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

TERM 1 – Sept – Dec 2024

ACKNOWLEDGEMENT

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 their culture, history, and traditions from one generation to the next on this site.

COURSE INFORMATION

Course Title	Course Code Number	Credit Value
Soil Sampling, Analyses and Data Interpretation	APBI 403 / SOIL 503	3

PREREQUISITES

APBI 200 - Introduction to Soil Science or equivalent

INSTRUCTIONAL TEAM

Instructors / TAs	Section	Contact Details	Office Location	Office Hours
Sandra Brown	Soil Physics / soil respiration	sandra.brown@ubc.ca	McMl 229	Zoom: t.b.a.
J.T. Cornelis Sasha Pollet	Soil Chemistry - lectures labs	jt.cornelis@ubc.ca Canvas mail	McMl 225	n.a. Zoom: t.b.a.
Akshit Puri	Soil Biology	akshit.puri@ubc.ca	FSC 3031	Zoom: t.b.a.

COURSE MEETING TIMES

Section	Component	Date / Time	Location
APBI 403 / SOIL 503	Lectures	Friday @ 1:00 – 2:00 pm	McMl 102A
	Labs	Thursday @ 1:00-4:00 pm	McMl 102A
SOIL 503 only	Tutorial	Thursday @ 11:00-12:00 (noon)	ORCH 3068

COURSE DESCRIPTION

Field and laboratory analytical techniques in the physical, chemical and biological assessment of soils.

LEARNING OUTCOMES

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

1. Develop a proper field sampling plan and calculate basic statistics that describe the variability and accuracy of the measurements.
2. Measure fundamental soil physical properties and states
3. Measure fundamental soil chemical properties
4. Measure fundamental soil biological properties
5. 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 independently prepare a lab report 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 lab session must be READ prior to labs.

LEARNING ACTIVITIES & ASSESSMENT OF LEARNING

Activity	APBI 403	SOIL 503
Weekly lab reports	60%	55%
Final summary reports for soil physics, chemistry and biology*	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.

**Presentations by graduate students registered in SOIL 503 will be scheduled during Tutorial times in November. Graduate students must signup for a presentation timeslot in Canvas by Oct 15.

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 must be written in your own words, and should be handed in on time. A 10% mark subtraction may be made for each day being late.
Late reports, past day 4 will NOT be accepted.

SCHEDULE OF TOPICS

Date	Lecture / Lab activity		Instructor(s)
Sep 5	Lab:	Course overview & data analysis	Brown
Sep 6	Lecture:	Sampling design (mineral soils)	
Sep 12	Lab:	Sampling & sample preparation for mineral soils in agriculture & forestry	Brown
Sep 13	Lecture:	Soil texture	
Sep 19	Lab:	Particle size – quick method	Brown
Sep 20	Lecture:	Soil bulk density and water content (Time Domain Reflectometry)	
Sep 26	Lab:	Field sampling of soil bulk density (core & excavation methods); water content (gravimetric, volumetric) & TDR	Brown
Sep 27	Lecture:	Soil structure and aggregate stability	Krzic
Oct 3	Lab:	Soil structure and aggregate stability	Krzic
Oct 4	Lecture:	Organic matter, electrical conductivity	Cornelis
Oct 10	Lab:	Organic matter content (loss on ignition and LECO)	Pollet
Oct 11		Electrical conductivity (saturation paste)	
	Lecture:	Cation exchange capacity	Cornelis
Oct 17	Lab:	Cation exchange capacity (CEC) and exchangeable cations - Ca, Mg, K, and Na (ammonium acetate extraction)	Pollet
Oct 18	Lecture:	pH, available P, micronutrients	Cornelis
Oct 24	Lab:	Soil pH Available P (Bray P-1 method) Available micronutrients – Cu, Zn, Fe, Mn (DTPA extraction)	Pollet
Oct 25	Tutorial:	optional	Pollet
Oct 31	Lab:	Lab tour: TOC-L, Flash smart combustion, ICP-EOS	Cornelis
Nov 1	Lecture:	Soil respiration	Brown
Nov 7	Lab:	Measurement of soil respiration – chamber method	Brown
Nov 8	Lecture:	Soil biodiversity	Puri
Nov 14	Lab:	Soil biological sampling (field) Extraction of soil macro- and meso-fauna from soil (set up)	Puri
Nov 15	Lecture:	Plant-microbe symbioses: N-fixing root nodules	
Nov 21	Lab:	Extraction of soil macro- and meso-fauna from soil (visual and microscopic identification)	Puri
Nov 22	Lecture:	Plant-microbe symbioses: mycorrhizae	
Nov 28	Lab:	Mycorrhizal fungi AM and ECM (% colonization & morphotyping). Nodules (identification, N-fixation estimation using given acetylene reduction rates)	Puri
Nov 29	Lecture:	Soil biological functions and activity	
Dec 5	Lab:	Enzyme assays (colorimetric microplate for B glucosidase, phosphatase, chitinase) Demonstration: molecular biology & stable isotope techniques	Puri
Dec 6	Lecture:	Course summary & certificates	All

Any changes to the schedule will be announced on Canvas. Please be sure you are receiving Canvas announcements for this course.

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. [https://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. https://soilweb200.landfood.ubc.ca/ [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.

UNIVERSITY POLICIES

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 Integrity

Academic honesty is a core value of scholarship; all students are expected to know, understand and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you, and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not copy, present the work of others as your own, or self-plagiarize. Definitions of Academic Misconduct can be found at https://academicintegrity.ubc.ca/regulation-process/academic-misconduct/. Violations of academic integrity (i.e., misconduct) are taken very seriously at UBC. A detailed description of academic integrity, including the University's policies and procedures, may be found in the UBC Calendar: Student Conduct and Discipline. Please contact me if you are unsure about these policies so that I can clarify them for you.

The use of **generative AI tools, including ChatGPT and other similar tools,** to complete or support the completion of any form of assignment or assessment in this course is **not allowed** and would be considered academic misconduct.

Academic Concession

For the first occurrence of an acute illness (cold, flu or other) or compassionate grounds, a *self-declaration* will suffice. To request academic concession, please email the relevant instructor prior to the due date. A doctor's note is NOT required for this request. If you have an ongoing issue including: conflicting responsibilities, medical circumstance, or compassionate ground (e.g. death in the family) please contact your Faculty's advising office for guidance.

Once academic concession is granted, the weight of the missed assignment will be redistributed to the other course items of the same type.

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GUIDELINES FOR WEEKLY LAB AND 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 *https://learningcommons.ubc.ca/resource-guides/understand-academic-integrity/*
- We encourage you to refer to "Professional Communications Handbook" by Garland and Shackleton https://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.

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