

**SWS 4451/5406**  
**Soil and Water Chemistry**

**Instructor:** Dr. Jonathan Judy, Assistant Professor, Soil and Water Sciences Dept.

**Office location:** 3169 McCarty Hall A

**Office hours:** Please call or email for an appointment.

**Course Prerequisites:** SWS 3022 or SWS 5050 (or equivalent); General Chemistry (CHEM 2046 or equivalent); instructor permission.

**Credit Hours:** 3 credits

**Delivery Method:** Web, Fall semester every year

**Enrollment Cap:** 15 Undergraduates and 15 Graduate Students

**Online meetings /Chat sessions:**

*Wednesdays 6-7 pm.* Chat dates and topics are listed on lecture schedule (in this syllabus). We will use Zoom video conference software for all chats. Invitations to chats will be sent via email.

Participation using a microphone and/or webcam is strongly encouraged.

**First chat for Fall 2022 is Wednesday, August 23 @ 6 pm ET.**

Please note all chats are recorded and posted (usually the following day) on Canvas. The purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to

social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

**Course Overview:**

The course will cover the basic principles of soil and water chemistry. The class will cover the fundamentals principles of the properties of soil components and soil reactions that affect plant growth and environmental quality.

**Course Objectives:**

In this course, we will describe the soil solid and solution phases, introduce the chemical principles necessary to examine the soil environment, and identify the chemical processes that occur in the soil environment and ultimately impact the fate and behavior of substances in soil and other natural water systems.

After finishing this class, you will be able to:

1. Discuss the importance of the soil solution phase in which almost all chemical reactions in the soil occur and be able to use and understand applications of speciation models.
2. Identify the common primary and secondary minerals, and solids that compose soils; explain their characteristics and potential reactivity in the environment.
3. Distinguish between ion exchange, adsorption, and precipitation reactions.
4. Debate the importance of pH and reduction/oxidation (redox) status of a soil in dictating the aqueous speciation of an element, as well as reactivity, mobility, and toxicity; interpret solubility and pH vs. Eh diagrams; and, given the chemical and mineralogical properties of a soil, determine which of these processes would dominate.
5. Characterize the chemistry, diagnosis, and reclamation of problematic soils like acid and alkaline soils.

**Course Requirements:** Students must have an e-mail account, Internet access, access to a computer that meets the [University of Florida computer standards](#).

**Required Text:** Soil Chemistry; Strawn, Bohn and O'Connor. 2015 (5<sup>th</sup> edition)

**Course Web Site:** Narrated lectures, handouts and assignments are posted on the class website on Canvas. Go to <http://elearning.ufl.edu/>, log on using your Gatorlink. You need to have a Gatorlink account <http://www.gatorlink.ufl.edu/> to be able to log on to the class. Please note that E-learning needs Java to work properly. You can download Java from the same website.

**Supplemental Reading Materials** (Selected materials from other books posted on class website):

1. Chemical Equilibria in Soils. W. L. **Lindsay**. 1979. John Wiley and Sons.

2. The Chemistry of Soils. G. **Sposito**. 1989., 2<sup>nd</sup> edition Oxford University Press.
3. Soil and Water Chemistry: An integrative approach. M. **Essington**. 2015. 2<sup>nd</sup> edition, CRC Press.
4. The Nature and Properties of Soils, **Brady and Weil**. 2008. Prentice Hall.

### **Students Responsibilities:**

Students are expected to study the assigned text sections and listen to narrated lectures prior to lecture coverage in class. Students are expected to actively participate in class chat discussions.

### **HW, Class Discussions and Exams:**

This class has required HW, discussion posts, and exams as follows: 7 homework assignments, 2 discussion posts, 10 quizzes and 2 on-line exams. Students will also be provided practice/study questions to help achieve course learning objectives but **quizzes will focus on the relevant book chapter.**

Your final grade will be based on the cumulative score for the exams, homework assignments and discussion posts. See tables below for details regarding grading system and points required to get specific grades.

**Quizzes and exams will be open book/internet/notes but you are required to work independently.** Exams will feature additional, graduate student only questions.

The midterm and final exams will be proctored by Honorlock. Honorlock is an online proctoring service that allows you to take your exam from the comfort of your home. You DO NOT need to create an account, download software or schedule an appointment in advance. Honorlock is available 24/7 and all that is needed is a computer, a working webcam, and a stable Internet connection.

To get started, you will need Google Chrome and to download the Honorlock Chrome Extension. You can download the extension at [www.honorlock.com/extension/install](http://www.honorlock.com/extension/install)

When you are ready to test, log into Canvas, go to your course, and click on your exam. Clicking "Launch Proctoring" will begin the Honorlock authentication process, where you will take a picture of yourself. Honorlock will be recording your screen and web traffic. Honorlock support is available 24/7/365. If you encounter any issues, you may contact them via live chat.

**Graduate students will also be required to complete a term project. Undergraduates will not** have to complete this assignment but are strongly encouraged to attend the term project presentations. The term project subject matter will be selected by the student in consultation (usually via an email discussion) with the instructor and **agreed to by the required date (see Canvas for due date)**. 10 points will be awarded for on-time submission of topics, 10 points for on-time submission of the outline, and 80 points for the completed project.

**Examples of a term project outline, report and presentation are available for review from the beginning of the semester in the "Term Project" assignment category.**

See also UF policies at: <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>.

<b>Grade</b>	<b>Undergrad Points Required</b>	<b>Grad Student Points Required</b>
A	368	460
A-	358	447
B+	346	432
B	326	407
B-	318	397
C+	306	382
C	278	347
D+	266	N/A
D	238	N/A
E	<238	N/A

### **Make-Up Work and Absences**

Make up exams are rarely authorized and must be medically justified and authenticated.

Homework assignments will be assigned regularly and will be graded. A *10% per day* lateness deduction will be assessed for any assignments (not just homework) turned in late. Work more than a week late *will not be accepted*.

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>.

	<b>Number</b>	<b>Points Each</b>	<b>Total Points</b>
Homework	7	20	140
Quizzes	10	4	40
Discussions	2	10	20
Midterm	1	100	100
Final	1	100	100
<b>Undergrad Total</b>			<b>400</b>
Term Project		100	
<b>Graduate Total</b>			<b>500</b>

### **Online Course Evaluation Process**

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/>.

### **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/honorcodes/honorcode.php>.

### **Software Use:**

All faculty, staff and students of the university 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.

### **Services for 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 requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students

Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation  
0001 Reid Hall, 352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)

**Campus Helping Resources:**

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

1. *University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, [www.counseling.ufl.edu/cwc/](http://www.counseling.ufl.edu/cwc/)*
  - Counseling Services
  - Groups and Workshops
  - Outreach and Consultation
  - Self-Help Library
  - Training Programs
  - Community Provider Database
2. U Matter We Care, [www.umatter.ufl.edu/](http://www.umatter.ufl.edu/)
3. *Career Resource Center, First Floor JWRU, 392-1601, [www.crc.ufl.edu/](http://www.crc.ufl.edu/)*

**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-complaint-process/> for more details.

**TENTATIVE SCHEDULE**

<b>Week (s)</b>	<b>Section 1: Introduction and Review</b>	<b>Readings</b>	<b>Chats</b>	<b>Assessments (Check due dates on Canvas)</b>
<b>1</b> Week of Aug. 22	<p>Definition of Soil Chemistry; Relation to Plant Growth &amp; Environmental Quality</p> <p>Review of chemical Principles (review handout)</p>	<p><b>SBO Chapter 1</b></p> <p><b>Chapter 1 Study Questions</b></p> <p>Review of chemical principles handout</p>	<p><b>Chat 1:</b> <b>Aug 23 6-7 PM</b> Introduction and AV/Tech issues</p>	<p><b>Chapter 1 Quiz (9/1)</b></p>
<b>Week (s)</b>	<b>Section 2: Soil and Water Chemistry</b>	<b>Readings</b>	<b>Chats</b>	<b>Assessments (Check due dates on Canvas)</b>
<b>2-4</b> Weeks of Aug. 29 Sept. 5 Sept. 12	<p>Soil and Water Chemistry Part I: Soil Water Sampling; Composition of Soil Solution &amp; Activity Concepts</p> <p>Soil and Water Chemistry Part II: Water and Ion Water Interactions; Chemical reactions</p>	<p><b>Week 2: Ch 2</b> <b>Weeks 3-4: Ch. 4</b></p> <p><b>Chapter 2 and 4 Study Questions</b></p>	<p><b>Chat 2:</b> <b>August 30 6-7 PM</b> Ionic Strength and Soil Water Calculations, HW 1</p> <p><b>Chat 3:</b> <b>Sep 6 6-7 PM</b> Chapter 2, HW 2</p> <p><b>Chat 4:</b> <b>Sep 13 6-7 PM</b> Chapter 4</p>	<p><b>Chapter 2 Quiz (9/8)</b></p> <p><b>Discussion 1 (Due 9/8)</b></p> <p><b>HW # 1 (Due 9/8)</b></p> <p><b>Term Project Topics (Due 9/15)</b></p> <p><b>Chapter 4 Quiz (9/15)</b></p> <p><b>HW # 2 (Due 9/15)</b></p>

Week (s)	Section 3: Soil Solid Phases	Readings	Chats	Assessments (Check due dates on Canvas)
<p><b>5-9</b> Weeks of Sept. 19 Sept. 26 Oct. 3 Oct. 10</p>	<p>Soil Solids Part I: Elemental Composition of Soil, Principles of ionic solid structure &amp; primary minerals</p> <p>Soil Solids Part II: Secondary minerals, Layer silicates, oxides &amp; soil organic matter</p>	<p><b>SBO Chapters 6-8</b> <b>Week 5: Ch. 6</b> <b>Week 6: Ch. 7</b> <b>Week 7: Ch. 8</b> <b>Week 8: Ch. 9</b></p> <p><b>Chapters 6-8 Study Questions</b></p>	<p><b>Chat 5:</b> <b>Sept 20 6-7 PM</b> Chapter 6, HW 3</p> <p><b>Chat 6:</b> <b>Sept 27: 6-7 PM</b> Chapter 7</p> <p><b>Chat 7:</b> <b>Oct 4: 6-7 PM</b> Chapter 8, HW 4</p> <p><b>Chat 8:</b> <b>Oct 11: 6-7 PM</b> Catch up/Review</p>	<p><b>Chapter 6 Quiz</b> <b>(9/22)</b></p> <p><b>HW # 3</b> <b>(Due 9/29)</b></p> <p><b>Chapter 7 Quiz</b> <b>(9/29)</b></p> <p><b>Chapter 8 Quiz</b> <b>(10/6)</b></p> <p><b>Term Project</b> <b>Outline</b> <b>(Due 10/13)</b></p> <p><b>Chapter 8 Quiz</b> <b>(10/13)</b></p> <p><b>HW # 4</b> <b>(Due 10/13)</b></p> <p><b>Mid-term Exam</b> <b>Oct. 13-16</b></p>

Week (s)	Section 4: Sorption Phenomenon	Readings	Chats	Assessments (Check due dates on Canvas)



<p><b>10-11</b> Weeks of Oct. 17 Oct. 24</p>	<p>Sorption Phenomena Part 1: Ion Retention and Cation Exchange</p> <p>Sorption Phenomena Part 2: Cation Exchange Equations, Anion Exchange and Neutral Molecule Retention</p> <p>Sorption Phenomena Part 3: DDL and Adsorption Isotherms</p>	<p><b>SBO Chapters 9-11</b> <b>Week 9: Ch 9</b> <b>Week 10: Ch. 10-11</b></p> <p><b>Chapters 9-11</b> <b>Study Questions</b></p>	<p><b>Chat 9:</b> <b>Oct 18: 6-7 PM</b> Post Exam Discussion, Chapter 9</p> <p><b>Chat 10:</b> <b>Oct 25: 6-7 PM</b> Chapters 10-11, HW 5</p>	<p><b>Chapter 9 Quiz</b> <b>(10/20)</b></p> <p><b>Chapter 10 Quiz</b> <b>(10/27)</b></p>
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Week (s)	Section 5: Chemistry of Acid Soils	Readings	Chats	Assessments (Check due dates on Canvas)
<p><b>11 &amp; 12</b> Weeks of Oct. 31 Nov. 7</p>	<p>Soil Acidity Part 1: Source, Classification and AI theory of soil acidity</p> <p>Soil Acidity Part 2: Buffers, Lime requirement and hazards of soil acidification</p>	<p><b>SBO Chapter 12</b></p> <p>Review tutorial on soil acidity calculations</p> <p><b>Chapter 12 Study Questions</b></p>	<p><b>Chat 11:</b> <b>Nov 1: 6-7 PM</b> Chapter 12, HW 6</p> <p><b>Chat 12:</b> <b>Nov 8: 6-8 PM</b> Term Project Presentations</p>	<p><b>Chapter 12 Quiz</b> <b>(11/3)</b></p> <p><b>HW # 5</b> <b>(Due 11/3)</b></p> <p><b>Term Projects</b> <b>(Due 11/8)</b></p>
Week (s)	Section 6: Salt-Affected Soils	Readings	Chats	Assessments (Check due dates on Canvas)
<p><b>13</b> Week of Nov. 14</p>	<p>Salt Affected Soils Part 1: Sources of salinity and alkalinity, carbonate equilibria</p> <p>Salt Affected Soils Part 2: Clay dispersion, reclamation of salt degraded soils</p>	<p><b>SBO Chapter 13</b></p> <p><b>Chapter 13 Study Questions</b></p>	<p><b>Chat 12:</b> <b>Nov 15: 6-7 PM</b> Chapter 13, HW 7</p> <p><b>Chat 11/22</b> <b>TBD</b></p>	<p><b>HW # 6</b> <b>(Due 11/17)</b></p> <p><b>Discussion 2</b> <b>(Due 11/24)</b></p>
Week (s)	Section 7: Oxidation- Reduction Reactions	Readings	Chats	Assessments (Check due dates on Canvas)
<p><b>14 &amp; 15</b> Weeks of Nov. 21 Nov. 28</p>	<p>Oxidation-Reduction Part 1: Definitions and thermodynamic relationships</p>	<p><b>SBO Chapter 5</b></p> <p><b>Chapter 5 Study Questions</b></p>	<p><b>Chat 13:</b> <b>Nov. 29</b> Chapter 5, Final Review</p>	<p><b>Ch. 5 Quiz</b> <b>(12/1)</b></p> <p><b>Discussion 2</b> <b>(Due 12/1)</b></p>

	Oxidation-Reduction Part 2: Electron acceptors and redox couples in soils			<b>HW # 7 (Due 12/1)</b>
	<b>Classes END Dec. 6 Reading Days: Dec. 7-8</b>			<b><u>Final Exam:</u> Dec 11-13</b>