


## COURSE OUTLINE 2011

	<b>Course Code:</b>	<b>Semester Offering:</b>	<b>Credit Weight:</b>
	<b>SOIL*2010</b>	<b>Fall</b>	<b>0.50</b>
	<b>Course Title:</b>	<b>Lecture and Lab Hours (eg. 3-3):</b>	
	<b>Soil Science</b>	<b>Lectures: 3</b> <b>Lab: 2</b>	
<b>Instructor Name(s):</b>			
<b>John Milton- Parish Bldg. (Room 114 )</b> <a href="mailto:miltonj@kemptvillc.uoguelph.ca">miltonj@kemptvillc.uoguelph.ca</a>			

### **Calendar Description:**

*An introduction to the principles of soil science - the origin of soils, their classification and interpretation in natural and modified environments. Soil will be studied as a product of the natural environment, with a focus on formation processes and changes that occur when it is modified through use. A variety of uses including agriculture, forestry, recreation, and urban development will be considered.*

**Course Prerequisite(s): None**

**Course Restriction(s): Nil**

### **Evaluation**

Laboratory reports	15%
Seminar Reports	15%
Literacy assignment	15%
Mid-Term exam	20%
Final exam	30%
Class/Lab participation	<u>5%</u>
<b>TOTAL</b>	<b>100%</b>

### ***Course Objectives:***

**Upon completion of this course, successful students will be conversant with the origin and classification of soils, identification and importance of major soil types, identification of primary and secondary nutrients and how they are supplied, composition of soil including minerals, water, air, organic matter and biological organisms and how they interact and the importance of soil as a resource, and will have reliably demonstrated the ability to:**

1. Identify soil physical properties and relate them to plant growth.
2. Describe soil water, soil water storage and the importance of soil water to plant growth.
3. Describe the importance of soil chemical properties for nutrient storage and application.
4. List the essential elements required for normal plant growth and elements most commonly added to Ontario soils.
5. Describe the importance of soil pH and how it is measured and altered.
6. Describe nitrogen and phosphorus transformations in soils and relate their importance to plant growth.
7. Outline the practical significance of soil micro and macro organisms.
8. Make appropriate fertilizer recommendations from soil tests and calculate the amount of fertilizer required to fulfill the recommendations.
9. Describe the importance of soil organic matter in good soil management and identify methods of increasing or maintaining soil organic matter levels.
10. Describe the impact of tillage and compaction on soil structural properties and the effect on plant growth.
11. Apply knowledge of nutrient management planning to make the most efficient use of nutrients while reducing risks of water contamination.

## Weekly Course Outline

Week	Topics
Sept. 9	Introduction to soils.
12-16 Sept	Soil components, Soil formation, five soil forming factors, soil profiles. <b>Lab 1-</b> Soil: A Natural Product of the Environment; Formation and Description.
19-23 Sept	Soil physical properties, texture, structure, porosity, compaction, tillage. <b>Seminar 1</b> – Soil in the Field. <b>LITERACY ASSIGNMENT.</b>
26-30 Sept	Soil orders and classification. <b>Lab 2</b> - Soil: A Physical System.
03-07 Oct	Soil water, measuring water, water potential, irrigation and drainage. <b>Seminar 2</b> – Physical Characteristics of Soil.
10-14 Oct	Soil chemical properties, colloids. <b>Lab 3</b> - Characteristics and Behaviour of Water in Soil.
17-21 Oct	Cation exchange capacity, soil pH. Midterm Exam (October 21). <b>Seminar 3-</b> Tillage by B. Curnoe <b>Literacy Assignment</b> (due October 21)
24-28 Oct	Soil biology, bacteria, fungi, earthworms, introduction to soil organic matter. <b>Lab 4</b> - Colloids and the Charged Nature of Soils.
31 Oct-04 Nov	Soil as a source of plant nutrients, organic matter, the carbon cycle, decomposition. <b>Seminar 4</b> – Animals and Soils.
07-11 Nov	Nitrogen transformations, soil nitrogen, composting. <b>Lab 5</b> – Plant Nutrients.
14-18 Nov	Plant nutrients, essential nutrients, fertilizer sources. Soil testing, nutrient management. Fertilizer recommendations and calculations, environmental concerns, manures and compost use <b>Seminar 5</b> – Nutrient Management.
21-25 Nov	Resource use. <b>Seminar 6</b> – Soils in Equine Management by M. Goss
28 Nov	Resource sustainability. Course Review Final Exam – TBA

## Method of Presentation

**Course Delivery:** The course involves lecture, laboratory practical and tutorial sessions. The following topics will be covered:

### **Soil Origin and Composition**

- Composition of soil by vol., primary minerals, secondary minerals, rock classification, physical and chemical weathering.

### **Soil Development and Classification**

- Bedrock formations in southern Ontario, glaciation, glacial deposits, fluvio-glacial deposits, lacustrine deposits -shape, composition and agricultural value of each deposit.
- Parent material transported -ice, water, wind, residual parent material - sedimentary, igneous, and metamorphic, factors affecting soil formation - climate, vegetation, parent material, relief, and time.
- Soil classification, horizons, regosol, brunisol, luvisol, podzol, gleysol, conditions for formation parent material, climate, vegetation, agricultural potential and limitations, soil development.

### **Physical Characteristics**

- Soil physical properties, texture definition, particle size, use of textural triangle, texture by feel, measurement of soil texture, and ways to change soil texture.
- Soil structure definition, aggregation, water stability, types of soil structure, soil management practices which alter or improve soil structure.
- Macro pores, micro pores, location, role, bulk density, particle density, % pore space, aeration porosity, capillary porosity.
- Calculations of bulk and particle density, and % pore space.
- Soil-less potting mixes, compaction.

### **Water in Soil**

- Infiltration, percolation, evaporation, transpiration, field capacity, wilting point, hygroscopic coefficient, gravitational water, capillary water, hygroscopic water.
- Percent (%) moisture by weight/volume, water calculations.
- Water movement in soil, saturated and unsaturated flow, ways of measuring soil water, reason for drainage, surface and sub-surface drainage.
- Types of irrigation, rate and frequency of irrigation, water quality for irrigation.

### **Chemical and Mineralogical Characteristics of Soils**

- Cation exchange capacity, measurement, anions, cations, role of organic matter and clay, concept of base saturation.
- What is pH, active, reserve pH, sources of H, effect of low soil pH, crops response to pH, soil salinity and alkalinity, adjusting soil salinity.

### **Soil Biology**

- Soil organisms, bacteria, fungi, actinomycetes, and algae, relative numbers, role in organic matter decomposition and types, nitrogen fixation.
- Sources of organic matter, role of organic matter, losses of organic matter, cycling of organic matter, C:N ratios, C/N/Organic matter calculations.

- Elements required by plants, non-nutrient metal, nutrient uptake, root interception, mass flow, diffusion, mobility of nutrients in soil, nitrogen storage in soil mineralization (ammonification and nitrification), role of N.
- Composting - nutrients present, effect on organic matter level, method of incorporation, rate of application, time of application.

### **Soil as a Source of Plant Nutrients**

- How N<sub>2</sub> becomes available to plants, manufactured fertilizer, nitrogen fertilizers, slow release N fertilizers, rates and timing of application, etc.
- Crop response to N, N deficiency symptoms, soil nitrogen losses.
- Sources of phosphorous in soil, forms of phosphorous, availability, role of phosphorous, soil test, fertilizer P, sources and P fertilizer materials.
- P deficiency symptoms, crop response to P, P and Zn problems, sources of K, availability of K, role of K, soil test for K.
- Fertilizer K, deficiencies of K, hidden hunger, crop response to low K, K-Mg relationships.
- Secondary nutrients, Mg sources in soil, availability, areas of low Mg, role in plant, deficiency symptoms, correction of symptoms, Repeat for Ca.
- Sulphur, original source, sulphur in soils, role in plant, sulphur fertilizers, sulphur deficiency, introduction of micronutrients.
- Seven plant micronutrients, source, availability, deficiency, fertilizer, importance in Ontario.
- Slides of all deficiencies, macro, micro, secondary nutrients, fertilizer terminology, ratios, material, grade, bulk blending, granulation, liquids, suspensions.
- Fertilizer application, foliar, soil surface, worked in, placed, and in irrigation water, fertilizer toxicity, osmotic effect, specific ions, soil conditions.
- Soil testing, what a good soil test depends upon, how to take a good soil test, lab's responsibility, soil test development, extraction and field calibration, using a soil test form.
- Fertilizer calculations, rate per ha. and kg. of nutrient applied per ha., cost per kg. of a nutrient, cost per ha.
- Manure, composition, storage. Do's and don'ts of manure application, fertility value of manure, manure benefits other than nutrients.
- Sewage sludge and other wastes, nutrient value, guidelines for application, potential problems, role of urban or industrial waste on agricultural land, bio-concentration.

### **Resource Use**

- Resource concepts: stock, flow, carrying capacity, renewable and non-renewable resources, time horizons
- Canada Land Inventory for agriculture: class system
- Agricultural land capability class, demerit points system
- Land use planning: benefits, Ontario Planning Act, planning tools, zoning by-laws, land use planning and farm practices

### **Resource Sustainability**

- Land use and soil quality: trends in agricultural land use, sustainable agriculture, changes in farmland use
- Land degradation: loss of organic matter, soil structural deterioration, compaction, water erosion, Universal Soil Loss Equation, Wind erosion, salinization, acidification, desertification

### **Course Materials**

#### *Required Text Book and Course Notes:*

1. Brady, N.C. and R.R. Well. 2010. Elements of the *Nature and Properties of Soils* Upper Saddle River, NJ: Pearson Prentice Hall. 3<sup>rd</sup> edition.
2. Printed Laboratory Manual.

#### *Additional Reference Material:*

1. Soils and Soil Management - Soper, Baird
2. Intro. To Soils and Plant Growth - Donahue, Shickluna, Robertson.
3. Ontario Soils, Pub. #492 Fundamentals of Soil Science –Toth

**Additional Course Requirements:** (Students will wear laboratory coats for interior practicals)

### **Additional Information:**

#### **Literacy Assignment**

This is a 750-800 word critical response to an important problem/concern regarding soil science. You will have this assignment reviewed and constructively critiqued by a writing coordinator, giving you an opportunity to revise and re-write the assignment. The assignment will be graded out of 10 for the first hand in, and 5 for the revision for a total of 15 marks, representative of 15% of your final mark.

#### **Course Rules & Expectations**

1. Arrival to class will be prompt. (Consistent lateness will not be tolerated).
2. If you have to be away, make previous arrangements with me or the lab instructor.
3. Students are responsible for completing any missed work.
4. Treat lecturers, lab instructors and fellow students with respect.

**Please inform Heather Stewart if you have any special needs or requirements for learning accommodation.**