OCN 401
Biogeochemical Systems

(Welcome!)

Instructors:  Kathleen Ruttenberg
Frank Sansone
Chris Measures
Brian Glazer

Textbook:  *Biogeochemistry, An analysis of Global Change*
by William H. Schlesinger & Emily S. Bernhardt

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Course Goals

1. Understand the underlying principles of biogeochemical cycling in aquatic and terrestrial systems.

2. Identify the major global pathways of bioactive elements and human perturbations of these pathways.

3. Develop / improve written and oral communication skills focused on biogeochemical processes.

4. Achieve facility using electronic resources.
LECTURES

Lectures will generally be given using PowerPoint presentations. As a convenience to students, copies of the PowerPoint slides will generally be handed out in class. However, do not be fooled into thinking that the handouts are a substitute for careful note-taking in class. Much of the useful information in this class will be in the form of classroom discussion of the subject material.

Thus, students are expected to attend all lectures and to actively participate in class discussions.

GRADING

Midterm Exam: 25%
Final Exam: 25%
Homework & Class Participation: 20%
Term Paper & Presentation: 30%
Part II: Global Cycles

24
Mo
16 Nov
Global water cycle
11
CM

25
Tu
17 Nov
*** First Draft Due ***
CM

26
Wd
18 Nov
The Global Carbon cycle - I
11
CM

27
Th
19 Nov
The Global Carbon cycle - II
12
CM

28
Fm
20 Nov
The Global Nitrogen cycle
12
CM

29
Sa
21 Nov
*** First Draft Revised ***
CM

30
Su
22 Nov
The Global Phosphorus cycle
12
KCR

31
Mo
23 Nov
HOLIDAY: Thanksgiving (no class)
-

32
Tu
24 Nov
The Global Sulfur cycle
13
BG

33
We
25 Nov
Student Presentations
-

34
Th
26 Nov
Student Presentations-I
(ALL)

35
Fm
27 Nov
Student Presentations-II, course evaluations
(ALL)

36
Sa
28 Nov
*** Final Draft Due ***
(ALL)

10
Mo
4 Dec
FINAL EXAM: 11:50 to 1:50

Class: Tuesday & Thursday, 12:00 - 1:15 pm, MSB 307

Instructors: Kathleen Ruttenberg, Frank Sansone, Chris Measures, Brian Glazer

Office Hours: 1:30-2:30 after lectures

Course Coordinator: Kathleen Ruttenberg, MSB 222, x69371, kcr@soest.hawaii.edu

Teaching Assistant: N.A.


Final grade: Mid-term exam (30%); final exam (30%); class project (term paper, oral presentation) (30%); homework assignments and class participation (20%)

OCN 401 - STUDENT LEARNING OUTCOMES

Upon successful completion of the course, students are expected to be able to:
1) Explain the underlying principles of biogeochemical cycling in aquatic and terrestrial systems.
2) Identify the major global pathways of bioactive elements, and the ways human activities affect these pathways.
3) Use written and oral communication to clearly explain biogeochemical phenomena and related contemporary research.
4) Achieve facility using electronic resources (e.g. online journals, electronic searches for science references) to develop a bibliography for a research area.

Homework

i) Mini-essays (2) — writing mechanics (1.5 pp)

ii) Extended essay — critically review literature on a technical subject, organize arguments (3 pp)

Term paper and presentation — synthesize skill sets emphasized in homework categories (i) and (ii)
Term Project

Products:
- Term paper (70% of term project grade)
- Oral presentation (30% of term project grade)

Component parts of project:
- Choose a topic (get instructor’s OK)
- Mini-presentation of topic (1 to 3 slides / 2 minutes)
- Detailed, annotated outline for term paper; peer review
- Submit a complete draft of your term paper for instructor comments
- Submit corrected final draft of term paper
- In-class oral presentation of papers with peer review

Term Project Due Dates

Due dates are FIRM. Late assignments will be docked points (10% per day). See me in advance if you are unable to meet deadlines to arrange extension. Extensions will be granted only for emergency situations.

<table>
<thead>
<tr>
<th>Date</th>
<th>Assignment</th>
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</thead>
<tbody>
<tr>
<td>10/10</td>
<td>Term project topic due</td>
</tr>
<tr>
<td>10/17</td>
<td>Mini-presentations of topics</td>
</tr>
<tr>
<td>10/24</td>
<td>Outline due</td>
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<td>10/29</td>
<td>Outline peer reviews due</td>
</tr>
<tr>
<td>11/5</td>
<td>Final Outline due</td>
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<tr>
<td>11/19</td>
<td>1st draft of paper due</td>
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<tr>
<td>12/3</td>
<td>1st draft returned</td>
</tr>
<tr>
<td>12/12</td>
<td>Final paper due</td>
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<tr>
<td>12/10</td>
<td>Oral presentations</td>
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<tr>
<td>12/12</td>
<td>Oral presentations</td>
</tr>
</tbody>
</table>
## Past Term Paper Topics

(Note: These examples cannot be used this year)

### 2012

- Increase in nutrient loads and how that affects corals
- Arsenic in the marine environment
- Biochar, a way to improve soil quality and plant productivity
- Methane formation and oxidation in continental margin sediments
- Increasing CO$_2$ and the affect on trees
- Changes in calcification rates of marine invertebrates in response to increased atmospheric CO$_2$
- Urban runoff effects on microbial communities in receiving bodies
- Physical enrichment of nutrient uptake in corals
- How the hydrological cycle of wetlands affects the release of greenhouse gases
- Tracer transport in oceanic crust on the Juan de Fuca Ridge

### 2012 (cont’d.)

- Consequences of carbon enrichment on nitrogen biogeochemistry in subtropical oceans
- Carbon budgets in estuaries
- From Mississippi to the Gulf of Mexico: Runoff, leaching and the dead zone
- Origination of sequestered carbon in northern cryosphere and potential releases
- Anthropogenic influences on silicate weathering rates in river basins and the implications for atmospheric CO$_2$ concentrations
- Environmental impacts of a geothermal power plant
- Soil development in the North American Prairies in the last 100 years
- Precambrian stromatolite formations: Biogeochemical processes of early archaic life forms
- Carbon cycle in coastal upwelling regions
- The biochemical effects on chalcopyrite leaching
- Diapycnal and isopycnal mixing
2011

• Arctic sea ice: Adaptations and ecological ramifications.
• Delivery of anthropogenic nitrogen to the coastal ecosystem on basaltic shorelines by submarine groundwater discharge.
• Biochar double whammy: Carbon sequestration and increased food production.
• Methane formation and oxidation in continental margin sediments.
• Sediment redox chemistry in mangrove forests: He’eia Fishpond as a case study.
• Soil acidity and agricultural productivity of oxisols and ultisols in the tropics.

2010

• Environmental and biogeochemical changes associated with the evolution of eukaryotes.
• Spatial and temporal variability of the biogeochemical response to storm runoff in southern Kaneohe Bay, Oahu, Hawai’i.
• Lake Kivu: Catastrophe or gift of energy?
• Methane hydrates: Formation, stability, and effects on global climate.
• Effects on coral growth due to increased atmospheric CO$_2$.
• Mercury methylation in the marine environment.
• The effects of ocean acidification on the benthos.
• The generation, migration and climatic effects of coastal methane seeps.
• Oxygen minimum zones: Understanding the global biogeochemical characteristics of OMZs.
• The formation of biogenically derived marine aerosols, air-sea transport, and ecological effects.
• Factors influencing organic carbon sequestration in marine environments.
• The role of submarine groundwater discharge in coastal nutrient dynamics.
• Dammed nations, or damned ocean? The effect of dams on the coastal zone.
• Carbon capture and sequestration: Deep-sea CO$_2$ injection.
<table>
<thead>
<tr>
<th>Year</th>
<th>Topics</th>
</tr>
</thead>
</table>
| 2009 | Agricultural soil erosion: Carbon sink or source?  
• Beachrock: Evidence of shoreline change.  
• Bioaccumulation of toxic metals in fresh water and coastal marine systems: Arsenic, mercury and lead.  
• Effect of agriculture on nutrient loading in the Mississippi River: The Gulf of Mexico Dead Zone.  
• Forest fires and nutrient cycling.  
• New hypoxic zone: A comparison with other dead zones and implications of ocean current changes in the northwest Pacific Ocean.  
• Nutrient cycling within subsurface chlorophyll maximum and plankton thin layers.  
• Carbon sequestration: A comparison between biological and geological approaches.  
• Air pollution and atmospheric deposition in Istanbul.  
• Nitrogen fixation in the North Pacific Ocean.  
• Effects of submarine groundwater discharge on nutrient cycling and ecosystems. |
| 2008 | Sediment transport in coastal areas  
• As cycling in marine environments  
• Nutrient supply in Pacific versus Atlantic eddies  
• Biogeochemical interactions between the benthos & sediments  
• CO₂ sequestration in deep sea, acidification effects  
• Estuarine nitrification & denitrification  
• Nutrient uptake ratios & phytoplankton selection  
• Biogeochemical changes during PETM  
• Environmental causes of ciguatera outbreaks  
• Role of nutrients in HABs  
• CH₄ production in natural systems  
• Eutrophication: causes & oyster remediation  
• Anoxic conditions related to nutrient input |
Exams

There will be a 75-minute mid-term exam on October 15 and a 2-hour final exam on December 19. The final exam will cover all of the semester’s course material. Exams will cover the readings, lectures, and topics discussed in class.

Exams will be open book. Please bring a calculator.

Copies of previous exams can be examined in the Oceanography Office (MSB 205); these can give you an idea of the types of questions to be expected. However, it is very unlikely that any exam questions will be repeated!

No absences are allowed from any exam, except under circumstances totally beyond your control. Except for medical emergencies, excuses must be submitted and approved before the day of the exam.

Writing Rubric for Mini-Essays
## Mini-Essay Grading Template

<table>
<thead>
<tr>
<th>% of Grade</th>
<th>Category</th>
<th>Criteria</th>
<th>possible points</th>
<th>actual earned points</th>
</tr>
</thead>
</table>
| 25         | Content  | • central focus is on assigned topic, which is clearly stated in 1st paragraph  
• coverage of topic is sufficient to make a well-rounded essay  
• facts reported are accurate | 10              | 10                   |
|            | supermarkets        |                                                                          |                 |                      |
| 30         | Organization | • Each paragraph has a clear topic sentence  
• Ideas are ordered logically  
• Transitions from paragraph to paragraph are explicitly made | 10              | 10                   |
| 30         | Structure and Style | • Paragraph length is balanced  
• Word choice is appropriate  
• Writing is interesting, varied  
• Sentences and paragraphs are cohesive  
• synthesis of information is seamless | 5               | 5                    |
| 15         | Mechanics | • correct grammar is used  
• spelling is error-free  
• writer followed instructions* | 7               | 6                    |
| 100        | Total Points |                                                                          | 100             |                      |

* Typed in correct font size, double-spaced, page limit for essay.