BIOGEOCHEMISTRY OF WETLANDS & Distance Education -Course AQUATIC SYSTEMS
SWS 6448

Fall 2016, Credits: 3

INSTRUCTORS

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OFFICE HOURS:
All communication related to the course will be via email. Questions can be sent via email using the course website, please make sure your email is addressed to both the instructors and allow up to 48 hours for the response. Please post all material related general questions on the discussion board.

COURSE DESCRIPTION:
Environmental and ecological significance of biogeochemical properties of wetlands and aquatic systems in relation to elemental cycling and as related to water quality, carbon sequestration, greenhouse gas emissions, and sea level rise.
Overall course objectives: 1) To provide students with the basic concepts of biogeochemical cycling of macro and trace elements including carbon, nitrogen, phosphorus, iron and sulfur. 2) To discuss the environmental and ecological significance of these biogeochemical processes as they relate to environmental elemental cycling, water quality, carbon sequestration, climate change, and sea level rise.

COURSE WEBSITE:
http://elearning.ufl.edu/ . You need your Gatorlink account and password to login.

FREQUENCY TAUGHT: Fall Term

COURSE FORMAT
This course is offered in a web-based environment. The course consists of 9 modules (1 optional), an outline can be found at the end of the syllabus. Each module consists of recordings and associated texts presented as book chapters or other assigned reading material. This combination represents the bulk of the class material; additional information can be obtained in the references. Make your own notes on each module.

The course modules will be released on a set schedule. You will have access to one module at a time. At the beginning of each week, the instructor will assign the number of slides to be studied over the period of that week. In order for you to remain on schedule, the study of this material must be completed during that week. Even though the entire module is released and available, we strongly recommend you limit yourself to the material assigned by the instructor so as to gain a reasonable understanding of the material. Associated to each module will be the reading material that may elucidate the material in the texts or slides.

COURSE POLICIES

Chat session attendance and participation is **expected**. During this time, the applications of the concept learned in the class are discussed. *Students are expected to notify the instructors a day in advance if he/she is not able to attend the chat session.* Expectations will be discussed during the first chat session.

There will be **no makeup exams/assignments** given. All due dates (as in the schedule) need to be adhered to unless changed by the instructors. Students are responsible for all information in the assigned texts and information presented in class materials and during chat sessions.

Students are expected to read all assigned materials prior to contributing to discussion boards or completing related assignments/activities.

Students should always consider the possibility of technology failure, and complete assignments to allow adequate time to correct for potential technology problems.

TECHNOLOGY CHECKLIST:

In order to successfully participate in distance education courses offered by the Soil and Water Science Department, it is the responsibility of each student to have access to a personal computer (or laptop), the Internet, and other equipment to maintain the functionality of peripherals (e.g. Functional microphone). For more help with e-learning the students need to review the information found at https://kb.helpdesk.ufl.edu/FAQs/E-Learning

STUDENT EVALUATION SYSTEM

Final grades will be calculated based on completion of work and accumulation of points in each of the 5 following categories. 10% of points will be deducted for each day the assignment is late after the due date. Make up exams are not authorized and are at the discretion of the instructor. Any requests for make-ups due to technical issues MUST be accompanied by the ticket number received from LSS when the problem was reported to them. The ticket number will document the time and date of the problem. You MUST e-mail your instructor within 24 hours of the technical difficulty if you wish to request a make-up.

Quiz: (30% of final grade**):** Associated with each module will be assignment/s that must be completed within specified time period (see the due dates). Assignments may include short questions/quizzes/problem solving. In addition, there may be pop quizzes given during the chat sessions (for extra credit) that can count towards your final grade.

Discussions: (5% of final grade): To encourage the discussion and real life application of the concepts being reviewed in the course, students will have an opportunity to participate in the discussion 'Topic for the week' on the *Discussion Board*. Details will be discussed in class.

Calculations: (10% of final grade):To further understand the application of a few topics, we will be working on some basic calculations. Students are expected to review the basic concepts in chemistry.

Exams: (40% of final grade): Your understanding of the material will be assessed with **two exams** during the semester. Exam format is primarily as a few short objective type questions (multiple choice, fill in the blanks), short answers (4-5 sentences) and long discussion type questions. However, this can be modified as per the discretion of the instructor and will be explained at appropriate time.

Presentations and Attendance: (10% of final grade**):** will be *required* of the students. Each student will be provided a topic (related to the course subject matter) by the instructor, and will be required to develop a 10-12 minute presentation. This will be presented to the class via *Voice Thread* (found on e-learning website). Each presentation will be recorded and reviewed by the whole class. All presentations are considered are part of final grade and scheduled during the final exam week.

GRADING SCALE

100 - 93% = A; 92-90% = A- ; 89-87% = B+ ; 86-84% = B ; 83-80% = B- ; 79-77% = C+ ; 76-74% = C; 73-70% = C- ;69-65% = D+; 64-60% = D; 59% or less= E

**Note: Please keep a copy of all class communication in case you have a question regarding your final grade.

TEXTBOOK **(Highly recommended but not required)**

Biogeochemistry of Wetlands: Science and Applications. K. R. Reddy & R. DeLaune. 2008.

UNIVERSITY OF FLORIDA POLICIES

University policy on accommodating students with disabilities

- Students requesting accommodation for disabilities must first register with the Dean of Students Office (http://www.dso.ufl.edu/drc/) . The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation. You must submit this documentation prior to taking assignments or taking the quizzes or exams. Accommodations are not retroactive, therefore, students should contact the office as soon as possible in the term for which they are seeking accommodations.

University policy on academic misconduct

- Academic honesty and integrity are fundamental values of the University community. Students should be sure that they understand the UF Student Honor Code at http://www.dso.ufl.edu/students.php. 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 the responsibility of students to be aware of all university policies and procedures regarding academic integrity and the Student Honor Code. ANY violation of the Honor Code at the University of Florida is not to be tolerated and 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.

NETIQUETTE: COMMUNICATION COURTESY: All members of the class are expected to follow rules of common courtesy in all email messages, threaded discussions and chats. **Failure to do so can lead to disciplinary action to be taken as decided by the instructor.

OTHER HELPFUL RESOURCES

WEB RELATED

- Information related to the e-learning can be found at http://elearning.ufl.edu/. Look for the **Student FAQ** located on top of the page for help.
- For issues with technical difficulties for E-learning in Canvas, please contact the UF Help Desk either by going to http://elearning.ufl.edu and use the "**Message Us**" link (located on top right) or by contacting them at (352) 392-4357 x 2
- ** Any requests for make-ups due to technical issues MUST be accompanied by the ticket number received from LSS when the problem was reported to them. The ticket number will document the time and date of the problem. You MUST e-mail your instructor within 24 hours of the technical difficulty if you wish to request a make-up.

PERSONAL

Other resources are available at http://www.distance.ufl.edu/getting-help for:

Counseling and Wellness resources at

- University Counseling & Wellness Center, 3190 Radio Road, 352 -392-1575, www.counseling.ufl.edu/cwc

Library Help Desk support can be found at http://www.ufl.edu/academics/libraries/

Career Resource Center, Level 1 J Wayne Reitz Union, 392-1601, www.crc.ufl.edu

Resources for handling student concerns and complaints: Should you have any complaints with your experience in this course please visit http://www.distance.ufl.edu/student-complaint-process to submit a complaint.

COURSE OUTLINE

MODULE – I: BIOGEOCHEMICAL CHARACTERISTICS OF WETLAND SOILS

a) The extent and nature of wetland ecosystems in the earth's biosphere.
b) Overview of the significance of wetlands and the role of soils as a key component of wetlands.
c) Importance of wetland soils in the context of agronomic, ecological, limnological and environmental conditions.
d) Importance of biogeochemical cycles in wetlands and their role in the overall function of wetlands.
e) A discussion of the general properties of wetland soils as compared to upland soils. Including Accumulation of organic matter, absence of molecular oxygen, restricted gaseous exchange, presence of marsh plants, changes in electrochemical properties (pH, redox potential and conductivity) of soils, presence of reduced chemical species, criteria used to classify wetland (hydric) soils.

MODULE– II: ELECTROCHEMICAL PROPERTIES

a) A discussion on key physico-chemical properties that are influenced by hydrologic fluctuations of (temporary or permanent flooding) of wetlands.
b) Ranges in values of pH and redox potential, in natural systems. Principles, theory and techniques involved in the measurement of these properties. Seasonal changes as a result of hydrologic fluctuations.
c) Soil reductive processes showing the sequential reduction of oxidized compounds. The intensity and capacity aspects of energy yields due to reductive processes. Relationship between pH and Eh and concentrations of oxidized and reduced species of inorganic redox systems. Eh-pH stability fields for various soil redox.
d) The role of oxidized redox components as electron acceptors in microbial metabolic pathways. Vertical stratification of oxidized and reduced species and their importance in digenetic processes.
e) Experimental techniques to measure soils reductive processes. Reactors to control Eh and pH of soil suspensions and techniques to measure vertical stratification of redox species.
f) Characteristics of wetland plants. Development of aerenchyma and role in gas exchange through plants.

MODULE- III: BIOGEOCHEMISTRY OF CARBON

a) Sources and nature of soil organic matter in wetland soils.
b) The role of soil organic matter as electron donor in the microbial respiratory activities.
c) Mechanisms regulating organic matter accumulation in wetland soils. Role of plants in accumulation of organic matter under various ecosystems. Techniques to measure historical organic accumulation rates.
d) Decomposition of organic matter and the role of different electron acceptors (oxygen, nitrate, manganese, iron, sulfate and CO_2). Kinetics of organic matter decomposition. Turnover rates of organic matter as influenced by different climatic and hydrologic regimes.
e) Methanogenesis - role in organic matter decomposition. Mechanisms involved in methanogenesis in wetlands. Influence of plants and methane fluxes from wetlands.

f) Carbon budgets for wetlands in different ecosystems. Discuss the use of mathematical models to synthesize various carbon processes in wetlands.

MODULE- IV: BIOGEOCHEMISTRY OF OXYGEN

a) Oxygen/H_2O redox couple
b) Soil aeration
c) Establishment of aerobic (oxygen reduction zone) zone at the soil and floodwater interface and plant root-soil water interface.
d) Oxygen transport through the floodwater and consumption by wetland soils. Oxygen production benthic photosynthetic algae and its role in oxygen diffusion and consumption.
e) Oxygen transport through wetland plants and its role in rhizosphere oxidation. Mechanisms (diffusion and mass flow) governing oxygen through the plants.
f) The role of aerobic zone on exchange of nutrients and gases between soil and the overlying water column (include the works of Mortimer and Pearsall).
g) Oxygen budget in wetlands. Present the use of mathematical models describing the reactions associated with oxygen consumption in wetlands.

MODULE- V: BIOGEOCHEMISTRY OF NITROGEN

a) Distribution, sources and forms of nitrogen. Describe in detail nitrogen cycle in different wetland ecosystems.
b) Mineralization and immobilization processes under different redox (aerobic, facultative and anaerobic) conditions.
c) Nitrification-denitrification reactions at the aerobic -anaerobic interface at the soil surface and in the rhizosphere of wetland plants in natural and constructed wetlands and rice paddies. Environmental and soil factors regulating these reactions. Conditions under which nitrification-denitrification is minimized and maximized.
d) Ammonia volatilization as a nitrogen loss mechanism in wetlands. Influence of photosynthetic algae and other submerged macrophytes on floodwater pH and ammonia volatilization. Conditions under which this loss mechanism is minimized and maximized.
e) Biological nitrogen fixation in wetlands. Significance of this process to supply the nitrogen requirements of wetland plants and its contribution to overall nitrogen budget.
f) Exchange (diffusion and mass flow) of dissolved nitrogen species between soil and water column. Discuss the significance of these processes in nitrogen biogeochemistry.
g) Role of plants in nitrogen cycling (storage by assimilation and release during decomposition).
a) Nitrogen budget in different wetland ecosystems. Present nitrogen models to simultaneously discuss the processes involved in nitrogen cycling of wetlands.

MODULE-VI: BIOGEOCHEMISTRY OF PHOSPHORUS

a) Distribution, sources and forms of phosphorus.
b) Mineralization of organic phosphorus in soil and the overlying water column. Role of phosphatase in breakdown of soil organic P.
c) Inorganic phosphate reactions including adsorption, desorption and precipitation.
d) Phosphorus solubility as influenced by redox potential and pH.

e) Exchange (diffusion and mass flow) of dissolved phosphorus species between soil and water column. Discuss the significance of these processes in phosphorus biogeochemistry.
f) Role of wetland plants in phosphorus cycling (storage through assimilation and release during decomposition.
g) Phosphorus budget in different wetland ecosystems. Present phosphorus models to simultaneously discuss the processes involved in phosphorus cycling of wetlands.

MODULE-VII: BIOGEOCHEMISTRY OF IRON AND MANGANESE

a) Distribution, sources and forms of iron and manganese.
b) Reactivity of iron and manganese as influenced by pH and redox potential.
c) Role of iron and manganese as an electron acceptor in organic matter decomposition and nutrient release.
d) Exchange (diffusion and mass flow) of dissolved iron and manganese species between soil and water column. Discuss the significance of digenetic processes in manganese biogeochemistry.
e) Iron and Manganese budget in different wetland ecosystems.

MODULE-VIII: BIOGEOCHEMISTRY OF SULFUR

a) Distribution, sources and forms of sulfur.
b) Reactivity of sulfur forms as influenced by pH and redox potential.
c) Role of sulfate as an electron acceptor (dissimilatory sulfate reduction) in organic matter decomposition and nutrient release.
d) Exchange (diffusion and mass flow) of dissolved iron species between soil and water column. Discuss the significance of digenetic processes in iron biogeochemistry.
e) Formation of metal sulfides and stability of metal sulfides under various physico-chemical environments.
f) Sulfur budget in different wetland ecosystems. Present sulfur models to simultaneously describe the processes involved in sulfur cycling of wetlands.

ADDITIONAL HELPFUL REFERENCE

Mitsch, W. J. and J. G. Gosselink. 1993. *Wetlands.* New York: Van Nostrand Reinhold. Chapter 1, 2, 3 and 5.
Kozlowski, T. T. 1984. *Flooding and Plant Growth*. Academic Press, Inc. Chapter 8.
Zehnder, A. J. B. 1988. *Biology of Anaerobic Microorganisms*. John Wiley and Sons, Inc. Chapter 1.
Brock, T. D. and M. T. Madigan. 1993. *Biology of Microorganisms*. New Jersey: Prentice Hall Publishers.
Brady, N. C. 1992. *The Nature and Properties of Soils*. New York: Macmillan Publishing Co.
Pankow, J. F. 1991. *Aquatic Chemistry* Concepts. Lewis Publishers. Chapter 19.
Butcher, S. S., R. J. Charlson, G. H. Orians, and G. V. Wolfe. 1992. *Global Biogeochemical Cycles.* Academic Press.
Stumm, W., and J. J. Morgan. 1981. *Aquatic Chemistry*. John Wiley & Sons.
McBride, M. B. 1994. Environmental Chemistry of Soils. Oxford Univ. Press.

Garrels, R. M., and C. L. Christ. 1965. *Solutions, Minerals and Equilibria*. Harper and Row. Chapter 5 and 7.
Stevenson, F. J. 1994. *Humus Chemistry*. John Wiley & Sons. Chapter 1, 5 and 16.

Reference Journals [few examples]

1. Aquatic Geochemistry
2. Biogeochemistry
3. Biogeosciences
4. Ecological Engineering
5. Ecosystems
6. Ecological Monographs
7. Environmental Microbiology
8. Environmental Science and Technology
9. Journal of Environmental Quality
10. Limnology and Oceanography
11. Nature
12. Nature-Geosciences
13. Science
14. Soil Science Society of America Journal
15. Wetlands
16. Wetland Ecology and Management