Syllabus: SIO 143
Ocean Acidification Spring quarter 2019

Lectures:	Tuesday & Thursday	14:00-15:20	VH100
Discussions:	Thursday	15:30-16:20	VH100
Office hours:	By appointment or before and after class		

INSTRUCTOR:	Andreas Andersson
Office:	VH301
Tel.:	858-822-2486
E-mail:	aandersson@ucsd.edu

OBJECTIVES: The objective of this class is to provide a broad understanding of the problem of ocean acidification (OA) and its potential effects and consequences to the Earth's geobiosphere on timescales ranging from decades to 100,000s of years. To understand the problem of OA it is critical to have a good understanding of seawater CO_2 chemistry and how physical, chemical, geological and biological processes affect and interact with the marine CO_2 system. Thus, the intricacies of this system will be reoccurring topics throughout this class as we explore the effects of OA on biogeochemical processes, organisms, ecosystems, food webs, and human communities. Different experimental approaches, basic chemical measurements, calculations and modeling approaches will also briefly be covered.

TEXTBOOKS: The lectures will follow the chapters in Gattuso & Hansson (2011) and this book is required/strongly recommended in order to succeed in the class. In addition, students will be provided relevant material from Zeebe & Wolf-Gladrow (2001) and are not required to buy this book. Some material will be used from Riebesell et al. (2010) and Mackenzie & Andersson (2013), which can be downloaded for free online. Note that there is a scam site that is trying to charge money for the Riebesell book – do not pay for it!

Gattuso & Hansson, 2011. *Ocean Acidification*. Oxford University Press, 326 p.

Zeebe & Wolf-Gladrow, 2001. *CO_2 in seawater: equilibrium, kinetic, isotopes*. Elsevier, 346 p.

Riebesell et al., 2010. *Guide to best practices for ocean acidification research and data reporting*. European commission, 258 p. Available online at: http://www.epoca-project.eu/index.php/guide-to-best-practices-for-ocean-acidification-research-and-data-reporting.html

Mackenzie & Andersson, 2013. *The marine carbon system and ocean acidification during Phanerozoic time.* Geochemical Perspectives, vol 2, 227 p. Available online at: http://www.geochemicalperspectives.org/online/v2n1

ARTICLES: In addition to readings from the textbooks you will be assigned to read several scientific articles. On occasion we will discuss these articles in class and it is critical that you have read the articles prior to class.

COMPUTER SOFTWARE: As part of the class you will be asked to carry out a number of calculation and modeling exercises. To do this you will need access to CO2SYS (Excel version; https://www.nodc.noaa.gov/ocads/oceans/CO2SYS/co2rprt.html) or CO2calc (https://www.usgs.gov/software/co2calc). If time permits we may also briefly explore Seacarb (to run Seacarb you have to first install R), Ocean Data View v. 4.2.0., and Matlab to conduct marine carbon chemistry calculations. To install these programs, go to http://www.whoi.edu/courses/OCB-OA/ click on *Course Materials*, scroll down until you get to the title REQUIRED SOFTWARE and follow the instructions.

ASSIGNMENTS: Both reading assignments and computational exercises will be given throughout the course. It is expected that each student will complete these. Collaboration is encouraged.

TERM PROJECT: A term project will be assigned during the second week of class. As part of this project you will have to give a short presentation and submit a final paper.

DISCUSSION SESSIONS: are not mandatory due to that some students have conflicting schedules and it would be unfair to require participation of some but not others. Discussion sessions will mainly focus on addressing questions or reviewing material covered in the class.

GRADING:

The main objective is that you learn something from this class. You will have the opportunity to demonstrate this by showing your knowledge and understanding during a midterm and final exam, assignments and term project, and participation (ask questions and participate in discussions).

Participation	10%
Assignments	10%
Term project	25%
Midterm exam	25%
Take-home final exam	30%

MAINTAINING ACADEMIC INTEGRITY:
Students agree that by taking this course all required papers will be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use of the Turnitin.com service is subject to the terms of use agreement posted on the Turnitin.com site. This course will also adhere to the standard UCSD policy on academic integrity: "Students are expected to do their own work, as outlined in the UCSD Policy on Integrity of Scholarship. Cheating will not be tolerated, and any student who engages in forbidden con- duct will be subjected to the disciplinary process. Cheaters will receive a failing grade on the assignment or the exam and/or in the entire course. They may also be suspended from UCSD." See http://www-senate.ucsd.edu/manual/Appendices/app2.htm for details.

Week	Lecture	Topic
		SEAWATER CHEMISTRY & PAST OA EVENTS
1	1	Introduction/Marine CO2 system
	2	Marine CO2 system
2	3	Marine CO2 system/Methods and instrumentation
	4	CO2 system calculation software
3	5	Past changes in ocean carbonate chemistry & past OA events
	6	Past changes in ocean carbonate chemistry & past OA events
4	7	Recent and future changes in ocean carbonate chemistry
	8	Biogeochemical consequences
		EFFECTS ON BIOGEOCHEMICAL PROCESSES
5	9	Update/discussion Term project
	10	Biogeochemical consequences
6	11	Biogeochemical consequences
	12	Biogeochemical consequences/Midterm review
		EFFECTS ON ORGANISMS ECOSYSTEMS AND FOODWEBS
7	13	Midterm
	14	Effect on organisms/ecosystems
8	15	Effect on organisms/ecosystems
	16	Effect on organisms/ecosystems
9	17	Effect on organisms/ecosystems
	18	Effect on organisms/ecosystems/OA and society
		OA CHALLENGES FACING SCIENCE & SOCIETY
10	19	Solutions, mitigation scenarios
	20	Presentations and discussion Term project
FINALS WEEK		Take home exam