

SOIL QUALITY (SWS 6134)

3 Credits- Fall 2020

- INSTRUCTOR:** Dr. Zhenli L. He, Professor
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- COURSE OBJECTIVES:** To acquaint students with basic concepts, principles, components, measurements, and evaluation of **soil quality** and its management for sustainable agriculture. Soil quality is the capacity of the soil to function within the ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health. In this course, state-of-the-art studies on soil quality and the principles, assessment and management of soil quality are examined with respect to biological production, plant and animal health, food security, and environmental quality. After studying this course, the students should be able to understand basic principles of soil quality and to analyze and evaluate soil quality related to agricultural production and environmental quality.
- DELIVERY METHOD:** E-Learning System/Canvas and Audio lectures (with powerpoint presentations and reading materials)
- FREQUENCY:** Fall semester, every even year
- TARGET STUDENTS:** Graduate students who wish to become specialists in the management of nutrients, soils, agroecosystems, and environmental quality.
- CLASS ATTENDANCE:** **Attendance of chat sessions is mandatory.** There is 5% grade for chat room participation.
- CHAT ROOM SESSION:** Chat room session is scheduled 5-7 PM every Monday except for public holidays.
- GRADING:**
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|-----------------------|-----|
| Homework: | 30% |
| Chat room attendance | 5% |
| Mid-term Examination: | 20% |
| Review or research | |
| Paper / presentation | 20% |
| Final Examination | 25% |

Total 100%

There will be no make-up homework and exams. Late submission of assignments will result in reduced credit (10% per assignment) if it is not agreed upon in advance.

A 94 – 100%
A- 90 – 93%
B+ 87 – 89%
B 83 – 86%
B- 80 – 82%
C+ 77 – 79%
C 73 – 76%
C- 70 – 72%
D+ 67 – 69%
D 63 – 66%
D- 60 – 62%
E < 60%

ASSIGNMENTS/
EXAMS/PROJECTS
/LECTURES

Soil quality is one of the rapidly-developing frontiers in soil and environmental sciences, with emphasis on soil's functions in plant and animal production, food safety, and environmental quality. This course involves many new concepts, principles, evaluation expertise, and test methods. It is important that the students have a good understanding of the concepts and principles. Therefore, in addition to lectures, the students will be also provided with supplementary course materials to read and homework to do at the end of each chapter. The students are required to submit homework report timely in order to obtain scores. The mid-term examination is designed to check the study progresses of each student so that some adjustment can be made based on student's performance. In addition, each student is required to conduct an independent soil quality evaluation project. For this project, students will select one of the soil quality related study areas (crop production-, animal production-, food safety-, environmental quality (water quality/air quality)-oriented soil quality issue), conduct a literature review based on journal articles, textbook chapters, and/or proceeding papers, discuss the characteristics of the concept/approach, its limitations, and benefits, submit a report, and present results of their independent study.

- REFERENCES:** Reference books, journal articles, and related information links are provided on course website and in disk (some references are listed at the end of this syllabus).
- PREREQUISITES:** Soil Science for Environmental Professionals (SWS 5050).
- OFFICE HOURS**
- INSTRUCTOR:** Open for e-mail and phone call at any time or chat room by appointment.

COURSE MODULES

1. Concepts, principles, and components of soil quality
 - 1.1. Definition and concepts of soil quality
 - 1.2. Soil components and basic soil quality properties
 - 1.3. Soil quality indicators
2. Methods of soil quality evaluation
 - 2.1. Soil quality assessment
 - 2.2. Measurements of soil quality indicators
3. Management of soil quality for agriculture and environmental quality
 - 3.1. Soil quality management for plant production
 - 3.1.1. Soil quality factors
 - 3.1.2. Processes and management
 - 3.2. Management of soil quality for the environment
 - 3.2.1. Water quality
 - 3.2.2. Air quality
4. Management of soil quality for health and food security
 - 4.1. Soil quality management for plant health
 - 4.2. Soil quality management for animal health
 - 4.3. Soil quality management for human health and food security

GRADES AND GRADE POINTS: For information on current UF policies for assigning grade points, see <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

ABSENCES AND MAKE-UP WORK: Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: <https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>

ACADEMIC HONESTY: As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity." You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to

appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: <http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code>

STUDENT RESPONSIBILITIES: Students should report any condition that facilitates dishonesty to the instructor, department chair, college dean or Student Honor Court. More information about student responsibilities are available from the current University catalog, online at: <http://www.registrar.ufl.edu/catalog1011/policies/students.html>

SOFTWARE USE: All faculty, staff, and students of the University of Florida are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

CAMPUS RESOURCES:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center:

<http://www.counseling.ufl.edu/cwc/Default.aspx>, 392-1575;

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department, 392-1111 (or 9-1-1 for emergencies).

<http://www.police.ufl.edu/>

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling.

<http://www.crc.ufl.edu/>

Library Support, <http://cms.uflib.ufl.edu/ask> . Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.

<http://teachingcenter.ufl.edu/>

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. <http://writing.ufl.edu/writing-studio/>

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.

STUDENTS WITH DISABILITIES: The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

ONLINE COURSE EVALUATION: Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

STUDENT COMPLAINTS: Each online distance learning program has a process for, and will make every attempt to resolve, student complaints within its academic and administrative departments at the program level. See <http://distance.ufl.edu/student-complaints> for more details.

PRIVACY STATEMENT OF RECORDED MATERIALS

Our class sessions may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

The grading rubric for graduate student's final project

Components	Poor (≤ 60 %)	Acceptable (61-80 %)	Good (81-90 %)	Excellent (91-100 %)	Full score
<i>Content</i>					
Scientific questions	No obvious scientific questions to be addressed.	Scientific question is not explicitly presented.	There is a scientific question clearly stated.	Significant questions are logically addressed.	10
Hypothesis	No hypothesis.	There is hypothesis, but not well presented.	There is a well presented hypothesis.	Meaningful hypotheses are logically addressed.	5
Methodology	No experimental design and lack of adequate methods.	There is experimental design, but lack of adequate methods.	There is experiment design with measurement methods.	The experiments are statistically designed with adequate methods.	10
Data process & statistical analysis	No statistical analysis of the data.	There is statistical analysis of the data but not sufficient.	The data are statistically analyzed but not well presented.	The data are statistically analyzed and well presented.	5
Results and Discussion	Interpretation of the data is lacking.	The results are presented but not well discussed.	The results are adequately presented and discussed.	The results are well presented and discussed.	20
<i>Communication</i>					
Organization	No logical structure of the paper and presentation.	The paper and presentation is structured in a way but hard to follow.	The paper and presentation is logically structured.	Well organized with proper proportions of text, figures, and pictures.	10
Language	Poor with many errors in grammar and spelling.	Adequate with minor errors in grammar and spelling	Written clearly without obvious errors in grammar and spelling	Well written with good flow of ideas and easy to follow	10
Colors & figures	Colors are arbitrarily chosen and figures are poorly designed.	Use of some colors and figures to present information.	Colors and figures are used to enhance presentation.	Colors and figures are well designed to communicate ideas.	10
Presentation	Not clear and timely	Good speech but not timely	Good speech and timely	Well presented and timely	10
Acknowledgment	Minimal citation	With some citations and references	Completely cited and acknowledged.	Well cited and acknowledged with journal standards	10

TOPIC OUTLINE OF SOIL QUALITY

Chapter 1. Definition and Concepts

1.1. What is soil quality?

Soil quality is the capacity of the soil to function within the ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health (Soil Sci. Soc. Am, 1997). Soil quality is a measure of the conditions of soil relative to the requirement of one or more species and /or to any human need or purpose (Johnson et al., 1997; Lal, 1997; Doran et al., 1998). Soil quality consists of physical, chemical, and biological components.

1.2. Why do we need soil quality concept?

The importance of developing the concept of soil quality was enhanced because of the need to apply soil science to address the problems of nonagricultural uses of soil (e.g., mineland restoration, urban uses and disposal of urban wastes, soil contamination and pollution by industrial activities, athletic and recreational uses of soil, and environmental regulatory functions with particular reference to water quality and the greenhouse effect). A strong need, therefore, arose to develop appropriate indicators of soil quality in relation to specific soil function (e.g., agricultural, urban, industrial, recreational, athletic, environmental, and waste disposal).

1.3 How do we evaluate soil quality?

1.4 What are the potential applications of soil quality in agriculture, food and environment?

Chapter 2. Soil Components and Basic Soil Quality Properties

2.1. Soil development and quality changes

2.2. Soil components

2.2.1 Inorganic components

Primary minerals

Clay minerals

Oxides

2.2.2 Organic components

Organic matter

Humus

Soil organisms

2.3. General soil quality attributes

2.3.1 Soil texture

2.3.2 Soil reactions

2.3.3 Soil charges

- 2.3.4 Ion exchange
 - 2.3.5 Buffering capacity
 - 2.3.6 Adsorption-desorption
 - 2.3.7 Microbial turnover
 - 2.3.8 Nutrient cycling
- Chapter 3. Soil Quality Indicators
- 3.1. What are soil quality indicators?
 - 3.2. Physical indicators
 - 3.3. Chemical indicators
 - 3.4. Biological indicators
- Chapter 4. Soil Quality Assessment
- 4.1. The need of soil quality assessment
 - 4.2. Approaches of soil quality assessment
 - 4.3. Procedures of soil quality assessment
 - 4.4. Site selection
 - 4.5. Identification of soil quality attributes
 - 4.6. Soil quality indexing
- Chapter 5. Measurements of Soil Quality Indicators
- 5.1. Soil sampling
 - 5.2. Physical Parameters
 - Soil texture
 - Depth of soil and rooting
 - Soil bulk density and filtration
 - Water holding capacity
 - Water retention characteristics
 - Water content
 - 5.3. Chemical Parameters
 - Total organic C and N
 - pH
 - Electrical conductivity
 - Labile nutrients and metals
 - Labile contaminants
 - 5.4. Microbiological and Biochemical Parameters
 - Microbial biomass C and N
 - Potentially mineralizable N
 - Soil respiration
 - Enzyme activity
 - Microbial quotient
 - Microbial respiration quotient
- Chapter 6. Soil Quality Management for Plant Production: Part I. Soil quality factors
- 6.1 Plant nutrients
 - 6.2 Nutrient availability
 - 6.3 Chemical quality factors
 - 6.4 Biological quality factors

Chapter 6. Soil Quality Management for Plant Production: Part II. Processes and management

- 6.5 Objectives of soil quality management
- 6.6 Management strategies
- 6.7 Management criteria
- 6.8 Land use and soil quality
- 6.9 Soil quality indexing of plant production
- 6.10 Soil erosion
- 6.11 Quality restoration of eroded soils
- 6.12 Soil acidification
- 6.13 Quality improvement of acid soils

Chapter 7. Management of Soil Quality for the Environment: Water Quality

- 7.1 Soil and water quality relationship
- 7.2 Nutrient and contaminant transport and surface water quality
- 7.3 Surface runoff and leaching
- 7.4 Phosphorus cycle
- 7.5 Soil biogeochemistry of phosphorus
- 7.6 Phosphorus management for water quality
- 7.7 Nitrogen cycle
- 7.8 Ammonia volatilization
- 7.9 Nitrate leaching and ground water quality
- 7.10 Nitrogen management for water quality
- 7.11 Heavy metals and pesticides

Chapter 8. Soil Quality Management for Air Quality

- 8.1 Greenhouse effects and soil quality
- 8.2 Soil carbon pools
- 8.3 Soil carbon sequestration
- 8.4 Conservation reserve program and carbon sequestration
- 8.5 Nitrogen emissions
- 8.6 Soil nitrogen losses and soil quality
- 8.7 Soil quality management to reduce nitrogen losses

Chapter 9. Soil Quality Management for Plant Health

- 9.1 Nutrient need for healthy plants
- 9.2 Nutrient deficiencies
- 9.3 Plant toxicity
 - Al, Mn and Fe
 - Heavy metal
- 9.4 Water stresses
 - Water supplying conditions
 - Flooding effects
- 9.5 Other soil constraints for plant Health
- 9.6 Optimal fertilization and irrigation

9.7 Soil quality evaluation for plant health

Chapter 10. Soil Quality Management for Animal Health

- 10.1 Essential elements for animal health and growth
- 10.2 Forage quality and animal production
- 10.3 Nutrient imbalance
- 10.4 Toxic effects of heavy metals
- 10.5 Other contaminants
- 10.6 Soil quality evaluation for animal health

Chapter 11. Soil Quality Management for Food Security

- 11.1 Food chain principles
- 11.2 Human nutrition and food
- 11.3 Food chain contamination: heavy metals and pesticides
- 11.4 Micro-nutrients, from soil to food
- 11.5 Soil quality management of quality food production
- 11.6 Soil quality evaluation for food security

BIBLIOGRAPHY

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Books

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Journal Articles

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