University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

Biogeochemistry

3 Credits

MEES 627
Spring 2023

Course Objectives / Overview
Prerequisites: MEES 640 Interconnected Earth Systems: Land, Ocean, and Estuary (Earth and Oceans Foundation), *or* MEES 660 Ecological Systems (Ecological Foundation), *or permission of instructor*.

This course is a detailed examination of Earth's biogeochemical cycles, with an emphasis on major elements and carbon cycling through globally important biomes. The course employs a textbook, which is supplemented with weekly readings that include foundational review papers, and original scientific works. Topics include biogeochemical cycles of organic carbon and nutrients in terrestrial, lacustrine, wetland, and marine systems. Emphasis is placed on understanding how global rates of biogeochemical transformations are estimated and how these rates may be changing during the Anthropocene. We will have lectures introducing each topic and then you will have the opportunity to use the information in the lecture to deepen your understanding by discussing peer review literature on the same topic. Students will acquire skills in quantitative approaches to biogeochemistry through classroom instruction and regular analytical problem sets.

Expected Learning Outcomes

By the end of the course, students will be able to...

1. articulate a familiarity with the major biogeochemical processes that occur in the atmosphere, on land, in terrestrial waters (lakes, rivers, aquifers), and the world's oceans.
2. through problem sets, apply quantitative approaches to environmental biogeochemistry problems, such as estimating mass balances of a variety of Earth System processes
3. understand and summarize multiple ways humans alter biogeochemical processes.
4. apply their knowledge of Earth's biogeochemistry to gain a deeper understanding of peer review literature about biogeochemical systems.

INSTRUCTOR DETAILS:
Hali Kilbourne
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Andrea Pain
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CLASS MEETING DETAILS:
Days: Monday and Wednesday
Times: 8:30-9:50
Originating Site: HPL, CBL, AL
IVN bridge number:
(*******)
Phone call in number:
(***)
Room phone number:
(*****)

CURRICULUM FULLFILMENT:
MEES *** fulfills a *** (PD, ISG, etc) MEES requirement. OR elective etc

Prerequisites
Insert here or state N/A

Teaching Assistant
TBD or N/A

Course Assessment / Grading
Students will demonstrate a mastery of course material by leading class discussions of primary literature, participation in class discussions, completing an exam, and preparing a term paper.

Points:

Lead Paper Discussion	150 Points
Discussion Participation	50 Points
4 Problem Sets (50 pts each)	200 Points
Mid-term Exam	300 Points
Term Paper – first draft	125 Points
Term Paper – second draft	125 Points
Presentation of Term Paper	50 Points
TOTAL	**1000 Points**

Tentative Weekly Course Schedule (SPRING 2023)

Each week will usually include a lecture and journal discussion, led by a student or the instructor. Students will sign-up to lead a journal discussion near the start of the course.

Week 1	(Jan 25)	*Introduction to the course; course overview and learning outcomes, expectations, and grading scheme; historical context and introduction to the field and introduction to major approaches (Malkin)*
Week 2	(Jan 30, Feb 1)	*Earth's origins (Pain)*
Week 3	(Feb 6, 8)	*The Atmosphere (Kilbourne)*
Week 4	(Feb 13, 15)	*The Lithosphere (Kilbourne)*
Week 5	(Feb 20, 22)	*Terrestrial carbon cycle (including photosynthesis, respiration) (Davidson)*
Week 6	(Feb 27, Mar 1)	*Terrestrial biogeochemical cycles (emphasis N, P cycles)(Davidson)*
Week 7	(Mar 6, 8)	*Biogeochemistry of inland waters – rivers and lakes (Malkin)*
Week 8	(Mar 13, 15)	*Biogeochemistry of wetlands – with introduction to anaerobic respiration (Malkin)*
Week 9	(Mar 20, 22)	*Spring Break / Reading Week*
Week 10	(Mar 27, 29)	*Biogeochemistry of the land-water interface, including estuaries (Pain)*
Week 11	(Apr 3, 5)	*Biogeochemistry of Oceans – emphasis on organic and inorganic C, and N cycles (Malkin)*
Week 12	(Apr 10, 12)	*Global water cycle (Pain)*
Week 13	(Apr 17, 19)	*Global carbon cycle (Pain)*
Week 14	(Apr 24, 26)	*Global cycles of nitrogen and phosphorus (Davidson)*
Week 15	(May 1, 3)	*Global sulfur cycle – reading on geoengineering (Malkin)*
Week 16	(May 10, 15)	*Global Change (Kilbourne)*

Required textbooks, reading and/or software or computer needs

Schlesinger and Bernhardt's *Biogeochemistry: An analysis of global change* is the main text for this course. Other textbooks you might find as handy references include *Biogeochemistry of Estuaries* by Thomas S. Bianchi and the textbook used in Environmental Geochemistry 1 (*Water Chemistry – An introduction to the chemistry of natural and engineered aquatic systems* by P. L. Brezonik and W. A. Arnold. The textbook readings will be supplemented with readings from recent journal articles available as electronic copies via Moodle.

Course Communication

We use Moodle as our course administration software. All materials, including this syllabus, will be posted on the Moodle site for this course. Lectures will be made available on Moodle after they are given. Research shows that the synthesis and writing required by note-taking is an important component of learning, thus to encourage deeper learning, lectures will be made available on Moodle after they are given and not before. If you have questions or need to discuss anything with your professors outside of class, we encourage you to email or call us via the contact information provided on the first page of this syllabus. Please allow 24hrs for a response to email and realize that over the weekend, there will be no communication. Your professors have other work and personal obligations besides this class for which we need to make time. A lack of planning on your part does not constitute an emergency on our part.

Campus Policies

The University of Maryland Center for Environmental Science has drafted and approved of various academic and research-related policies by which all students and faculty must abide.
Please visit http://www.umces.edu/consolidated-usm-and-umces-policies-and-procedures for a full list of campus-wide academic policies.

Course-Specific Policies and Expectations

Science is a quantitative endeavor. The problem sets provide practice for students to quantify concepts learned in class. The answers will be provided with the expectation that students will go over their answers and learn from their mistakes. Problem sets turned in late will be docked points, unless pre-approved by the instructor because of extenuating circumstances. We understand that research activities are a high priority for graduate students and we are committed to working with our students to balance the ability to take courses with research obligations.