

Physical Oceanography

Biology 610

Spring 2016

Lecture GML 202: M&W: 09:00-10:15

Laboratory GML 202 and/or 113: M&W 10:30-13:30

Instructor: Dr. Jack DiTullio: GML, Rm. 204; phone: 953-9196 (ditullioj@cofc.edu)

[Office hours: M&W 14:00 – 15:00 and by appointment]

This schedule is a general outline of the material that will be discussed each day. Please note, however, we will probably deviate from it somewhat as the course progresses. The outline is simply meant to be an overview of the topics to be discussed in roughly the order they will be covered. Some topics may take more or less time than listed.

	<u>Date</u>	<u>Topic</u>
Jan	11 M	Introduction, Origin of Universe, Earth & Oceans
	13 W	Marine Geophysics: Plate Tectonics/Sea Floor Spreading
	18 M	No Class—MLK Day
	20 W	Marine Geology/Plate Boundaries
	25 M	Marine Geology: Deep Sea Sediments
	27 W	Chemical/Physical Oceanography: Properties of H ₂ O, salinity, density
Feb		
	01 M	Chemical Oceanography: Global and Marine Carbon Cycles
	03 W	Chemical Oceanography: Marine Nutrient Cycles
	08 M	Meteorology; Gradient and Geostrophic Wind Systems
	10 W	Heat Budget, Hydrologic Cycle, Atmospheric-Oceanic Coupling
	15 M	EXAM I
	17 W	Sea Surface Temp and Salinity, Surface Currents & Circulation, Fronts
	22 M	Thermohaline circulation (Deep Ocean Circulation)
	24 W	Equations of motion, Continuity, Coriolis Force
	29 M	Hydrostatic Equation, Geostrophic Currents, Two-layer Ocean
Mar		
	02 W	Geostrophic Eddies, Sea Surface Dynamic Topographies
	07 M	Spring Break
	09 W	Spring Break
	14 M	Friction, Viscosity, Wind Stress, Turbulence
	16 W	Ekman Currents, Geostrophic Subtropical Gyres,
	21 M	Vorticity, Westward Intensification of Boundary Currents
	23 W	Coastal Upwelling
	28 M	EXAM II
	30 W	Waves, Internal Waves, Tsunamis

Apr

04 M	Tides & Tide Generating Forces
06 W	Estuaries, Coastal Oceanographic Processes
11 M	Equatorial Circulation
13 W	El-Nino Southern Oscillation (ENSO), Planetary Waves
18 M	Long-term Oceanic Oscillations and Teleconnections
20 W	Biogeochemical Cycles and Climate Change in the Oceans
25 M	FINAL EXAM

Texts: There is no one textbook required for the course as we will cover material from many different sources. A good general physical oceanographic textbook is *Descriptive Physical Oceanography*, Talley et al., 6th edition, 2011, ISBN: 978-0-7506-4552-2. In addition, a good general introductory textbook on Oceanography is also recommended such as *Introduction to Ocean Sciences*, 2007, Douglas Segar, 2nd edition. ISBN-13: 978-0-393-92629-3 or the 3rd edition which is available for **FREE** online: <http://reefimages.com/oceans/oceans.html> There is a link for user donations. Please contribute (e.g. a couple of dollars) to help cover the labor and editorial costs that make this resource available. I believe Dr. Segar has also updated the link so that you can highlight and make notes on the pdf using Adobe Pro. Any other general introductory ocean sciences textbook can be substituted for this text as well. While we will cover some basic oceanographic principles in class, because of time constraints you will be expected to cover some of the general oceanographic knowledge found in those introductory textbooks on your own. The Open University (Pergamon Press) also has a very good set of paperback books on various oceanographic topics including *Ocean Circulation*. In addition, another good dynamical PO book that is recommended is *Introduction to Physical Oceanography* by John A. Knauss, 2005, ISBN: 1-57766-429-9. Finally please see the on-line text *Introduction to Physical Oceanography* textbook by Robert Stewart at the following link: http://oceanworld.tamu.edu/home/course_book.htm

Course Objective: To introduce students to multi-disciplinary marine sciences specifically focusing on geological, chemical and physical oceanographic concepts and principles. The main emphasis of the course will be on physical forces in the ocean, especially those forces that drive ocean currents. The student will be expected to understand concepts relating to atmospheric-oceanic coupling, planetary forces, fluid dynamics and wind-driven and thermohaline circulation. Coastal processes including estuaries, tidal influences, wave dynamics, and coastal upwelling will also be covered.

Policies and Requirements: This course will be conducted strictly in accordance with the honor system of the College of Charleston (<http://www.cofc.edu/studentaffairs/HonorBoard.htm>). All work that you turn in for this course (whether for a paper, exam or quiz) must be your own, and have not been used, partially or totally, to fulfill requirements for other classes. Any form of plagiarism (intentional and unintentional), cheating, or presenting someone else's work as one's own will be treated as a serious academic transgression and will be communicated accordingly by the instructor as an honor code violation to the Division of Student Affairs.

All activities performed as part of the BIOL 610 Laboratory in room GML 113 will fall under the College of Charleston Safety Policies and Procedures (Full version has been handed to you with this syllabus, please read them carefully).

According to this college-wide policy: *“Students dismissed from a teaching lab due to violations of the safety procedures will not be allowed to re-enter the laboratory until authorized to do so by their supervisor (instructor). Any course work missed because of a violation of these guidelines cannot be made up at another time (or by an extension of the lab period) and will be treated as an unexcused absence”*

1. You are responsible for knowing the biological, chemical, electrical, ergonomic, mechanical, and physical hazards associated with the equipment and materials that are being utilized in the laboratory. Listen to all instructions and ask questions about that which you do not understand.
2. Know the location of safety equipment: telephones, emergency shower, eyewash, fire extinguisher, fire alarm pull.
3. Know the appropriate emergency response procedures. If there is an injury or emergency, call 953-5611.
4. Do not work alone in the laboratory if you are working with hazardous materials or equipment.
5. Use hazardous chemicals, equipment, and biological agents only as directed and for their intended purpose.
6. Do not engage in horseplay, pranks or other acts of mischief while in lab.
7. Drinking, eating, and application of cosmetics is forbidden in laboratories where chemicals or biohazards are present. Smoking is forbidden in all College buildings.
8. Appropriate personal protective equipment shall be worn. The dress code for laboratory work when using chemicals, biological or physical hazards, or when instructed to do so by the laboratory supervisor is as follows:
 - a) Wear safety glasses or goggles at all times.
 - b) No exposed skin on arms, legs or torso.
 - c) Wear lab coats or other approved protective garments.
 - d) Wear gloves or other personal protective equipment (PPE) as directed by the instructor or mandated by prudent practices based on the chemicals being handled. If in doubt, wear appropriate gloves. Latex is not permitted. Avoid cross-contamination.
 - e) Remove PPE (gloves and lab coat) when exiting the laboratory.
 - f) Wash your hands, even if gloves were used, before leaving a lab where you did any lab work.
 - g) Closed toe shoes are required. The heel and top of foot must be covered. High heeled shoes, sandals, and perforated shoes are not permitted.
 - h) Confine long hair and loose clothing.
9. Inspect equipment or apparatus for damage before adding chemical reagents or biological samples or energizing electrical equipment. Do not use damaged equipment.
10. Never remove chemicals, biological samples, or laboratory equipment from a lab without proper authorization.
11. Presume that all chemicals and biological samples used in the laboratory are hazardous for you and the environment, unless instructed otherwise.
12. Never leave an experiment unattended unless proper safety precautions are in place.

13. Read all labels on chemicals twice before using them in the lab. Read all instructions twice for the operation of any equipment or machinery.
14. Properly and safely dispose of all waste materials.
15. Treat sharps and broken glassware containers carefully.
 - a) Broken glass should be disposed of in properly marked safety containers. All sharps (needles, razor blades, etc.) used for any purpose must be disposed of in specially labeled SHARPS containers.
 - b) Do not place contaminated glass in the broken glassware container. Consult your supervisor.
 - c) Waste chemicals and contaminated PPE should be discarded as directed.
16. When using a reagent, replace the lid immediately. Never return unused reagents to stock bottles. Take only the amount needed for your experiment.
17. All chemicals and biological samples/media are to be disposed of in appropriately labeled containers. Specific instructions for each material will be provided. Pay attention to waste container labels before adding the material to be discarded.
18. Use good personal hygiene. Keep your hands and face clean. Wash hands thoroughly with soap and water after handling any chemical or biological agent.
19. Keep the work area clean and uncluttered with chemicals and equipment. Clean up the work area on completion of an operation or an experiment. Before leaving the laboratory, you are responsible for making sure your lab area is clean and organized.
20. Never store a chemical or biological specimen in an unlabeled container.
20. Always have your College of Charleston identification and insurance information with you when working in a laboratory. MedicAlert identification must be worn if you have any potential life-threatening chemical sensitivities or medical conditions.
21. Report any accident or injury, however minor, to your teaching assistant, instructor, or lab supervisor immediately. An accident report form must be completed and forwarded to the department chair, dean, and to the Director of Environmental Health and Safety.

Laboratories: The laboratory portion of the course will include problem sets, chemical lab analyses and some computer analyses. The labs will be held in either the classroom (Rm. #202) or in Rm. # 113. The laboratories will consist of chemical analyses, journal discussions, debates, demonstrations as well as hands-on experiments. Various homework assignments will count toward the lab grade. Problem sets will be assigned for some of the labs and lab write-ups will be required for all. Students will also be required to pass a short course on small boat handling as part of their lab grade. Two harbor samplings on a small boat and a 3 hr harbor cruise aboard the R/V *Silver Crescent* on March 28 and 30, 2016 will be conducted to collect physical and chemical oceanographic data using a CTD (conductivity –temperature-depth) system. Note that all boating operations are weather dependent. More information on cruise specifics will be given the week before the lab. In addition, each student will be required to present a power point-presentation (15 min) on the variability of physical oceanic properties in a certain oceanographic province using various oceanic databases (e.g. Ocean Data View, ARGOS floats etc.). These presentations will be done on the last week of classes (April 18/20). The ODV program can be found on the computers in the GML computer lab. You can download the program onto your laptops using the following link: <http://odv.awi.de/en/software/download/>

Please note that the topic of your presentation must be submitted before spring break. A written report of the presentation and harbor sampling lab must be submitted on or before April 21st.

Grades: Final grades will be determined using the following format:

Exam I-----	20%
Exam II-----	20%
Final Exam-----	25%
Labs-----	15%
Presentations-----	10%
Problem Sets-----	10%

Exams will cover all assigned readings as well as lecture material. Exams will consist of mostly essay type questions and a few problems. The final exam will be a cumulative exam but the emphasis will be on the last third of the semester. Note that class attendance is strongly advised as many lectures will include material taken from various textbooks. Grades will be determined according to the following scale:

A	=	91-100
B+	=	86-90
B	=	81-85
C+	=	76-80
C	=	65-75
F	=	0-64

Oceanography Lab

Biology 610, Spring 2016

Teaching Assistant: Rachel Grey (greyr@g.cofc.edu)

Oceanography labs will meet on Mondays and Wednesdays in GML Rm #202. On some labs we will go over to GML Rm. # 113 or possibly to HML Rm # D109.

Some problem sets will be assigned during the course and will contribute to your overall lab grade. Lab reports must be turned in the following week unless otherwise noted. Late lab reports will be penalized 10% per day. Individual power point presentations and a write up will be worth a total of 10% of the final grade. More information on the power point presentation will be provided in lab class. Journal article discussions will periodically be assigned and each student is expected to lead a discussion. A class debate on climate change and geoengineering will be held and all students will be required to read the paperback book *Fixing Climate* by Wallace S. Broecker and Robert Kunzig (2008), ISBN: 978-08090-4502-0. Further details on the class debate will be provided during one of the first lab periods.

<u>Date</u>	<u>Topic</u>
Jan	
11/13	Lab Intro; Bathymetry and contouring/Plate tectonics assignment
18/20	No Labs---MLK
25/27	Plate tectonic presentations +journal discussion (JD)
Feb	
01/03	Total CO ₂ , Alkalinity & the Carbonate Buffering System in Seawater
08/10	Measurement of the Primary Nutrients in Seawater + JD
15/17	Charleston Harbor Sampling on R/V <i>Chamberlain</i>
22/24	Spectrophotometric and Fluorometric Pigment Analyses +JD
29/02	Light and Sound in the Sea +JD
Mar	
07/09	No Labs --- Spring Break
14/16	Charleston Harbor Sampling on R/V <i>Chamberlain</i>
21/23	Ocean Fluid Dynamics--- Taylor Columns and Eddies +JD
28/30	Charleston Harbor Cruise aboard R/V <i>Silver Crescent</i>
Apr	
04/06	Charleston Harbor Sample Analyses
11/13	Class Climate Debate +JD
18/20	Class Presentations ----- Regional Oceanography
21	Papers Due