APBI 403 / SOIL 503
SOIL SAMPLING, ANALYSES AND DATA INTERPRETATION

UBC's Point Grey Campus is located on the traditional, ancestral, and unceded territory of the xwməθkwəy̓əm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on in their culture, history, and traditions from one generation to the next on this site.

TERM 1 – 2019/20

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Lectures: Friday @ 1 – 2 pm (MCML 160)

Labs: Monday @ 1 - 4 pm (MCML 102A)

Pre-req: APBI 200 **Credits:** 3

Course Description:

Application of fundamental field and laboratory measurement procedures and techniques in soil science.

Course Learning Outcomes:

Upon completion of APBI 403 / SOIL 503 course students will be able to:

- Develop a proper field sampling plan and calculate basic statistics that describe the variability and accuracy of the measurements.
- Measure fundamental soil physical properties and states
- Measure fundamental soil chemical properties
- Measure fundamental soil biological properties
- Interpret and summarize laboratory and field soil data in a written format.

The course learning outcomes will be met through various lab exercises and field visits.

Course Format:

- The course is organized into three modules: soil physics, chemistry and biology.
- Agriculture and forest sites will be sampled, and samples prepared and stored for subsequent analysis. Additionally, samples previously collected from throughout the province will be used to illustrate the variety of soil types. Analyses conducted during the course reflect common, standard and novel approaches quantifying and monitoring soil properties. See the course schedule for topics and dates associated with specific labs.
- In each weekly lab period, you will be responsible for collecting data on sample(s) assigned to you utilizing the method(s) discussed in the lecture on that topic. During most lab exercises, students will work in pairs.
- Each student will prepare lab reports for each laboratory session.

- There will be no textbook for the course and background readings will be drawn from a variety of sources.
- All students must complete UBC's online student laboratory safety course – details are provided in your lab manual.

Attendance to ALL lab sessions is mandatory; notes for each laboratory session must be READ prior to labs.

Course Marks:

Activity	APBI 403	SOIL 503
Weekly lab reports	60%	55%
Final summary reports for soil chemistry, biology, and physics modules*	40%	35%
Presentation + extended abstract on a specific method**	n/a	10%

***Each student will prepare a total of **3 final summary reports**. These reports will be assessed on the basis of content (i.e., data presentation and interpretation), organization, and quality of writing.

**Note, presentations by graduate students registered in SOIL 503 will be scheduled November 8 during class, and Nov 13 & 14th, 1:00-3:00 pm. Graduate students must signup for a presentation timeslot in Canvas by Oct 11 at the latest.

Guidelines on what is expected in **weekly lab reports** and in the **final summary reports** are given at the end of this syllabus**.**
All weekly lab and summary reports should be handed in on time and 10% mark subtraction will be made for each day being late. Late reports, past day 4 will **not** be accepted.

2019 Schedule

Date	Lecture / Lab activity	Instructor(s)
Sep 6	Lecture: Course overview, review of basic concepts of soil science Sampling design (mineral soils)	Krzic Brown
Sep 9	Lab: Sampling & sample preparation for mineral soils in agriculture and forestry	Brown & Krzic
Sep 13	Lecture: Soil texture & aggregate stability	Krzic
Sep 16	Lab: Soil texture & aggregate stability	Krzic & Brown
Sep 20	Lecture: Soil bulk density and water content (Time Domain Reflectometry)	Brown
Sep 23	Lab: Field sampling of soil bulk density (core & excavation methods); water content (gravimetric, volumetric) & TDR	Brown
Sep 27	Lecture: Organic matter, electrical conductivity	Krzic
Sep 30	Lab: Organic matter content (loss on ignition and LECO) Electrical conductivity (saturation paste)	Krzic
Oct 4	Lecture: Cation exchange capacity	Krzic
Oct 7	Lab: Cation exchange capacity (CEC) and exchangeable cations - Ca, Mg, K, and Na (ammonium acetate extraction)	Krzic

Oct 11	Lecture: Grad student topics (for methods papers)	Brown
Oct 14	Thanksgiving Day – UBC closed, no classes	
Oct 18	Lecture: pH, available P, micronutrients	Krzic
Oct 21	Lab: Soil pH Available P (Bray P-1 method) Available micronutrients – Cu, Zn, Fe, Mn (DTPA extraction)	Krzic
Oct 25	Lecture: Soil respiration	Brown
Oct 28	Lab: Measurements of soil respiration – chamber method	Brown
Nov 1	Lecture: Soil biodiversity	Grayston
Nov 4	Lab: Soil biological sampling (field) Extraction of soil macro- and meso-fauna from soil (Berlese funnels, visual identification).	Grayston
Nov 8	Lecture: Grad student presentation day 1	Krzic, Grayston
Nov 11	Remembrance Day – UBC closed, no classes	
Nov 15	Lecture: Plant-microbe symbioses: mycorrhizae and N-fixing root nodules	Grayston
Nov 18	Lab: Mycorrhizal fungi AM and ECM (% colonization & morphotyping). Nodules (identification, N-fixation estimation using given acetylene reduction rates)	Grayston Grayston
Nov 22	Lecture: Soil biological functions and activity	
Nov 25	Lab: Enzyme assays (colorimetric microplate for B glucosidase, phosphatase, chitinase) Demonstration: molecular biology & stable isotope techniques	Grayston
Nov 29	Lecture: Course summary & certificates	Krzic, Brown & Grayston

General References on Soil Lab Methods

Brady, N.C. and R.R. Weil. 2002. The nature and properties of soils. 13th edition. Pearson Education Inc. [*General reference on soil science*]

Carter, M.R. and E.G. Gregorich. 2008. Soil Sampling and Methods of Analysis, 2nd Ed**.** CRC Press and Taylor & Francis Group.

Coleman, D.C., D.A. Crossley and P.F. Hendrix. 2004. Fundamentals of Soil Ecology, 2nd Edition. Elsevier Academic Press, San Diego, CA, USA.

Dane, J.H. and G.C. Topp. 2002. Methods of soil analysis. Part 4 - Physical methods. Soil Science Society of America, Book Series No. 5. SSSA. Madison. WI.

Krzic M., T. Naugler, S. Dyanatkar, and C. Crowley. 2010. Virtual Soil Lab Modules. The University of British Columbia, Vancouver. [http://labmodules.soilweb.ca/]

Page, A.L. 1982. Methods of soil analysis: chemical and microbiological properties. Part 2, 2nd edition. ASA-SSSA, Madison, WI.

Paul, E.A. 2015. Soil Microbiology, Ecology and Biochemistry 4th Edition. Elsevier Academic Press, San Diego, CA.

Ruiz, N., P. Lavelle and J. Jiménez. 2008. Soil Macrofauna Field Manual Technical level. Food and Agriculture Organization of the United Nations, Rome.

Schinner, F., R. Öhlinger, E. Kandeler and R. Margesin (Eds.) 2011. Methods in Soil Biology. Paperback edition. Springer-Verlag, New York, NY.

Sparks, D.L. 1996. Methods of soil analysis. Part 3 - Chemical methods. Soil Science Society of America. Book Series No. 5. ASA-SSSA, Madison, WI.

SoilWeb200. 2014. On-line teaching tool for the APBI 200 course developed by Maja Krzic. http://www.landfood.ubc.ca/soil200 [*Quick overview of basic concepts of soil science*]

Su, C., L. Lei, Y. Duan, K-Q. Zhang and J. Yang. 2012. Culture-independent methods for studying environmental microorganisms: methods, application, and perspective. Applied Microbiology & Biotechnology 93 (3): 993-1003.

Westerman, R.L. 1990. Soil testing and plant analysis. 3rd edition. ASA-SSSA, Madison, WI.

UBC Policy & Academic Honesty

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on **the UBC Senate website.**

Academic honesty is a core value of scholarship. Cheating and plagiarism (including both presenting the work of others as your own and self-plagiarism), are serious academic offences that are taken very seriously at the University of British Columbia. By registering for courses at the University of British Columbia, students have initiated a contract with the university that they will abide by the rules of the institution. It is the student's responsibility to inform themselves of the University regulations. 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

If you are unsure of whether you are properly citing references, please ask your instructor for clarification before the assignment is submitted. Improper citation will result in academic discipline.

Guidelines for Weekly Lab & Final Summary Reports

Soil Scientists have a unique ecologic perspective on the natural environment as a holistic, complex, and interrelated ecosystem. The Environmental consulting sector (as one of the main employers of those with soil science knowledge) has identified the need for excellent technical communication skills based on the **5 Cs of communication** - **correct, clear, concise, consistent,** and **complete**. We will use the 5 Cs approach to report writing in this course.

Weekly Lab Reports

Weekly lab reports will include:

a) compilation and tabulation of the data collected
b) calculations involving data obtained
c) graphical or other presentation of your data, and

d) questions focused on the main relationships of the data determined during that week

Note that additional data may also be provided for specific labs.

While you are encouraged to work in groups, all reports must be written up individually in your own words. Any references used must be cited and references provided. Students are expected to be familiar with Excel (or other graphing software), and descriptive summary statistics. A data analysis tutorial will be provided for students (see course schedule).

Final Summary Reports

Each student will be required to write three final summary reports; one at the end of each module (soil physics, soil chemistry and soil biology). Data collected using the same (or similar) laboratory methods that students used during the weekly lab periods will be provided.

The objectives of these final summary reports are to:

- compare between soil types and/or land uses
- assess trends within variables (e.g., by depth) and
- importantly to assess trends between variables.

The **final summary reports** should be maximum 1,500 words, excluding graphs, tables, and list of references. Please use font size 10 or 12 (preferable).

The final summary report should consist of the following sections: introduction, objective(s), material and methods, results and discussion, conclusions, and list of references.

- Tips on how to approach preparing your summary reports:
  - Before you start writing the report, make an outline and identify the key sub-sections.
  - Be sure to include all necessary data tables - and figures,
  - Before you submit the paper, make sure that it is **correct, clear, concise, consistent,** and **complete** (so-called 5 Cs of communication).

These reports will be assessed on the basis of content (i.e., data presentation and interpretation), organization, and quality of writing.

CONTENT (80%):

- *Introduction:* Provide background information on the study site(s) and management practices as well as soil type, climate, topography, parent material, and type of vegetation on the study site(s) if available
- *Objective(s):* be clear on what you are comparing
- *Material and methods*: note that the section on materials and methods should be very short (i.e., it is sufficient to refer back to the lab manual), but be clear in stating how you are making your comparisons
- *Results: summary graphs and tables*
- *Discussion:* discuss key data, ensuring that you address both data trends and connections among different groups of data. Soil type should be discussed regarding its natural advantages and disadvantages for a specific management practice.
- *Conclusions:* Briefly summarize the body of your report and restate your argument. Always remember to check that your conclusions match the study objective(s).

ORGANIZATION (10%)

- Use logical structure appropriate to report's topic including headings and subheadings.

- Provide background information on the study (e.g., soil, land-use, etc.) and integrate it with your data discussion.
- Provide a logical, clear order to your data presentation, results and discussion; avoid including data tables or graphs which do not support your discussion (see tips for data presentation below).

GRAMMAR AND WRITING STYLE (10%):

- Ensure that your report is free of spelling, punctuation, and grammatical errors.
- Keep your sentences simple. That does not necessarily mean that your thoughts are simple. Complex and adjective-laden sentences just make your great ideas hard to follow.
- Each paragraph should contain one main idea. Paragraphs should be logically organized. For example, you should discuss ideas in the order in which they appear in your introduction.
- As a university student, you are expected to submit original work and give credit to other peoples' ideas; hence, plagiarism will not be tolerated. If you are unclear on the concept, please see *http://learningcommons.ubc.ca/resource-guides/avoid-plagiarism/*
- We encourage you to refer to "**Professional Communications Handbook**" by Garland and Shackleton (http://lfs-lc-collabtm.sites.olt.ubc.ca/files/2013/11/professional.communication.handbook.pdf).

Data Presentation Tips:

1) In your discussion, data could be pooled (grouped) for the same soil orders and the same land-use types. However, data obtained from different soil horizons (i.e., A, B and C) should NOT be pooled together and must be assessed separately for each horizon.
2) Either plot the data or summarize them in tables, but do not do both.
3) Check for observable trends between parameters plotted or tabulated.
4) If there is a trend, discuss the whole data set as a group. Alternatively, if there are 2 distinct groups (that show 2 different trends) discuss them separately.
5) If there are no trends (as may be the case with a small dataset), then discuss individual samples by focusing on:
    a. Anomalies or outliers (comment on why they are different from the rest of the data set).
    b. If you can group these outliers do it and discuss them as a group instead of individually.
    c. Utilize all available information. For example, is a particular sample high or low in soil organic matter; under agricultural production or forest vegetation; from what horizon was it taken; what was the soil type; were agricultural crops grown on the site, and if yes, that implies that liming and fertilizers were applied, etc.
6) If a graph that you have created in the 1st attempt is not helping you to discuss the data it is very likely that you should try to graph the data in a different way. So, graph it again, and again….
7) Do not include too much data per graph, but split overcrowded, complicated graphs into 2 or 3 separate graphs.
8) Make sure that you identify independent variables (or properties) and plot them on the x-axis of your graph. Do NOT plot sample numbers as the independent variable.
9) Remember to address all relationships that you were asked to look into during the weekly lab assignments.