

# Physical Oceanography

## Biology 610

### Fall, 2020

Lecture: Via Zoom and/or GML 202: M&W: 09:30-11:30  
 Laboratory: Via Zoom and/or GML 202/113: M&T 14:00-17:00  
 Instructor: Dr. Jack DiTullio: GML, Rm. 204; phone: 953-9196 (ditullioj@cofc.edu)  
 [Office/Zoom hours: M&T 17:00 – 18:00 and by appointment]

We may or may not be able to have in-class lectures this semester. At present, Sept 14 would be the first possible date for an in-class lecture. We will discuss this possibility in early Sept. 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 time than listed.

	<u>Date</u>	<u>Topic</u>
Aug	26 W	Introduction, Origin of Universe, Earth & Oceans
	31 M	Marine Geology/Geophysics/ Plate Boundaries
Sept	02 W	Marine Geology/Geophysics/ Plate Boundaries
	07 M	Marine Geology: Deep Sea Sediments
	09 W	Chemical/Physical Oceanography: Properties of H <sub>2</sub> O, salinity, density
	14 M	Chemical Oceanography: Marine Inorganic & Organic Carbon Cycles
	16 W	Chemical Oceanography: Marine Nutrient Cycles
	21 M	Meteorology; Gradient and Geostrophic Planetary Wind Systems
	23 W	Heat Budget, Hydrologic Cycle, Atmospheric-Oceanic Coupling
	28 M	<b>EXAM I</b>
	30 W	Temperature, Salinity, Density Relations, Water Column Stability
Oct	05 M	Surface Currents, Circulation & Frontal Boundaries
	07 W	Thermohaline circulation (Deep Ocean Circulation)
	12 M	Equations of motion, Continuity, Coriolis Force
	14 W	Hydrostatic Equation, Geostrophic Currents, Two-layer Ocean
	19 M	Geostrophic Eddies, Sea Surface Dynamic Topographies
	21 W	Friction, Viscosity, Wind Stress, Turbulence
	26 M	Ekman Currents, Geostrophic Subtropical Gyres,
	28 W	Vorticity, Westward Intensification of Boundary Currents
Nov	02 M	<b>EXAM II</b>
	04 W	Mesoscale eddies, Coastal Upwelling
	09 M	Progressive Waves, Internal Waves, Tsunamis

11	W	Tides & Tide Generating Forces; Equilibrium & Dynamic Tides	
16	M	Estuaries, Coastal Oceanographic Processes	
18	W	Equatorial Pacific Ocean Circulation	
23	M	El-Nino Southern Oscillation (ENSO), Planetary Waves	
25	W	No Class—Thanksgiving Break	
30	M	Long-term Oceanic Oscillations and Teleconnections	
Dec	02	W	Oceans and Climate Feedback Loops
	07	M	Reading Day
	09	W	<b>FINAL EXAM</b>

Texts: There is no specific 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., 6<sup>th</sup> 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*, 2018, Douglas Segar, 4th edition. This text can be accessed for free at the following link: <http://www.reefimages.com/oceansci.php>. This edition is available for **FREE**. Please note, however, that there is a link for user donations to the author. Please contribute (e.g. a couple of dollars) to help cover the labor and editorial costs that make this resource publicly available for free. 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 Knauss and Garfield, 2017, ISBN: 978-1-4786-3250-4. Finally, you may also download the on-line text *Introduction to Physical Oceanography* textbook by Robert Stewart at the following link: [http://oceanworld.tamu.edu/home/course\\_book.htm](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, 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.

Student Learning Outcomes:

- Students will learn important principles of both descriptive and dynamic physical oceanographic processes.
- Students will learn how to solve various numerical problems relating to physical oceanography including equations of motion and calculating Ekman and geostrophic

current velocities.

- Students will gain an understanding of concepts relating to the Earth's heat budget and atmospheric-oceanic coupling by solving analytical problem sets.
- Students will lead journal discussions from important peer reviewed literature.
- Students will gain field experience by designing and implementing the collection of oceanographic data using a CTD system. Temporal and spatial variability in various physical-chemical parameters will be observed during three field expeditions in Charleston Harbor.
- Students will learn how to analyze seawater for various chemical components including nutrients such as phosphate and silicate and the marine dissolved inorganic carbon system including carbonate and total alkalinity
- Students will demonstrate an ability to collect, assimilate, synthesize and interpret oceanographic datasets from distinct oceanographic regimes using various databases such as OceanDataView and ARGO Float datasets. Class presentations interpreting their regional data will be presented in a power point presentation to the class.

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”*

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 Sept 28/29, 2020 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 (Nov 23/24). 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 26<sup>th</sup>.

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

Exam I-----	15%
Exam II-----	15%
Final Exam-----	25%
Labs-----	35%
Presentations-----	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	=	80-85
C+	=	75-79
C	=	65-74
F	=	0-64

# Oceanography Lab

## Biology 610, Fall 2020

Teaching Assistant: Rachel Prostko (protstkora@g.cofc.edu)

Oceanography labs will tentatively meet on Mondays and Tuesdays from 1400 to 1700h in GML Rm # 113/202. Initially (until Sept 14) we will only meet online. Then depending on CofC's policy we may have to continue online labs. Some problem sets will be assigned during the course and will contribute to your overall lab grade. Lab reports and problem sets 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. A class debate on climate change and geoengineering will be held on Nov 16/17. Further details on the class debate will be provided during one of the first lab periods. Individual regional oceanographic presentations will be done on Nov 23/24. Charleston Harbor water sampling will be done aboard the R/V *Silver Crescent* (tentatively the last week in Sept) and possibly periodically aboard one of our smaller boats (covid and weather permitting). All lab activities will be completely voluntary, and data will be provided to all students regardless of direct participation in the activity. The Final Charleston Harbor Lab Report will be due on Nov 30 and Dec 1 (i.e. last week of labs) and will contribute the equivalent of 4 individual lab grades.

<u>Date</u>	<u>Topic</u>
Aug	
25	No Lab
31/01	Plate tectonics assignment + Bathymetry
Sept	
07/08	Ocean Data View and Oceanographic Databases
14/15	Dissolved Inorganic Carbon System in Seawater + Problem Set #1
21/22	Plate tectonic presentations + Problem Set #2
28/29	Charleston Harbor Cruise aboard R/V <i>Silver Crescent</i>
Oct	
05/06	Primary Nutrients in Seawater + Problem Set #3
12/13	Spectrophotometric and Fluorometric Pigment Analyses
19/20	Charleston Harbor Sample Analyses + Problem Set #4
26/27	Light in the Sea + Problem Set #5
Nov	
02/03	No Labs--- Elections + Problem Set #6
09/10	Problem Set #7
16/17	Class Climate Discussion/debate
23/24	Class Presentations + Regional Oceanography Papers Due
30/01	Charleston Harbor Lab Reports Due

### **Honor Code and Academic Integrity:**

Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each incident will be examined to determine the degree of deception involved.

Incidents where the instructor determines the student's actions are related more to misunderstanding and confusion will be handled by the instructor. The instructor designs an intervention or assigns a grade reduction to help prevent the student from repeating the error. The response is recorded on a form and signed both by the instructor and the student. It is forwarded to the Office of the Dean of Students and placed in the student's file.

Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students. A student found responsible by the Honor Board for academic dishonesty will receive a XXF in the course, indicating failure of the course due to academic dishonesty. This status indicator will appear on the student's transcript for two years after which the student may petition for the XX to be expunged. The F is permanent.

Students can find the complete Honor Code and all related processes in the *Student Handbook* at <http://deanofstudents.cofc.edu/honor-system/studenthandbook/index.php>

---

### **Disability/Access Statements:**

The College will make reasonable accommodations for persons with documented disabilities. Students should apply for services at the Center for Disability Services/SNAP located on the first floor of the Lightsey Center, Suite 104. Students approved for accommodations are responsible for notifying me as soon as possible and for contacting me one week before accommodation is needed.

---

### **Center for Student Learning:**

The Center for Student Learning's (CSL) academic support services provide assistance in study strategies, speaking & writing skills, and course content. Services include tutoring, Supplemental Instruction, study skills appointments, and workshops. Students of all abilities have become more successful using these programs throughout their academic career and the services are available to you at no additional cost. For more information regarding these services please visit the CSL website at <http://csl.cofc.edu> or call (843) 953-5635.

---

### **Mental & Physical Wellbeing:**

At the college, we take every students' mental and physical wellbeing seriously. If you find yourself experiencing physical illnesses, please reach out to student health services (843.953.5520). And if you find yourself experiencing any mental health challenges (for example, anxiety, depression, stressful life events, sleep deprivation, and/or loneliness/homesickness) please consider contacting either the Counseling Center (professional counselors at <http://counseling.cofc.edu> or 843.953.5640) or the Students 4 Support (certified volunteers through texting "4support" to 839863 or visit <http://counseling.cofc.edu/cct/index.php>). You can also visit both on campus on the 3rd floor of Robert Scott Small. These services are there for you to help you cope with difficulties you may be experiencing and to maintain optimal physical and mental health.

---

## **ATTENDANCE POLICY**

Attendance is not monitored but regular attendance is highly recommended as most of the lecture material is taken from a variety of sources.