation for their remediation.

##### Learning Outcomes:

1. Fundamental Concepts of Soil Science
  - Identify different methods of soil sampling, processing and analyses
  - Apply the fundamental concepts of soil science
  - Describe different systems of soil classification
2. Degraded Soils & their Management
  - Recognize sustainable soil management practices and provide examples using case studies
  - Explain how degraded soils can be remediated or restored
3. Soil Pollution & Environmental Integrity
  - Show how soil and soil pollution can influence atmospheric and hydrologic processes

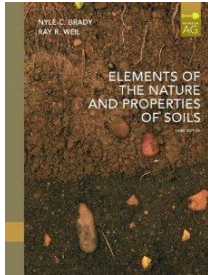
## COURSE MEETINGS TIMES & LOCATION

Lecture Times	Location
Wednesday 8:30 am to 11:20 am	EV3 Room 4408

## INSTRUCTIONAL TEAM

	PROFESSOR	TEACHING ASSISTANT
NAME	Prof. Dr. M. Oelbermann	TBD
CONTACT INFORMATION	Office: EV-2, room 2008 E-mail: <a href="mailto:moelbermann@uwaterloo.ca">moelbermann@uwaterloo.ca</a> Phone: 519-888-4567 Ext. 37552	TBD
OFFICE HOURS	TBD	TBD

## REQUIRED MATERIALS



**This textbook required & available in UW Bookstore:**

***Strongly Recommended***

*N.C. Brady, Weil, R.R. 2010. Elements of the Nature and Properties of Soils. 3<sup>rd</sup> Edition, Pearson-Prentice Hall Publishing (a copy has been placed on reserve for 3 hr loan)*

Additional (*but not required for the course*) readings to supplement the textbook will be available on Learn. These readings will be relevant to the material discussed in class; help with the assignment and provide further insight for interested students.

## COURSE ASSESSMENT

LEARNING OUTCOME	ASSESSMENT METHODS (FORMATIVE & SUMMATIVE)	% OF OVERALL GRADE	TEACHING & LEARNING METHODS
<b>1. FUNDAMENTAL CONCEPTS OF SOIL SCIENCE</b>	<ul style="list-style-type: none"> <li>• Class discussions</li> <li>• Midterm                             <ul style="list-style-type: none"> <li>▪ lectures 1 to 5</li> <li>▪ held in class</li> </ul> </li> </ul>	0 20	<ul style="list-style-type: none"> <li>• Interactive lectures</li> <li>• Case studies</li> <li>• Video presentation</li> <li>• Textbook readings</li> <li>• Course website</li> <li>• PowerPoint slides</li> </ul>
<b>2. DEGRADED SOILS &amp; THEIR MANAGEMENT</b>	<ul style="list-style-type: none"> <li>• Class discussions</li> <li>• Assignment (see assignment outline)</li> </ul>	0 80	<ul style="list-style-type: none"> <li>• Interactive lectures</li> <li>• Case studies</li> <li>• Textbook readings</li> </ul>
<b>3. SOIL POLLUTION &amp; ENVIRONMENTAL INTEGRITY</b>	<ul style="list-style-type: none"> <li>• Final Exam</li> <li>• No final exam for graduate students</li> </ul>	0	<ul style="list-style-type: none"> <li>• Course website</li> <li>• PowerPoint slides</li> </ul>

## SUMMARIZED SCHEDULE OF COURSE ACTIVITIES

MODULE #	DAY OF LECTURE	LECTURE #	TOPIC	READING MATERIAL
1. FUNDAMENTALS OF SOIL SCIENCE	Sept 12, 2018	1	- Introduction - The soil around us: composition & importance - DVD – Dirt: The Movie	Chapter 1
	Sept 19, 2018	2	- Soil sampling methods - Soil physical properties	Chapters 4, 7
	Sept 26, 2018	3	- Soil chemical properties	Chapter 8
	Oct 3, 2018	4	- Soil water	Chapters 5, 6
	<b>Oct 8, 2018</b>	--	- <b>Reading Break (no class)</b>	--
	Oct 17, 2018	5	- Soil biology and soil organic matter	Chapters 10, 11
	<b>Oct 24, 2018</b>		<b>- Midterm (in class starting at 8:30 am)</b>	
	Oct 31, 2018	6	- Soil formation & classification	Chapter 2 Chapter 3 (pp.58-68)
2. DEGRADED SOILS & THEIR MANAGEMENT	Nov 7, 2018	7	- Acidic soils - Soil tillage systems	Chapter 9 (pp. 270-298)
	Nov 14, 2018	8	- Soil salinity - Soil sodicity	Chapter 9 (pp. 301-318)
	Nov 21, 2018	9	- Soil erosion & erosion control measures	Chapter 14
3. SOIL POLLUTION & ENVIRONMENTAL INTEGRITY	Nov 28, 2018	10	- Soil pollution - Environmental integrity	Chapter 15

## DETAILED SCHEDULE OF COURSE ACTIVITIES

### MODULE I: FUNDAMENTAL SOIL CHARACTERISTICS

#### LECTURE 1:

##### Introduction

- Introduction to ERS 484/GEOG 404: Soil Ecosystem Dynamics
- 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 II: DEGRADED SOILS & 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 III: SOIL POLLUTION & 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
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## DESCRIPTION OF DVD

### Dirt! The Movie

"Floods, drought, climate change, even war are all directly related to the way we are treating dirt." DIRT! The Movie-directed and produced by Bill Benenson and Gene Rosow-takes you inside the wonders of the soil. It tells the story of Earth's most valuable and under-appreciated source of fertility-from its miraculous beginning to its crippling degradation. The opening scenes of the film dive into the wonderment of the soil. Made from the same elements as the stars, plants and animals, and us, "dirt is very much alive." Though, in modern industrial pursuits and clamor for both profit and natural resources, our human connection to and respect for soil has been disrupted. "Drought, climate change, even war are all directly related to the way we are treating dirt." DIRT! The Movie-narrated by Jaime Lee Curtis-brings to life the environmental, economic, social and political impact that the soil has. It shares the stories of experts from all over the world who study and are able to harness the beauty and power of a respectful and mutually beneficial relationship with soil. DIRT! The Movie is simply a movie about dirt. The real change lies in our notion of what dirt is. The movie teaches us: "When humans arrived 2 million years ago, everything changed for dirt. And from that moment on, the fate of dirt and humans has been intimately linked." But more than the film and the lessons that it teaches, DIRT! The Movie is a call to action. "The only remedy for disconnecting people from the natural world is connecting them to it again." What we've destroyed, we can heal.

—[Common Ground Media, Inc.](#)

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## 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.

### INTELLECTUAL PROPERTY:

Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo. Intellectual property includes items such as:

- Lecture content, spoken and written (and any audio/video recording thereof);
- Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides);
- Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exams); and
- Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).

Course materials and the intellectual property contained therein, are used to enhance a student's educational experience. However, sharing this intellectual property without the intellectual property owner's permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for permission before uploading and sharing the intellectual property of others online (e.g., to an online repository).

Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.

Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online. The intellectual property rights owner deserves to know (and may have already given their consent).

#### **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. The University's guiding principles on academic integrity can be found here: <http://uwaterloo.ca/academicintegrity>. ENV students are strongly encouraged to review the material provided by the university's Academic Integrity office specifically for students: <http://uwaterloo.ca/academicintegrity/Students/index.html>

Students are also expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for their actions. Students who are unsure whether an action constitutes an offense, or who need 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. Students may also complete the following tutorial: <https://uwaterloo.ca/library/get-assignment-and-research-help/academic-integrity/academic-integrity-tutorial>

When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to Policy 71 - Student Discipline: <https://uwaterloo.ca/secretariat-general-counsel/policies-procedures-guidelines/policy-71>. Students who believe that they have been wrongfully or unjustly penalized have the right to grieve; refer to Policy #70, Student Grievance:

<https://uwaterloo.ca/secretariat-general-counsel/policies-procedures-guidelines/policy-70>

**STUDENTS WITH DISABILITIES:** [AccessAbility Services](#), located in Needles Hall, Room 1401, 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 [AccessAbility Services](#) at the beginning of each academic term.

**MENTAL HEALTH:** The University of Waterloo, the Faculty of Environment and our Departments/Schools consider students' well-being to be extremely important. We recognize that throughout the term students may face health challenges - physical and / or emotional. **Please note that help is available.** Mental health is a serious issue for everyone and can affect your ability to do your best work. Counselling Services <http://www.uwaterloo.ca/counselling-services> is an inclusive, non-judgmental, and confidential space for anyone to seek support. They offer confidential counselling for a variety of areas including anxiety, stress management, depression, grief, substance use, sexuality, relationship issues, and much more.

**RELIGIOUS OBSERVANCES:** Students need to inform the instructor at the beginning of term if special accommodation needs to be made for religious observances that are not otherwise accounted for in the scheduling of classes and assignments.

**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. See Policy 70 - Student Petitions and Grievances, Section 4, [www.adm.uwaterloo.ca/infosec/Policies/policy70.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm). When in doubt please contact your Undergraduate Advisor for details.

**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) [www.adm.uwaterloo.ca/infosec/Policies/policy72.htm](http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm)

**COMMUNICATIONS WITH INSTRUCTOR AND TEACHING ASSISTANTS:** All communication with students must be through either the student's University of Waterloo email account or via Learn. If a student emails the instructor or TA from a personal account they will be requested to resend the email using their personal University of Waterloo email account.

**TURNITIN:** Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, and are subject to the USA PATRIOT ACT, 2001; therefore, students must be given an alternative (e.g., scaffolded assignment or annotated bibliography) if they are concerned about their privacy and/or security. Students will be due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin® in this course.

**RECORDING LECTURES:**

Use of recording devices during lectures is only allowed with explicit permission of the instructor of the course. If allowed, video recordings may only include images of the instructor and not fellow classmates. Posting of videos or links to the video to any website, including but not limited to social media sites such as: facebook, twitter, etc., is strictly prohibited.

**CO-OP INTERVIEWS AND CLASS ATTENDANCE:** Co-op students are encouraged to try and choose interview time slots that result in the least amount of disruption to class schedules. When this is challenging, or not possible, a student may miss a portion of a class meeting for an interview. Instructors are asked for leniency in these situations; but, a co-op interview does not relieve the student of any requirements associated with that class meeting.

When a co-op interview conflicts with an in-class evaluation mechanism (e.g., test, quiz, presentation, critique), class attendance takes precedence and the onus is on the student to reschedule the interview. CECA provides an interview conflict procedure to manage these situations. Students will be required to provide copies of their interview schedules (they may be printed from WaterlooWorks) should there be a need to verify class absence due to co-op interviews.