Syllabus: EPS/ENG-SCI 130: Biogeochemistry of Carbon Dioxide and Methane

Schedule

Class:	Monday, Friday	2:30pm – 4:00pm	Geological Museum 375
Section:	Friday	11:00pm – 12:30pm	Geological Museum 204
Midterm:	Friday, March 9	2:30pm – 4:00pm	Geological Museum 375
Final:	Friday, May 4	9:00am – 12:00pm	TBD

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Course Overview

A comprehensive study of the major carbon-containing gases in the atmosphere (CO2 and CH4), emphasizing biogeochemical processes in the oceans, land and atmosphere that regulate their global abundances, plus the human-controlled processes and multiple feedbacks that perturb them. Roles in energy balance, air chemistry and pollution, and stratospheric chemistry will be studied. The course emphasizes active learning, including hands on data analysis of global, regional, and ecosystem observations and creation of models for understanding the cycles and their responses to a changing environment. Students develop research projects throughout the course, and present them publicly in lieu of a final exam.

Notes: This course includes a weekly two-hour lab or section to be arranged. EPS 130 is also offered as ES 130. Students may not take both for credit. This course fulfills the EPS sub-discipline requirement of Atmospheres and Oceans.

Prerequisites: EPS 22, or EPS 10, or EPS 133, or ES 6; or permission of the instructor

Grading

25% Homework
20% Midterm
30% Project
25% Final

Homework

This course is broken into 4 phases: (1) Overview and Fundamentals (2) Biogeochemistry of Carbon Dioxide (3) Biogeochemistry of Methane (4) Final Project.

The homework is designed so that you build the biogeochemical cycles one step at a time, then bring them together into complete systems. The purpose is to give you an up-close look at specific aspects of the cycles, and a broad view of the complete system. There will also be a first homework that solidifies the overview and fundamentals.

There will be 7 homework assignments. They will be due at the beginning of Friday lectures and new ones will be released at the end of Friday lectures. The schedule is on the course calendar on the last page. You must complete all the assignments because they build upon each other, but your lowest grade will be dropped. Solutions will be released immediately after the Friday lecture. Your work will be graded Friday evening and returned immediately via email. Therefore, late homework will not be accepted. The reason for all this is the pedagogical benefits of getting immediate feedback and not being allowed to fall behind.

IMPORTANT NOTE: Please label your homework with your student number, but *not* your name. This allows for anonymous grading, a practice used for fairness and bias prevention.

Midterm Exam

The midterm exam will cover the (1) Overview and Fundamentals and (2) Biogeochemistry of CO_2 sections of the course. It will take place in class, on the last day of class before spring recess (Friday, March 9). You will be provided with a comprehensive review set one week before the midterm, and it will be taken up during section on the Wednesday before of the midterm.

Project

The class will include a project. In this project, students will take a close look at some aspect of the CO_2 and/or CH_4 model and add an innovation to it. For example, this might be a complication of the global model to include more processes, or a detailed regional model. You will have two in-class sessions with access to Professor Wofsy and Josh. You will give a 12-minute presentation about your project on the last day of class (plus 3 minutes for questions). The deliverables for the project are your Stella files and presentation slides.

Final Exam

The final exam will cover all topics taught in the course (not the projects). It is at 9:00am on May 4. The location is TBD.

Computers in class

You will need to bring a laptop computer to class to take part in active learning exercises. If you need to borrow a computer, let us know ahead of time and we can facilitate it.

Note that you should only have your computer out while doing these exercises and you should not use the computer for anything else. This course will move fast, and you will need to pay attention to everything to succeed.

Sections:

Sections will be held on Wednesdays at 2:30 – 4pm in Hoffman 129. Succeeding in this course will be much easier if you attend all the sections.

When applicable, we ask that you come to section prepared to answer three questions:

1) How do you feel about the latest lecture material?
   What are you struggling with and what do you find interesting?
2) How did you feel about the last homework? Do you have any lingering issues?
3) How do you feel about the current homework? What are

We will go over these questions, some additional lecture information, and sometimes deviate, as described in the class schedule below.

Week	Monday Lecture	Wednesday Section	Friday Lecture
1	**1. Jan 22** Introduction to the class: Overview of CO_2 and CH_4 biogeochemistry History of CO_2 and CH_4	**Jan 24** How to succeed in this course	**2. Jan 26** Lecture 2: How global warming works: *Part 1. Thermal Physics and Energy Balance.*
2	**3. Jan 29** Lecture 2, *Part 2. We build a climate model, and* ***quantify the link to CO_2***	**Feb 2** Missed Section: Steve Away, Josh Sick	**4. Feb 2** Missed Lecture: Steve Away, Josh Sick *HW1 Released*
3	**5. Feb 5** Life processes and the Carbon Cycle 2: Photosynthesis and respiration; nutrients (N, P, S, ...) and carbon	**Feb 9** Stella Tutorial / Life as a redox process	**6. Feb 11 (Telecon)** The terrestrial carbon cycle; links to our climate model. *HW1 Due; HW2 Released*
4	**7. Feb 12** The terrestrial carbon cycle; links to our climate model.	**Feb 16** HW 1 / HW 2 / Concepts	**8. Feb 16** Oceanic carbonate chemistry; separating organic and inorganic C *HW2 Due* *HW3 Released*
5	**Feb 19** No Class: President's Day	**Feb 21** HW 2 / HW 3 / Concepts	**9. Feb 23** Slower cycles: Glacial and weathering HW 3 Due HW 4 Released
6	**10. Feb 26** Anthropogenic CO_2 emissions	**Feb 28** HW 3 / HW 4 / Concepts	**11. Mar 2** Feedbacks and the future + Hands on *HW 4 Due* *Midterm Review Released*
7	**12. Mar 5** Round-up and reflection	**Mar 7** HW4 / Midterm Review	**13. Mar 9** *Midterm Exam 2:30 – 4* *GM 375*
8	**Mar 12** No Class: Spring Recess	**Mar 15** No Class: Spring Recess	**Mar 17** No Class: Spring Recess
9	**14. Mar 19** Biogenic methane: methanogenesis and methanotrophics	**Mar 21** Midterm Recap / Special Section	**15. Mar 23** Thermogenic methane and hydrocarbon maturation *HW 5 Released*
10	**16. Mar 26** Atmospheric removal processes	**Mar 28** HW 4 / HW 5 / Concepts	**17. Mar 30** The consequences of atmospheric methane oxidation *HW 5 Due* *HW 6 Released*
11	**18. Apr 2** The integrated pre-industrial CH_4 budget (+ in the oceans)	**Apr 4** HW 5 / HW 6 / Concepts	**19. Apr 6** Anthropogenic CH_4 emissions *HW 6 Due* *HW 7 Released*
12	**20. Apr 9** Feedbacks and the future	**Apr 11** HW 6 / HW 7 / Concepts	**21. Apr 13** Round-up and reflection *HW 7 Due* *Final project released*
13	**22. Apr 16** Final project session 1	**Apr 18** HW7 / How to give a great talk	**23. Apr 20** Final project session 2
14	**24. Apr 23** *Final project presentations*	**Apr 25** Presentations recap / Final exam review	**Apr 27** No Class: Reading Period
15	**Apr 30** No Class: Reading Period	**May 2** No Class: Reading Period	**May 4** *Final Exam 9:00 - 12* *Location TBD*