**Introduction**

*(Welcome!)*

**OCN 623 – Chemical Oceanography**

Drop deadline is January 17

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**Course Philosophy**

Every oceanographer needs to have a basic understanding of all of the disciplines of oceanography. This is not just because we desire to turn out well rounded oceanographers -- it is extremely important to your career.

Like any science, the most interesting discoveries are often waiting to be made at the interface between disciplines; it is the application of knowledge in one area to problems in another that leads to fundamental improvements in our understanding.

Further, "skills" from one branch of oceanography can frequently be useful to research efforts in the other branches.

Finally, all of us need to know enough about the other fields of oceanography so that we are literate in them and are thus capable of understanding the literature in those areas and able to talk other researchers.
Each of the other oceanographic sub-disciplines interact with chemical oceanography:

- **Physical oceanography** uses the chemical parameters provided by chemical oceanography to provide constraints on the origin and circulation of the water masses.

- **Geological oceanography** and chemical oceanography are related through both the chemical cycles and the interaction between rocks and water in the weathering cycle at both high and low temperature.

- **Biological oceanography** is highly affected by the chemical dependency of organisms and the inverse, their effect on the distribution of chemicals.

Therefore, upon successful completion of this course, students are expected to be able to:

- Explain the underlying principles of chemical and biogeochemical cycling in marine systems;

- Identify marine chemical and biogeochemical processes that impact the students’ areas of oceanographic interest, and know how to access and understand information on these processes;

- Use written and oral communication to clearly explain marine chemical and biogeochemical processes and related contemporary research.
Biogeochemical transformations – These lectures will demonstrate the fundamental processes (input, removal and recycling) that govern the behavior of chemicals in sea water. We will look at:

- The nature and reactivity of gases, organic compounds, nutrients, trace metals and stable and radio-isotopes
- The distributions of these chemicals, which will help us understand the processes that produce them
- The sinks of chemical materials in the oceans
- The biogeochemical processes that occur in estuaries, and the role that these processes have in modifying the fluxes of materials from the continents to the oceans
- The ocean-atmosphere interactions and the importance of the sea-surface microlayer
- The feedback mechanisms that exist between the oceans and atmosphere
- The importance of these feedbacks to global climate and the evolution of the chemical cycles
- The role that these cycles have played in maintaining the temperature and conditions at the surface of the Earth over geologic time
- Lessons that can be learned from the fossil record of these cycles in terms of predicting the future climatic consequences of anthropogenic activity
<table>
<thead>
<tr>
<th>Date</th>
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<th>Reading</th>
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<tr>
<td>10-Jan</td>
<td>Introduction to course</td>
<td>syllabus</td>
<td>BG</td>
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<tr>
<td>12-Jan</td>
<td>Balancing reaction equations, oxidation state, redox reactions</td>
<td>Handout</td>
<td>CM</td>
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<tr>
<td>17-Jan</td>
<td>Gibbs Free Energy and chemical equilibrium</td>
<td>L ch 7</td>
<td>CM</td>
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<td>19-Jan</td>
<td>Redox and pH-pH diagrams</td>
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<td>CM</td>
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<tr>
<td>24-Jan</td>
<td>ion speciation</td>
<td>L ch 5, 2, 3, 4</td>
<td>CM</td>
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<tr>
<td>31-Jan</td>
<td>Geochemical differentiation of the earth and origin of the oceans</td>
<td>Handout</td>
<td>MM</td>
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<tr>
<td>2-Feb</td>
<td>Geochemical reservoirs and transfer processes</td>
<td>L ch 21</td>
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<td>7-Feb</td>
<td>Dissolved gases other than carbon dioxide in sea water</td>
<td>L ch 6 (1st half)</td>
<td>FS</td>
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<td>9-Feb</td>
<td>Carbon dioxide, alkalinity and pH</td>
<td>L ch 15</td>
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<tr>
<td>14-Feb</td>
<td>Nutrients; Aerobic carbon production and consumption</td>
<td>L ch 9 &amp; 9</td>
<td>BG</td>
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<td>16-Feb</td>
<td>Aerobic to anaerobic diagenesis in sediments</td>
<td>L ch 12</td>
<td>BG</td>
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<td>21-Feb</td>
<td>Fluxes from high temperature reactions along the mid-ocean ridge axis</td>
<td>L ch 19</td>
<td>MM</td>
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<tr>
<td>23-Feb</td>
<td>Fluxes from diagenesis deep in sediments and basement</td>
<td>Handout</td>
<td>NA</td>
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<td>28-Feb</td>
<td>*** Mid-Term Exam (includes Jan 12 - Feb 23 lectures, readings, etc.) ***</td>
<td>Handout</td>
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<tr>
<td>1-Mar</td>
<td>Biogenic production, carbonate saturation and sediment distributions</td>
<td>L ch 15 &amp; 16</td>
<td>BG</td>
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<td>6-Mar</td>
<td>Organic compounds in sea water</td>
<td>L ch 22, 23</td>
<td>BG</td>
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<td>8-Mar</td>
<td>Estuaries: classification and mixing processes</td>
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<td>H</td>
<td>BG</td>
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<tr>
<td>13-Mar</td>
<td>Trace elements in sea water - I</td>
<td>L ch 11</td>
<td>CM</td>
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<tr>
<td>15-Mar</td>
<td>Trace elements in sea water - II</td>
<td>Handout</td>
<td>CM</td>
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<td>20-Mar</td>
<td>Oceanic water mass tracers</td>
<td>L ch 10 &amp; 24</td>
<td>DH</td>
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<td>22-Mar</td>
<td>Stable isotopic tracers</td>
<td>Handout</td>
<td>DH</td>
<td>First draft of term papers due</td>
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<td>27-Mar</td>
<td>Spring Break, No class</td>
<td>Handout</td>
<td>DH</td>
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<td>29-Mar</td>
<td>Spring Break, No class</td>
<td>Handout</td>
<td>DH</td>
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<td>3-Apr</td>
<td>Radio-isotopic tracers</td>
<td>Handout</td>
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<td>5-Apr</td>
<td>Air-sea exchange</td>
<td>L ch 6 (2nd half)</td>
<td>DH</td>
<td>Reviews of term papers due</td>
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<td>10-Apr</td>
<td>Atmosphere, the water cycle, and climate change</td>
<td>Handout</td>
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<tr>
<td>12-Apr</td>
<td>Ocean and climate change</td>
<td>L ch 25</td>
<td>FS</td>
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<td>17-Apr</td>
<td>Evolution of oceanic chemical cycles - I</td>
<td>Handout</td>
<td>H</td>
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<tr>
<td>19-Apr</td>
<td>Evolution of oceanic chemical cycles - II</td>
<td>Handout</td>
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<td>24-Apr</td>
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<td>FS/Handout</td>
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<td>26-Apr</td>
<td>Student presentations - I</td>
<td>all</td>
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<tr>
<td>1-May</td>
<td>Student presentations - II</td>
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<td>3-May</td>
<td>Final Study Period</td>
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<tr>
<td>5-May</td>
<td>Final Exam Week</td>
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**Class:** Tuesday & Thursday, 10:30 - 11:45 am, MSB 315

**Course Coordinator:** Chris Measures, MSB 512, 6-8693, chrism@soest.hawaii.edu

Office hours: 12-1 pm on days he lectures; call to make appointments for other times

**Instructors:** Chris Measures, Frank Sansone, Brian Glazer, David Ho, Mike Mottl, Kristen Fogaren (TA)

**Readings:** L = Libes, Marine Biogeochemistry, 2nd Ed. (course text); S = Snoeyink and Jenkins; H = Handout

**Final grade** = 25% final exam; 25% mid-term exam; 30% term paper, first draft, and oral presentation;

20% problem sets and class participation

**OCN 623 - STUDENT LEARNING OUTCOMES**

Upon successful completion of the course, students are expected to be able to:

1) Explain the underlying principles of chemical and biogeochemical cycling in marine systems;

2) Identify marine chemical and biogeochemical processes that impact the student's areas of oceanographic interest, and know how to access and understand information on these processes;

3) Use written and oral communication to clearly explain marine chemical and biogeochemical processes and related contemporary research.
**Homework:** The homework will give you a chance to develop chemical skills used in oceanography. Problems sets are due one week after they are assigned (e.g., homework assigned on Tuesday is due at the start of class on the following Tuesday). If homework is not handed in by the deadline, you will get a zero.

An optional homework discussion session will be run by the TA each week. Kristen will choose a day and time for this session at the beginning of the semester. The topics discussed will be determined by the questions of those attending each discussion session.

**Readings** are important! They are listed on the Course Outline. **DO** expect reading material to be covered on the exams, even if it isn’t specifically addressed in the lectures!!

**Lectures:** Nominally they are from 10:30 - 11:45, but realize that classroom discussion can cause the end of class to extend to 11:50 or, occasionally, 11:55. Please plan accordingly.

**Exams:** The mid-term and final exams will focus on the lectures from the first and second halves of the course, respectively, but not exclusively so: the use of knowledge gained in the first half of the course may be required to answer questions on the final exam. Both exams will be “open book” -- you can bring any written material you wish.

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**TERM PAPER INSTRUCTIONS**

Term Papers and Student Reports — Each student will be required to write a term paper on a topic of their choice, and to give an oral presentation based on the paper.

**Why a term paper??**

- Makes concepts covered in the course more "concrete"
- Opportunity to refine technical writing skills (esp. with detailed comments on first draft)
- Provides experience in finding chemical oceanographic info and references

**Topics:**

- You are free to choose a topic that interests you. They must be chosen by **February 9**.
- Must be a topic of current interest in Chemical Oceanography
- Unfortunately, research from Station ALOHA and HOT is basically "off-limits" -- due to the fact that all of the relevant papers are listed on the ALOHA/HOT web sites. (These convenient lists prevent you from showing that you can dig into the scientific literature and find relevant papers.)
- It can NOT be the primary topic of your thesis/dissertation research. (We hope that the term paper will be used to expand your scientific horizons.)
- Topics used in the past three years cannot be used
Objective
Provide a good review (at minimum) of a current topic of interest in the field of chemical oceanography

Guidelines
A good paper has two key points: good ideas and good writing
- Find references
- Take notes
- Organize topic/subtopics
- Incorporate class material
- Generate outline
- Write draft
- Revise paper
- Proof paper

Communicate efficiently and effectively

Requirements for the term paper:
- Papers should be printed double-spaced, 10 - 12 pages in length (not including figures or tables).
- The papers must have Abstract, Conclusions, and Reference sections.
- References must only be from the original (primary) scientific literature. Please, no textbooks or web pages!
- Each page should be numbered.
- You should strive to present a coherent story, hopefully interjected with novel observations and conclusions. We are looking for a synthesis/integration of information.
- Please use a spell-checker – they are a part of all word processors!

Two copies of the first draft are due March 22. (History has shown that students who turn in weak or incomplete first drafts rarely get good marks on the final version. Don’t let this happen to you!)

Peer reviews of papers:
- Each student will then be assigned a fellow student’s paper to anonymously review; Chris will also review each draft paper.
- Your review is due April 5.
- You will have until April 17 to revise your paper, trying to address the comments of the two reviews you received.
Grading of the term papers will be based on the following criteria:

- Comprehensive coverage of the topic, synthesis of the information presented and indication of critical thinking by the author
- Use of references, judged by quality and type (primary vs. secondary)
- Use of figures to illustrate ideas, judged by quality and appropriateness
- Written presentation, judged by writing skills, spelling, grammar, adherence to the rules

Grading of the presentations will be based on the following criteria:

- Quality and comprehensiveness of the material covered
- Organization of talk, including the quality of the conclusions given
- Quality and use of figures
- Keeping within the allotted time
- Quality of speaking style
- Participation in discussions
Name:  
Email:  
Office location:  
Phone:  

Degrees (& majors) earned:  

College-level chemistry courses taken:  

Current Grad Advisor:  

Current focus of study:  

Desired degree:  

OCN 623  
Biography  
2012