

Chemical Oceanography MSCI/GEOL 782

Instructor: Dr. Claudia Benitez-Nelson Email: cbnelson@geol.sc.edu
EWS 408/409 Phone: 777-0018
Office hours: W and Th 15:15 - 17:00 and by appointment

Class Schedule: Tues/Thurs from 9:30 to 10:45 in EWSC 604

Website: <http://blackboard.sc.edu/>

Text: *Chemical Oceanography* by Emerson and Hedges

Non-required, but useful texts:

Chemical Oceanography by Frank Millero

An Introduction to the Chemistry of the Sea by Michael Pilson

An Introduction to Marine Biogeochemistry by S. M. Libes

Marine Geochemistry, 2nd ed. by Chester

Readings from the literature and lecture notes (available on Blackboard)

Grading:	Homework (includes group discussions):	25 %
	Special topics paper and presentation:	25 %
	2 Midterms	30 %
	Final Exam	20 %

Course Description: Chemical oceanography is the study of everything having to do with the chemistry of the ocean and includes not only the distribution of elements and their isotopes, but also how these elements interact to provide important clues into how the oceans work. Studies in chemical oceanography span from global to microscopic lengths and cover minute to millennial timescales. The goal of this course is not to teach you everything there is to know about chemical oceanography (although I'll try), but rather to teach you how you can apply various chemical concepts to oceanographic questions.

Course Organization: This course will consist of 2 midterms and one final exam (that will cover all aspects of the class) and at least 5 problem sets including several group study/reading assignments. One special topics paper organized as an NSF type proposal (~ 10-15 pages) will be due at the end of the semester that focuses on a topic of your choosing (after discussion with CBN). You will be expected to give a 15 minute AGU style presentation on this topic to the rest of the class.

Lecture Notes: Prior to the start of each class, I will try to make the in class lecture notes available on the web. You should look at these AND the suggested pdf readings (see syllabus) BEFORE coming to class.

Learning outcomes: By the end of the semester it is anticipated that you will have learned the following:

- An understanding of the basic chemistry of the oceans with regards to pH, equilibrium, and kinetics.
- An understanding of the basic chemistry of the oceans and how saltwater differs from freshwater.
- Distribution of elements within the ocean and factors that effect that distribution ranging from gas exchange, to biological activity, to sedimentation.
- How to write a research proposal and defend those ideas in orally

Important Dates:

February	8	Tu	Approval of NSF Research Topic after discussion w/CBN
	10	Th	Exam #1
March	8	Tu	Spring Break, No classes
	10	Th	Spring Break, No classes
	24	Th	Exam #2
April	1	Fri	April Fools Day
	14	Th	NSF Style Proposal Due
	15	Fri	Taxes Due
	19	Tu	Student Presentations
	21	Th	Student Presentations
	22	Fri	Earth Day
May	02	Mon	2 pm Final Exam

Class Lecture Schedule 2011

- Introduction, Why the Oceans look they way to do.
 Properties of Seawater
 Salinity/Major Ions
 Concept of Residence Time
Readings: Introduction to Chemical Oceanography (pdf)
Major Ions & Conservative Elements in Seawater (pdf)
What Controls the Composition of River Water and Seawater (pdf)
Properties of water and seawater (pdf)
Temperature, Salinity, Density and Ocean Circulation (pdf)
Chapter 1 Emerson and Hedges
- Review of Important Concepts in Chemistry
 Radioactivity
 Chemical Equilibrium & the concept of Activity
 Acid-Base Reactions
Readings: Radionuclides (first section of pdf)
Chemical Equilibrium and Solution Chemistry (pdf)
Ion-ion interactions, Activity Scales and Activity Corrections (pdf)
Acids and Bases, Ocean Carbonate System (pdf)
Chapters 3-5 Emerson and Hedges
- Atmosphere/Ocean Boundary
 Gas Exchange
 Solubility
 Gases as tracers
Readings: Gases and Gas Exchange (pdf)
Chapter 10 Emerson and Hedges

- Biology (review) and Chemistry together
 - Stoichiometry
 - Nutrient Cycles
 - Limiting Nutrients and Trace Elements

Readings: Life in the Ocean – Primary Productivity and Respiration (pdf)
The Biological Carbon Pump (pdf)
Trace Elements in Seawater (pdf)
Chapter 6 Emerson and Hedges

- Carbonate Chemistry and Buffering
 - Alkalinity, Dissolved Inorganic C (DIC)
 - Ocean Acidification

Readings: Acids and Bases, Ocean Carbonate System (pdf)
Chapter 4 Emerson and Hedges

- Particle Production and Export
 - Particle formation and attenuation
 - Measurement technique: Sediment Traps, U-Th

Readings: Mass Balance and Box models (pdf)
Radionuclides (pdf)
Chapter 2 Emerson and Hedges

- Organic Matter in the Ocean
 - Composition
 - Biomarkers
 - Age

Readings: Dissolved Organic Matter (pdf)
Chapter 8 Emerson and Hedges

- Hydrothermal Vents
 - Tracers
 - Impact on SW Chemistry

Readings: Hydrothermal Vents & Circulation (pdf)
Chapter 2 Emerson and Hedges

- Marine Sediments
 - Composition
 - Tracers of sediment accumulation and mixing

Readings: Redox Chemistry (pdf)
Marine Sediments (pdf)
Chapter 12 Emerson and Hedges

- Carbon-14

Readings: Paleoceanography and Paleoclimatology (pdf)
Chapter 7 Emerson and Hedges