SOIL 501: ADVANCED SOIL PROCESSES

TERM 1 – September – December

Instructor	**Sandra Brown, MCML 229**	e-mail: sandra.brown@ubc.ca
Lectures	M, W, F @ 11 am – noon (MCML 160)	
Optional Tutorial	M 4:30-5:30 (MCML 258)	

Course Rationale:

Soils are a fundamental component of agro-ecological, forest and other land use systems; reflecting natural processes and the influence of human activities. Soil properties and processes regulate water and solute transport, the carbon cycle, nutrient and water cycles, energy fluxes and biomass productivity. An integrative approach covering the biological, chemical and physical properties and processes of soils is required to understand the functioning of natural and human modified ecosystems. For graduate students interested in gaining more depth in understanding soil processes, SOIL 501 is a keystone course.

Course Objective:

SOIL 501 provides students an understanding of the essential processes that take place in soils. Specifically: the genetic development of soils, their essential function for biomass production, nutrient cycling, water holding capacity and relation to the hydrologic cycle, C sequestration, and how processes are influenced by land use activities. Students will gain knowledge to understand the role of soil physics, chemistry and biology in soil formation, organic matter dynamics, recycling of nutrients, soil bio-meteorological processes, soil hydrology, soil quality and resilience, and spatial and temporal variability. Emphasis will be placed on the integration of soils, water, biota and the atmosphere, and anthropogenic influences on soil processes.

Learning Objectives:

The following learning objectives are to be achieved:

- A fundamental understanding of the role and dynamics of soils
- Ability to assess how processes change over time and space
- An understanding of processes, cycles and interactions
- Capacity to determine mass balances for carbon, nutrients and water
- Understand the role of physical, chemical and biological processes, and their interdependence
- Ability to quantify rates of changes in the soils and understand the reasons for these changes
- Ability to identify dominant genetic processes in soil formation and determine potential changes in the soil due to external impacts
- Ability to scale soil processes from micro scales to pedons to the soil landscape
- Ability to apply the gained knowledge to predict soil behaviors as a result of different land use activities and management practices

Course organization and delivery:

This course will be taught using a modular format (4-5 hours for each module). Lectures are held 3 times weekly, M W F from 11 to 12 pm. Invited speakers with expertise in specific topics will provide lectures to help integrate the applications of fundamental processes. Speakers will be selected from faculty members from the Faculty of Land and Food Systems, and the Faculty of Forestry.

Readings will be assigned prior to the start of each module, and will include class handouts, journal articles from the library, and various soil textbook chapters. Textbooks will be placed on reserve at the Woodward library. Students are expected to complete relevant readings before the module lectures.

An optional tutorial session will be held Mondays, 4:30-5:30 pm in MacMillan room 258. During this time students can bring questions for clarification or review on course material or assignments.

Topics to be covered:

1. Geology, geomorphology and soil parent materials
2. Soil genesis: factors of soil formation, weathering, anthropogenic influences on soil formation
3. Surface chemistry (charges): soil colloids, sorption processes, soil acidity, the mineral – organic interface, poorly crystalline and other reactive mineral phases
4. Soil physics and biometeorology: soil physical properties and processes, soil water content / soil water movement
5. Soil hydrology, irrigation, drainage
6. Carbon balance and carbon cycle, carbon sequestration
7. Soil organisms and biological processes: functions and roles of soil organisms, decomposition and recycling processes
8. Nutrient cycling and mass-balances: nitrogen, phosphorus cycles, and human impacts on nutrient balances
9. Scaling: micro- meso- macro-processes, temporal scales
10. Land management: influence of human activities on soils and soil processes; land-water interactions

Assessment:

SOIL 501 students will be evaluated on 3 assignments, a term paper, midterm exam and final exam; mark breakdown as follows:

	Soil 501	Due date
Assignments	25%	TBA
Midterm	25%	Oct. xx
Paper / presentation	10%	Nov xx
Final	40%	Dec, TBA

Assignments:

There are three assignments which follow the modular nature of the course: (1) soil-water retention and movement (soil physics); (2) weathering and soil chemistry; and (3) decomposition and nutrient cycling. For each assignment students are asked to integrate concepts covered in class via calculations, data interpretation and application of their assessments for soils, plants and/or the environment.

Assignment 1: students will be given information on soils, climate, crops, irrigation (other relevant site information) and asked to determine soil-water retention characteristics important for plants, soil water movement under various conditions, irrigation water requirements for different soil-crop combinations, and to interpret the relevance of soil characteristics in each scenario.

Assignment 2: students will be given information on soil parent material, geology, time, biota and climate; and asked to assess soil weathering (clay minerals) and soil properties under different scenarios (e.g. time, major rock type, climatic conditions etc.), and to interpret the implications for soil physical and chemical properties relevant for plants.

Assignment 3: focus on nutrient cycles in soils (e.g. N, P, C) and the importance of organic matter decomposition and soil organisms in nutrient cycles.

Specific details for each assignment will be posted 10 days to 2 weeks prior to the due date. Assignments will be marked based on calculations, data interpretation, and application as outlined below.

Grading rubric for SOIL 501 assignments

	Excellent	Good	Satisfactory	Unsatisfactory
Calculations (20-50%)	90-100% of steps and solutions are completed with no errors (mathematical or in formulas)	Almost all (80-89%) of steps and solutions completed without errors	Most (70-79%) steps and solutions completed without errors	Less than 70% of steps and solutions attempted or have errors
Interpretation (20-50%)	Interpretation of data detailed and clear; includes all key components and concepts	Interpretation of data clear and includes key components and concepts; lacks some detail	Data interpretation difficult to understand but includes key components and concepts	Data interpretation difficult to understand and is missing several key components; or interpretation lacking
Application / importance (20-40%)	Clear focus on relevant soil characteristics; detailed assessment of the importance of soil processes for plants and/or for the environment	Focus on major soil characteristics; demonstrates the importance of soil processes for plants and/or for the environment; lacks some detail	Not all relevant soil characteristics or processes considered; lacks depth	Fails to demonstrate an understanding of key soil processes and their importance for plants and/or the environment
Structure, organization, grammar, references (5-10%)	Report is presented in a well-organized, logical order; diagrams or sketches provide additional clarity; easy to read, few grammatical errors; sources referenced	Report is presented in a well-organized manner; diagrams or sketches used where appropriate; easy to read, few grammatical errors; sources referenced	Report lacks logical organization; diagrams or sketches not clear; some grammatical errors; not all sources referenced	Report unorganized, difficult to read; diagrams or sketches not used; many grammatical / spelling errors; sources not referenced

Term Paper (and in-class presentation)

Each student will submit a term paper focused on one or more related soil process. Topics can be related to a student's research project or a general area of interest. Topics must be related to a soil process with minimal duplication of course material. Examples of recent paper topics are posted online. Paper topics must be confirmed with the instructor a minimum of three weeks prior to the due date.

Papers should be no longer than 5 pages of text – 2,500 words (Tables, Figures and References extra) using 10+ font, single spaced. Your paper should be a state of the literature summary, synthesizing and integrating knowledge on relevant soil concepts and soil processes.

Paper due date will be posted online and announced in-class. Policy on late paper submission: 10% deduction for each day passed the deadline.

Papers will be marked as outlined below.

Grading rubric for SOIL 501 term papers

	Excellent	Good	Satisfactory	Unsatisfactory
Problem statement / topic focus (5%)	Introduction clearly and concisely outlines the topic and why it is important	Introduction outlines the topic and its importance	Introduction outlines the topic; relevance unclear	Topic not clearly defined
Depth of content / discussion (50%)	In-depth discussion and elaboration of relevant soil concepts and processes	Demonstrates knowledge of soil concepts	Omission of some pertinent content	Cursory discussion, lacks depth, missing key soil concepts
Integration of knowledge (30%)	Integrates concepts, synthesis of ideas; recognizes complexity	Integrates concepts, synthesis of ideas	Partial synthesis of ideas; inter-relationships not fully developed	Lacks integration
Summary (5%)	Concluding remarks explore implications	Some conclusions not supported	Conclusions not fully documented	Cursory or repetitive
Organization / structure / grammar (5%)	Well written report, flows logically, concepts linked; minimal grammar or spelling errors	Well written report, logical structure, minimal grammar or spelling errors	Well written report, lacks flows, some grammatical errors	Report unorganized, difficult to read; many grammatical / spelling errors
Sources (5%)	Well referenced (15+ citations); 5+ references from refereed journal articles; 5+ current sources[1]	Good blend of references including journal articles; 10+ references cited; most references recent	Reliance on textbook or limited journal article citations; 5-10 references listed; many dated references (more than 10 years out of date)	Lacked sufficient references; reliance on textbook or internet sources[1]; limited use of journal articles

[1] current sources published within last 10 years

[2] internet sources for refereed journal articles or relevant reports is acceptable; consider the credibility of online sources

In-class presentations (of term paper topics) will be scheduled for the last week of classes. The format for presentations is as follows:

- 2 slides (maximum) – 1 slide on the issue or problem you are addressing (context); 2nd slide on the relevant soil process(es)
- 3-4 minute presentation introducing the issue, discussing the relevant soil process(es) and how it might be addressed (if applicable)
- Followed by 1-2 questions

Presentations will account for 10% of paper/presentation mark. Presentations will be marked as outlined below.

Grading rubric for SOIL 501 in-class presentations

	Excellent	Good	Satisfactory	Unsatisfactory
Slides (20%)	Clear, graphic, engaging, relevant, uncluttered	Clear, relevant, uncluttered	Relevant, too much information	Unclear, too much information
Message (50%)	Clear, concise message; conveyed the science and its relevance	Clear, concise message; conveyed the science; lacked clarity in why it is important	Clear message; lacked clarity in science and its importance	Key point(s) unclear
Delivery (20%)	Within time, spoke clearly, good eye contact, enthusiastic	Within time, spoke clearly	Roughly within time limit, referred to notes on occasion, lacked eye content	Read notes, over time, hard to hear / spoke to the screen
Questions (10%)	Answered questions well; demonstrated knowledge of the topic	Answered questions well	Answered questions satisfactorily	Struggled with questions

Exams

Both the midterm and final exams will focus on concepts covered in-class and in readings. Questions will be short answer format. Study questions and example exam questions will be posted online for review prior to the exams.

Note on Academic Honesty and Standards:

Academic honesty is essential to the continued functioning of the University of British Columbia as an institution of higher learning and research. All UBC students are expected to behave as honest and responsible members of an academic community. Breach of those expectations or failure to follow the appropriate policies, principles, rules, and guidelines of the University with respect to academic honesty may result in disciplinary action.

It is the student's obligation to inform himself or herself of the applicable standards for academic honesty. Students must be aware that standards at the University of British Columbia may be different from those in secondary schools or at other institutions. If a student is in any doubt as to the standard of academic honesty in a particular course or assignment, then the student must consult with the instructor as soon as possible, and in no case should a student submit an assignment if the student is not clear on the relevant standard of academic honesty.

Definitions of Academic Misconduct can be found on the following website:
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,959#10894