Department of Plant, Soil, and Microbial Sciences
College of Agriculture and Natural Resources

Soil Health Concepts and Methodology (CSS 860)

Syllabus for Fall 2025
Credit hours: 1
Course dates: August 25th – October 27th, 2025
Course schedule: Weeks 1-10: W, 9:10 -10:50am; A111 PSSB
1 required Saturday field trip to the W.K. Kellogg Biological Station.

Instructor: Dr. Christine Sprunger
Office: W.K. Kellogg Biological Station, Stack 241
Office Hours: by appointment, in person or via zoom
Email: sprunge5@msu.edu

Course Description:
Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. Soil health is central to regenerative agriculture because soil health influences crop productivity and enhances ecosystem services. Soil health quantification requires integration of biological, chemical, and physical components of the system. Rigorous and quantitative soil health assessments are important to landowners managing farms for agricultural productivity and climate resilience. This course is designed to provide students with an overview of fundamental concepts in soil health through hands on field and laboratory experiences in soil health methodology.

Recommended background:
One undergraduate course in soil science and one undergraduate course in plant science or ecosystem science

Required Course Materials:

- All required readings will be posted on the course D2L page. Content for each week will include assigned readings, lectures, and lab and field instructions. There is no required textbook.

Course Requirements

- Internet connections AND access to Desire2Learn (D2L)

Course Structure:

This course will be offered as a 10-week lab-based course with one required Saturday field trip to the W.K. Kellogg Biological Station in Week 5. You will need your MSU NetID to login to D2L to

find readings and other course materials. Students should be prepared to go outside most weeks. Key skills will be introduced and demonstrated in the field and lab before students complete protocols on their own.

Technical Assistance

If you need technical assistance at any time during the course or to report a problem you can:

- Visit the MSU Libraries Discovery Services Site (https://lib.msu.edu/dls/)
- Visit the Desire2Learn Help Site (https://help.d2l.msu.edu/)
- Visit the MSU IT Help & Support Site (https://tech.msu.edu/support/help/), call (517) 432-6200 or toll free (844) 678-6200, or email ithelp@msu.edu

Resource Center for Persons with Disabilities (RCPD)

- To make an appointment with a specialist, contact (517) 353-9642 or TTY: (517) 355-1293
- RCPD Get Started Info: https://www.rcpd.msu.edu/get-started

Course Objectives and Learning Outcomes

Objectives:

- Students will demonstrate knowledge of soil health concepts and methodologies.
- Students will evaluate advanced field and laboratory methods used to measure soil health.
- Students will apply rigorous and quantitative assessments to analyze and interpret soil health data.

Using the knowledge gained in this course, students will be able to:

1. Define soil health and explain certain paradigms of soil health/soil quality.
2. Describe how soil health is connected to key ecosystem processes in agroecosystems.
3. Critically evaluate and compare soil health metrics and accurately measure chemical, biological, and physical soil health processes in the field and laboratory.
4. Validate and verify data through rigorous quality control.
5. Apply multivariate analyses to generate informed management decisions based on data collected in class.

Students will meet the objectives and learning outcomes listed above through a combination of the following activities in this course:

- Attending class on Wednesday each week
- Attending the field trip to KBS on one Saturday in late September
- Participating in field assessments and laboratory activities
- Completing papers and laboratory reports

Course Outline/Schedule:

Week	Date	Unit, Lab Activity, Required Reading
Weekly Seminar and Activities		
Week 1	8/27/25	Welcome /Overview of The Soil Health Framework **Lab Activity:** Assessing soil health in the field **Field:** Student Organic Farm Sampling
Week 2	9/03/25	The history of soil health, soil quality, and a critical review of these concepts **Readings:** Bünemann et al., 2018; Lehmann et al., 2020 *Bonus Reading:* Gamliel and van Bruggen, 2016 **Lab Activity:** Soil processing flowchart; soil texture
Week 3	9/10/25	Soil Physical Health **Readings:** Rieke et al., 2022 **Lab Activity:** Aggregate stability **Guest Lecture:** Rachel Drobnak

Week 4	9/17/25	Soil organic matter cycling / soil biological health **Readings:** Sprunger et al., 2020 **Lab Activity:** Solvita Test Experiment
W.K. Kellogg Biological Station Field Trip and Lab Activities		
Week 4	9/20/25 (Saturday: 8am – 7pm)	**Field Activity:** KBS LTER soil health field assessment **Lab Activity:** Soil respiration, autoclaved extractable protein, and permanganate oxidizable carbon
Weekly Seminar and Activities		
Week 5	9/24/25	Soil biological health continued **Lab Activity:** Soil health analysis and interpretation
Week 6	10/1/25	Organic Matter Cycling – Guest Lecture Katherine – POM and MOAOM

Week 7	10/8/25	Soil Food Webs and Soil Health **Readings:** Sprunger and Martin, 2023; Sprunger et al., 2019 **Lab Activity:** Nematode identification **Guest Lecture:** Katie Gattoni
Week 8	10/15/25	Soil Health Assessment Frameworks **Readings:** Rinot et al., 2019; Nunes et al., 2021 **Computer Lab:** Soil health scoring and interpretation
Week 9	10/22/25	Multivariate Statistics and Soil Health **Readings:** Wade et al., 2022 **Computer Lab:** Statistics and graphics for soil health
Week 10	10/29/25	Student Presentations

Course Schedule (May be subject to change based on weather, discretion of instructor, and timing of the Tri-Societies meeting with changes posted on D2L).

Grading Policy

The table below describes the graded course activities including points and activity description. The first column includes the metric/activity, the second column includes the due date, and the third includes the points possible.

Grading and Expectations

Metric	Due Date	Points
Synthesis Paper #1	9/17/25	20
Synthesis Paper #2	10/8/25	20
Comprehensive Soil Health Test Report	10/29/25	25
Presentation to class	10/29/25	15
Participation	NA	20
Total Points Possible		100

Description of required assignments

Synthesis papers: Two synthesis papers will be due in the fourth and seventh weeks of the semester. These synthesis papers should be approximately 5 pages double spaced. The purpose of these papers are to give students the opportunity to demonstrate their knowledge of soil health concepts discussed in lectures and lab activities. Students will be expected to describe at least one key soil health concept, discuss how one might measure this concept, citing literature. Students can also discuss the strengths and weaknesses of these various concepts and measurements and describe the utility or application of the specific soil health concept for addressing key questions in agroecology.

Comprehensive Soil Health Test Report: This report is in lieu of a final exam and will cover the soil health results from the field and laboratory exercises conducted over the course of the semester. Students will be expected to report key findings, interpret the results, and generate key soil health recommendations based on the agroecosystems they chose to assess.

Active participation and attendance: Contributions to class discussions, field assessments, and laboratory activities will account for 20% of the final grade. Attending the Saturday field trip accounts for 10 points or 10% of the final grade.

Presentation to class: Students will be required to give a 10-minute presentation that summarizes the comprehensive soil health test report. The presentation should include a brief overview of the treatment/ecosystem where the soils were taken, a summary of the soil health findings, and recommendations to farmers or landowners.

Late Work Policy

Assignments turned in after the designated due dates will result in 5% points deducted from that assignment for each day late.

Viewing Grades

Assignments will be graded within one week of the due date. Feedback on assignments and grades will be returned via D2L.

Final Grades will be assigned based on final scores as described in the table below

Final Score (%)	Grade
90-100	4.0
85-89	3.5
80-84	3.0
75-79	2.5
70-74	2.0
65-69	1.5
60-64	1.0
<60	0.0

Course Policies

Artificial Intelligence:

This is a graduate level class, and it is my personal belief that you should challenge yourself to generate your own ideas and draft essays without the use of artificial intelligence (AI). This will only serve you as you move through your academic career. Thus, I ask that you NOT use AI for drafting your essays. You may use AI for copy editing only.

Commit to Integrity: Academic Honesty

Article 2.3.3 of the Academic Freedom Report states that "The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards." In addition, the Department of Plant, Soil, and Microbial Sciences adheres to the policies on academic honesty as specified in General Student Regulations 1.0, Protection of Scholarship and Grades; the all-University Policy on Integrity of Scholarship and Grades; and Ordinance 17.00, Examinations. (See Spartan Life: Student Handbook and Resource Guide and/or the MSU Web site: www.msu.edu.)

Therefore, unless authorized by your instructor, you are expected to complete all course assignments, including homework, lab work, quizzes, tests and exams, without assistance from any source. You are expected to develop original work for this course; therefore, you may not

submit course work you completed for another course to satisfy the requirements for this course. Also, you are not authorized to use the www.allmsu.com Web site to complete any course work in this course. Students who violate MSU academic integrity rules may receive a penalty grade, including a failing grade on the assignment or in the course. Contact your instructor if you are unsure about the appropriateness of your course work. (See also the Academic Integrity webpage.)

Inform Your Instructor of Any Accommodations Needed

From the Resource Center for Persons with Disabilities (RCPD): Michigan State University is committed to providing equal opportunity for participation in all programs, services and activities. Requests for accommodations by persons with disabilities may be made by contacting the Resource Center for Persons with Disabilities at 517-884-RCPD or on the web at rcpd.msu.edu. Once your eligibility for an accommodation has been determined, you will be issued a Verified Individual Services Accommodation ("VISA") form. Please present this form to me at the start of the term and/or two weeks prior to the accommodation date (test, project, etc.). Requests received after this date may not be honored.

Participation and Engagement

During all classes, the instructor expects students to be fully engaged and prepared to discuss reading assignments. Students are encouraged to ask questions of the instructor, guest speakers, and their peers.