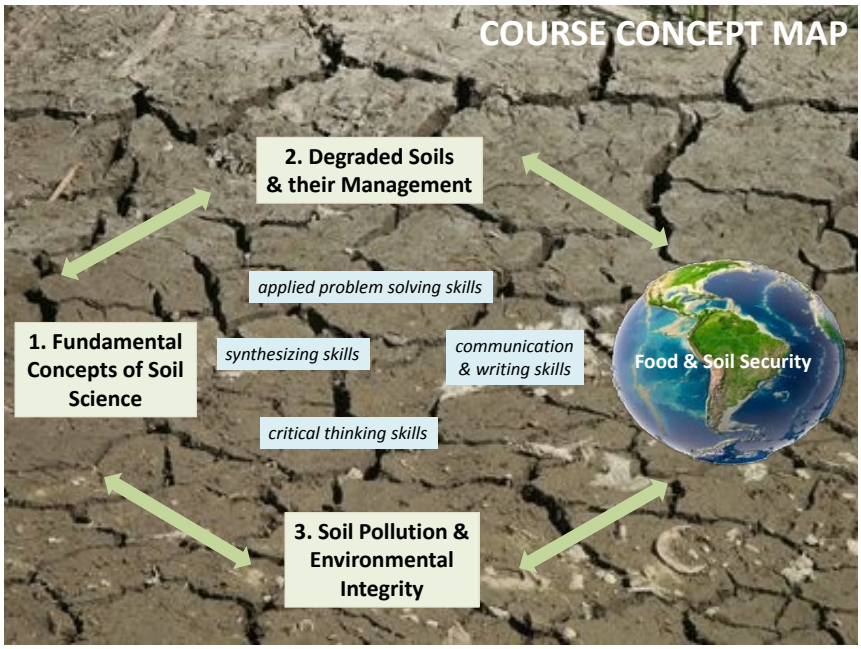
SOIL ECOSYSTEM DYNAMICS
ERS 484 / GEOG 404
Course Outline: September 2019

"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. Prerequisite: Env 200.

COURSE 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.

INTENDED 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

TECHNIQUES LEARNED

- Applied problem solving skills
- Critical thinking skills
- Writing & time management skills
- Synthesizing new knowledge skills
- Communication & organizational skills
- Writing exams under pressure

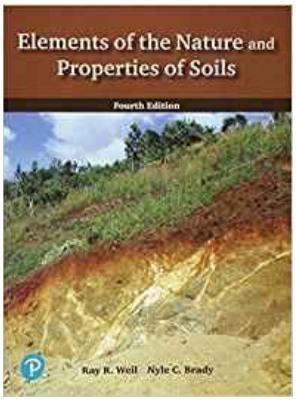
COURSE MEETINGS TIMES & LOCATION

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

INSTRUCTIONAL TEAM

	PROFESSOR	*TEACHING ASSISTANT*
NAME	Prof. Dr. M. Oelbermann	Mr. E. Badewa
CONTACT INFORMATION	Office: EV-2, room 2008 E-mail: moelbermann@uwaterloo.ca Phone: 519-888-4567 Ext. 37552	emmanuel.badewa@uwaterloo.ca
OFFICE HOURS	TBD	Contact TA

REQUIRED MATERIALS



This textbook is available in UW Bookstore:
Strongly Recommended
N.C. Brady, Weil, R.R. 2019.Elements of the Nature and Properties of Soils. 4rd Edition, Pearson-Prentice Hall Publishing (a copy of the 3rd edition has been placed on reserve)

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
1. Fundamental Concepts of Soil Science	**Class participation** **Midterm** ▪ lectures 1 to 4 ▪ held in class	5 25	• Interactive lectures • Case studies • Video presentation • Textbook readings • Course website • PowerPoint slides
2. Degraded Soils & their Management **3.** Soil Pollution & Environmental Integrity	**Class participation** **Assignment** **Final Exam** (not cumulative) includes lectures 5 to 10	5 25 40	• Interactive lectures • Case studies • Textbook readings • Course website • PowerPoint slides

SUMMARIZED SCHEDULE OF COURSE ACTIVITIES

Module #	Day of Lecture	Lecture #	Topic	Reading Material
module 1: Fundamentals of Soil Science	Sept 5, 2019	1	- Introduction - The soil around us: composition & importance **- DVD: Dirt The Movie**	Chapter 1
	Sept 12, 2019	2	- Soil sampling methods - Soil physical properties	Chapters 4, 7
	Sept 19, 2019	3	- Soil chemical properties	Chapter 8
	Sept 26, 2019	4	- Soil water	Chapters 5, 6
	Oct 3, 2019	5	- Soil biology and soil organic matter	Chapters 10, 11
	Oct 10, 2019	**Midterm (in class starting at 9:30 am)**		
	Oct 14, 2019	**Autumn Reading Week**		
	Oct 24, 2019	6	- Soil formation & classification	Chapter 2 Chapter 3
	Oct 31, 2019	7	- Acidic soils - Soil tillage systems	Chapter 9
	Nov 7, 2019 **Nov 7, 2019**	8	- Soil salinity - Soil sodicity **- Assignment due**	Chapter 9
	Nov 14, 2019	9	- Soil erosion & erosion control measures	Chapter 14
Module 3: Soil Pollution & Environmental Integrity	Nov 21, 2019	10	- Soil pollution - Environmental integrity	Chapter 15

DETAILED SCHEDULE OF COURSE ACTIVITIES

MODULE 1: FUNDAMENTAL SOIL CHARACTERISTICS

LECTURE 1:

Introduction

- Introduction to ERS 484/GEOG 404: Soil Ecosystem Dynamics
- Course Syllabus
- Course Expectations

The Soils Around Us (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 (Chapter 4) & Soil Aeration and Temperature (Chapter 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:

The Colloidal Fraction: Seat of Soil Chemical and Physical Activity (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 (Chapter 5) & Soil and the Hydrologic Cycle (Chapter 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

Nutrient Cycles and Soil Fertility (Chapter 12)

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

LECTURE 5:

Organisms and the Ecology of Soil (Chapter 10) & Soil Organic Matter (Chapter 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:

Formation of Soils from Parent Material (Chapter 2) & Soil Classification (Chapter 3; pp 72-80 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 & THEIR MANAGEMENT

LECTURES 7:

Soil Acidity (Chapter 9, pp. 313-345))

- 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 Sodicity (Chapter 9: pages 301 to 318)

- Characteristics and Problems of Dry Regions Soils
- Development of Salt-affected Soils
- Measuring Salinity and Sodicity
- 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 and its Control (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 & ENVIRONMENTAL INTEGRITY

LECTURE 10:
Soils and Chemical 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

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.*

STUDENT CONDUCT AND APPROPRIATE BEHAVIOUR

Pages 6 to 8 in this Course Syllabus

I encourage students to study together, however each student is expected to individually fulfill the requirements of the midterm and the final exam. The assignment is a group effort Please refer to the **Assignment Outline** on Learn for further details. 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.

STUDENT & FACULTY RESOURCES

The Faculty of Environment has an entire webpage https://uwaterloo.ca/environment/undergraduate-teaching-resources) dedicated to Student Resources including issues surrounding the following topics. Further detailed topics are outlined below:

- Teaching Resources
- Important Dates
- The Course Outline
- Student Privacy
- Academic Integrity
- Group Work
- Scheduling and Administration of Tests and Exams
- International Exchange Students
- Accommodation and Accessibility

ACCOMMODATION & ACCESSIBILITY

Please note that if you are registered with AccessAbility Services https://uwaterloo.ca/accessability-services/about, please write your midterm and final exam in accessibility if this is one of the requirements you requested. The instructor has to send a certain number of midterms and final exams to AccessAbility Services several days before the midterm/final exam is written. If you write in the class-room you must let the instructor know about a week ahead of time to ensure that sufficient number of midterms/exams are available.

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 (more information below)

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. if you think you are experiencing mental health issues, please see this website for guidance and support: https://uwaterloo.ca/environment/get-mental-health-support-when-you-need-it Also see last page of this syllabus.

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).

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. 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

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.

MENTAL HEALTH

Everyone struggles at some point

From transition to university life, to changes in expectations, to relationships, there are a lot of reasons you might seek help for your mental health. 1 in 5 Canadians experience poor mental health in their lifetime. **You are not alone.**

Signs that something might not be quite right

If you notice any of the following situations, consider getting some support:

- Your mood is low for more than two weeks
- You've lost focus or motivation
- You're having difficulty sleeping or your energy levels are poor
- You feel extreme loneliness
- You think about harming yourself
- You feel extreme fear about certain situations

Counselling Services is here to support you

We offer a variety of confidential services at no charge to University of Waterloo students who are currently registered or are on a co-op term. Our mental health professionals are here for you and interested in helping you through whatever you are experiencing. Our regular hours are Monday to Friday 8:30 a.m. to 4:30 p.m.

Emergency appointments

Emergency appointments are available during our regular hours and are provided to any student who is at **immediate risk** of self harm or harming someone else, or have recently experienced a trauma.

Booked appointments

Regular booked appointments can be made and scheduling depends on the urgency of your needs. When you meet with a counsellor they will listen to your concerns and develop a plan that suits your individual situation and needs. This plan could consist of booking a series of regular appointments, readings, meditations, or practical exercises.

Walk-in appointments

Walk-in appointments are available each **Wednesday and Thursday between 11:30 a.m. and 3:30 p.m.** These appointments are 90-minutes in length and are focused on finding you practical solutions for your most pressing concern.

UW MATES peer counselling

Peer counselling is available on a walk-in or booked basis. MATES student volunteers are trained by Counselling Services and are available to offer confidential support to students struggling with social issues, mental health issues, and transitioning to university life.

Coping Skills seminars

Over the last couple of years, hundreds of students have found our Coping Skills seminars valuable. Coping Skills seminars are 1-hour seminars that focus on cultivating resilience, challenging thinking, managing emotions, and changing behaviour. They are offered a variety of times per term and can be registered for on LEADS.

Group therapy and workshops

Our groups and workshops provide you with the opportunity to learn more about topics such as: Managing anxiety and stress, regulating emotion, increasing motivation, sustaining recovery from depression, learning to meditate, and much more. Registration is online through LEADS.

More information about all of our services can be found at: https://uwaterloo.ca/counselling-services

After-hours and off campus resources

If you need to speak with someone outside of our regular hours the following resources are available 24/7.

Good2Talk

Good2Talk is a free confidential help line for post-secondary students.
1-866-925-5454

Grand River Hospital Mental Health Emergency Care

Grand River Hospital offers 24/7 emergency care for mental health emergencies. 834 King Street West, Kitchener. 519-749-4300 x 6880.

Here 24/7

Here 24/7 is Waterloo Region's Mental Health and Crisis Services team.
1-844-437-3247

WatSAFE app

Download the WatSAFE app to have access to a list of support contacts at all times.