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

Course Goals (SLOs)

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.
Course Informational Resources

1. Syllabus with important due dates highlighted
2. Course Info Sheet – your ‘go to’ for ‘how to’
3. Professor Office Hours (by appointment)
4. Writing Assistance.
   - Manoa Writing Center
   - Course hand-outs
   - Meet with professors

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%
Lecture

• Important to grasp the overview; understand but (no need to memorize)

• Almost without exception, very specific examples are given from the literature.

• Subsections generally begin with an overview, and build from the general to the specific

• Read chapter before class

• Important to grasp the overview; understand but (no need to memorize specific examples.)
### Homework

i) Mini-essays (2) → writing mechanics (2-3 pp)

ii) Extended essay → critically review literature on a technical subject, organize arguments (3-5 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 (*must get instructor’s approval*)
- Mini-presentation of topic (1 to 2 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 paper 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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<tbody>
<tr>
<td>10/13</td>
<td>Term project topic due</td>
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<tr>
<td>10/15</td>
<td>Mini-presentations of topics</td>
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<tr>
<td>10/22</td>
<td>Outline due</td>
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<td>10/27</td>
<td>Outline peer reviews due</td>
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<td>11/3</td>
<td>Final Outline due</td>
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<td>11/24</td>
<td>1st draft of paper due</td>
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<td>12/1</td>
<td>1st draft returned</td>
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<td>12/3</td>
<td>Oral presentations</td>
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<td>Meet with KCR to discuss paper revisions</td>
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<tr>
<td>12/8</td>
<td>Oral presentations</td>
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<tr>
<td>12/10</td>
<td>Oral presentations</td>
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<tr>
<td>12/10</td>
<td>Final paper due</td>
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Past Term Paper Topics

(Note: These examples cannot be used this year)

2014

- El niño southern oscillation and subsequent effects on weathering and nutrient distributions along the eastern pacific
- Effects of anthropogenically induced change on salt marsh ecosystems in California
- Acid rain: effects on lake and terrestrial ecosystems
- Sedimentation on coral reefs: A comparison of reefs in the Hawaiian islands and Puerto Rico
- An analysis of the physical and biogeochemical impacts of Heinrich events
- Influence of jellyfish blooms on nutrient cycles
- Redox regime of biogeochemical successions in he'eia fishpond
- Future changes in oceanic dissolved oxygen concentrations
Past Term Paper Topics

(Note: These examples cannot be used this year)

2014 (cont’d)

• High Temperature Geothermal Sources of Hawaii and New Zealand: Water Chemistry and Associated Microbial Communities
• Picoplankton Photoheterotrophic Production in the Subtropical North Pacific Ocean
• Methane Hydrates: Formation, Distribution and Potential Effects on Climate
• The Effects of Urban Runoff on Coral Communities

Past Term Paper Topics

2013

• Biochar Addition and Greenhouse Gas Emissions from Soil
• The Sulfur Cycle in Marine Environments
• Oceanic anoxic events of the Cretaceous Period Methane formation and oxidation in continental margin sediments
• Impacts of Land Use on Coastal pH
• Contrasting the Impact of Ocean Acidification on Coral Reef Organisms vs. Sea Anemones
• The Roles of Macro-scale, Meso-Scale, and Micro-scale fauna and flora in soil formation and carbon cycling
• How Did Coral Reefs Affect CO₂ Levels During Deglaciation?
• Paleoclimate Reconstruction with Coccolith Vital Effects
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 CO₂.
- 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 CO₂ injection.
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 13 and a 2-hour final exam on December 15. 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.

Mini-Essay #1 Assignment Sheet

Overview of assignment:

Read the assigned article: Iron Toxicity for cyanobacteria delayed oxygen accumulation in early Earth’s atmosphere (Science Daily, 6/1/15), and write a 2 to 3 page Mini-Essay on some aspect of the article. The objective of this writing assignment is to employ excellent writing mechanics and style, and to compose a brief, easily readable essay.

Assignment Due Date: September 1 (Tuesday)

Instructions:

1. Read over the Mini-Essay writing rubric to familiarize yourself with the criteria that will be used to evaluate the essay.
2. Read over the Mini-Essay grading template to see how points will be distributed among the different assessment criteria.
3. Read the assigned article and compose a mini-essay on some aspect of the article. The essay need not be a strict summary of the article – feel free to take literary license, as long as your essay is well written.
4. You must use 11 pt (PC) or 12 pt (Mac) font.
5. Text must be double-spaced.
6. You must number the pages.
7. Give your essay a title, and put your name, the date, the assignment type and the course # in the header.
8. You must underline the topic sentence of EACH paragraph.
9. You must not exceed the page limit!
## Writing Rubric for Mini-Essays

### Content:
- Is the topic adequately summarized and discussed?
- Are the facts reported accurately?
- Are the ideas and concepts presented clearly described and articulated?

### Organization:
- Is the essay topic and/or objective clearly stated in the 1st paragraph?
- Does each paragraph have a topic sentence?
- Are ideas ordered logically, so that the thread of the essay is clear and easy to follow?
- Are transitions made between sentences/ideas within paragraphs, and between paragraphs?

### Structure and Style:
- Are paragraphs the right length (not too long or too short)?
- Is appropriate word choice used?
- Are sentences and words varied to make the writing interesting?
- Is the writing style clear? Are sentences & paragraphs cohesive?

### Mechanics:
- Are there grammatical or spelling problems?

## Mini-Essay Grading Template

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<th>Student:</th>
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<tr>
<td>% of Grade</td>
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<td>Category</td>
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<td>30</td>
<td>Structure and Style</td>
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<tr>
<td>15</td>
<td>Mechanics</td>
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Total Points: 100

* Typed in correct font size, double-spaced, page limit for essay.
GES Capstone Course: Global Cycles and Underlying Processes

• Utilize the knowledge base you have built over the past semesters as a GES student

• Apply this knowledge to the understanding of biogeochemical processes in different Earth environments

• End with synthesizing into an overview of global cycles of elements, emphasizing processes and coupled cycles

• Venture into discussions of extrapolating knowledge of current Earth biogeochemical cycles to the Earth’s past and future