



Course number	EES 212/412 (4 credits)
Course title	Chemical Oceanography
Term	Fall 2026
Face-to-Face Meeting times and location	TR 12:30-1:45PM, Morey Hall, Room 504

COURSE DESCRIPTION: Most introductory courses to chemical oceanography cover a variety of topics that are only related because they are under the broad umbrella of chemical oceanography. Some of these topics include carbon dioxide and inorganic carbon chemistry, salinity, marine nutrients, dissolved gases, and organic constituents. Similarly, most discussions of climate change and chemical oceanography only touch on ocean acidification. This course seeks to provide the same broad perspective to conventional chemical oceanography courses but will interweave the unifying theme of climate change into these numerous and diverse topics.

LEARNING GOALS AND OUTCOMES: The primary goals of this course are (1) to familiarize students with the current state of knowledge in the diverse topics of chemical oceanography and (2) to equip them with the ability to formulate, and create plans for testing, hypotheses regarding current unknowns in chemical oceanography and climate change science.

More specifically, at the end of this course, the students will be able to describe both with words and equations:

- 1) how chemical measurements in ocean waters are both modified by and help quantify geological, biological, and physical processes,
- 2) the transport of gases across the air-sea boundary,
- 3) the cycling and dynamics of organic matter and related chemical constituents (e.g. nutrients, trace metals, oxygen) in the water column from production to decomposition as well as in ocean sediments throughout the processes of deposition, remineralization, and burial,
- 4) the cycling of bulk carbon, inorganic carbon, nutrients, O₂, and silicates throughout the global ocean.

INSTRUCTOR INFORMATION

Name	Professor John Kessler
Email address	john.kessler@rochester.edu
Office location	Hutchison Hall, Room 210
Office hours	Thursdays from 3:00-5pm (or by appointment)

TEACHER'S ASSISTANT INFORMATION

Name	Rebecca Rust (graduate student)
Email address	rrust2@ur.rochester.edu
Office location	Hutchison Hall, Room 107D
Office hours	Fridays from 10:00am – 12:00pm (or by appointment)

PREREQUISITIES: CHM 131 and MTH 161

TEXTBOOK AND/OR RESOURCE MATERIALS:

1) *Ocean Biogeochemical Dynamics* (2006), by Jorge Sarmiento and Nicolas Gruber.

ISBN: 0691017077; ISBN-13: 9780691017075

2) Recorded lectures, discussions, assignments, and additional course materials will be posted on *Blackboard* as needed. We will use *Blackboard* heavily, so please refer to it regularly.

COLLEGE CREDIT HOUR POLICY: This course follows the College credit hour policy for four-credit courses. This course meets two times weekly for three academic hours per week. This course also includes (1) several prerecorded learning activities and readings to be completed prior to the face-to-face classroom discussions, (2) online classroom discussions, and (3) independent out-of-class assignments. These “outside” activities count for one academic hour per week to both review and dive deeper into topics discussed during our classroom sessions.

FACE-TO-FACE CLASSROOM ATTENDANCE AND PARTICIPATION: Face-to-face classroom sessions are scheduled on Tuesdays and Thursdays from 12:30-1:45PM in Morey Hall, Room 504. If you are unable to participate in these face-to-face sessions, they will be streamed online using the course Zoom link and recorded so that they will also be available asynchronously. The classroom zoom link is best accessed from our Course Home Page on Blackboard. However, I emphasize that *in real life* participation in the face-to-face class is required and attendance will be taken as part of your Participation grade. Excused absences will only be given if requests are made **ahead of time**.

COURSE STRUCTURE: This course is structured so that in a typical week you will first watch several learning activities which are prerecorded and placed on Blackboard. This will provide a solid foundation for the material covered that week. After watching those videos, you will then read sections of the textbook. The hope is that by first watching the videos, you will better understand the textbook material. After you watch the videos and complete the reading assignments, you are encouraged to post questions to the discussion board on Blackboard which we will address during the face-to-face classroom sessions on Tuesday and Thursday. In addition to providing clarifying discussion during the classroom sessions, we will also work through several problems to better understand this material. Several of these problems will be components of your “Problem Set” for that week. Weekly Problem Sets must be uploaded to Blackboard using Gradescope no later than 6:00pm on Friday. Finally, a short quiz will be given each week on Blackboard. If you have been participating all week, this quiz should take you less than 15 minutes to complete and can be completed anytime between the end of class on Thursday and 6:00pm on Saturday.

Note: The course structure described here may deviate slightly from this general organization in order to accommodate examinations, holidays, and slight variations in the speed at which material is covered.

PARTICIPATION:

1) Synchronous participation in the classroom sessions is strongly encouraged whenever possible either through face-to-face instruction or via Zoom. If you are participating synchronously over Zoom, please let the instructor know ahead of time or you will be considered absent.

2) Asynchronous online participation will take place through Discussion Forums on Blackboard. You will find links to different discussions within each of the Learning Modules.

These discussion platforms are places to ask questions, respond to assist your classmates, and share ideas to better understand the topics and readings under investigation. Each class member is expected to participate in these discussions by both posting original comments and subsequently replying to the posts of classmates, **with a minimum of two posts per week (a “post” is an original post or a reply).** You may comment on the course readings or material, ask a question about an assignment, respond to some of your classmate’s posts, or even share a link to a news article or video that is related to what we are studying. At times, the professor or TA may post a prompt and request your response.

Since the discussion board is a place to not only ask questions, but also to help your classmates by providing clarification on points of confusion, you are asked to participate in these discussions even if you don’t have a specific question. As such, you should contribute to these discussions over the course of the week, not simply within one brief session. Finally, always remember the rules of online etiquette when posting and replying to classmates' posts.

GRADING POLICIES:

Grading will be based on the following structure:

Participation in discussion and classroom activities (20%)

Problem Sets (20%)

Section Quizzes (20%)

3 exams at the end of each module (10% each)

Final exam (10%)

Note: Graduate students registered for EES 412 should expect assignments and exams that will have additional (and more challenging) problems which will be graded more strictly.

Late Assignments: Problem Sets and Quizzes turned in after the due date will be accepted with a 25% reduction if they are received less than 24 hours after the due date. Any assignment received more than 24 hours after the due date will not be accepted for credit.

Basis of Grade Determination: Your semester grade will be determined using the following scale:

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
94-100	90-93	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	<60

Instructor Response and Feedback: Students should expect to receive feedback and grades on their assignment within approximately one week after the due date. Grades will be posted on Blackboard.

ACADEMIC HONESTY:

All assignments and activities associated with this course must be performed in accordance with the University of Rochester's Academic Honesty Policy. Unless otherwise noted, I strongly encourage active collaboration among students currently enrolled in this course when studying and investigating assignments; this is all part of the course policy promoting discussion. However, all individual assignments must be completed independently and must represent the work of only the specific student completing the assignment. In short, work together but write separately and independently. Verbatim copying from another person, the textbook, the web, AI, or any other resource is a violation of the course Academic Honesty policy.

Generative AI Policy: This course does not permit the use of AI programs such as ChatGPT in any way. You may not submit any text or image generated by an AI program as your own on any assignment in this class. The Instructors for this course also pledge to not use generative AI for any part of this course.

In addition, collaborating with students who have previously taken EES 212/412 is prohibited, including the sharing of assignments, exams, notes, and lecture materials from past semesters, unless permission to do so is granted from the instructor prior to such collaboration.

A comprehensive description of the University of Rochester's Academic Honesty Policy is available at: <https://www.rochester.edu/college/honesty/policy/index.html>

Course Topics, Calendar of Activities, Major Assignment Dates

- 1) *Module 1 – Fundamentals of Chemical Oceanography*
 - a) Week 1: August 31 – September 5
 - i) Course Overview, Climate, CO₂, and Oceanic CO₂ Uptake
 - b) Week 2: September 6 – 12
 - i) Introduction to the Chemical Composition and Distribution in Seawater
 - c) Week 3: September 13 – 19
 - i) Air-Sea interface and dissolved gas exchange
 - d) Week 4: September 20 – 26
 - i) Ocean circulation, transport, and mixing
 - e) Week 5: September 27 – October 3
 - i) Review
 - ii) **Module 1 Exam**
- 2) *Module 2 – Organic Matter Dynamics*
 - a) Week 6: October 4 – 10
 - i) Organic matter production and the biological pump
 - b) Week 7: October 11 – 17
 - i) Fall Break!
 - ii) Organic matter export, remineralization, and oxygen utilization
 - c) Week 8: October 18 – 24
 - i) Remineralization and burial in ocean sediments
 - d) Week 9: October 25 – 31
 - i) Review
 - ii) **Module 2 Exam**
- 3) *Module 3 – Global Chemical Cycles and Climate Changes*
 - a) Week 10: November 1 – 7
 - i) Global Oceanic Silicate Cycle
 - b) Week 11: November 8 – 14
 - i) Global Oceanic Carbon Cycle
 - c) Week 12: November 15 – 21
 - i) Global Oceanic Calcium Carbonate Cycle
 - d) Week 13: November 22 – 28
 - i) Anthropogenic CO₂, the oceanic carbon cycle, and climate
 - ii) Thanksgiving!
 - e) Week 14: November 29 – December 5
 - i) Conclude Anthropogenic CO₂, the oceanic carbon cycle, and climate
 - f) Week 15: December 6 – 12
 - i) Review
 - ii) **Module 3 Exam**
- 4) **Final Exam**
 - a) Sunday, December 20
 - b) 7:15 – 9:15pm

ACCOMMODATIONS:

If you have a qualified disability or a temporary medical condition with associated accommodations, please request accommodations through the Office of Disability Resources as early in the semester as possible. Information on accessing accommodations can be found at the Office of Disability Resources website, <http://www.rochester.edu/college/disability/>.

RELIGIOUS HOLIDAYS:

I have done my best to ensure major assignment due dates and exams do not fall on or during religious holidays. If an assignment or exam is scheduled to conflict with your ability to observe a religious holiday in your tradition, please let me know as soon as possible so that we can arrange an alternative date or assignment.

ACADEMIC CALENDARY AND REGISTRAR POLICIES:

The [Academic Calendar](#) provides important deadlines for drop/add/withdraw from courses, as well as breaks and holidays. The [University Registrar's website](#) also covers policies for audits, leaves of absences and withdrawal from the University, incompletes, and privacy.

ANTI-DISCRIMINATION AND HARASSMENT:

Please see the [Policy Against Discrimination, Harassment, and Discriminatory Employment/Service Practices website](#) for the University anti-discrimination and harassment policy. You can report an issue using this [link](#).

TITLE IX:

All members of the URochester community have the right to learn and work in a safe environment free from all forms of discrimination, harassment, and related retaliation. This includes discrimination and harassment based on protected characteristics, and Title IX-prohibited behaviors, which include sexual assault, dating and domestic violence, and stalking. Students who have been subjected to sexual misconduct have the right to receive academic and [other supportive measures](#), to receive counseling and health services, and to make a report to the university and/or to law enforcement. In addition, [students who are pregnant, have recently experienced childbirth, and/or have medical needs related to childbirth](#) can contact the Title IX office for assistance.

All [faculty and teaching assistants are mandatory reporters](#) who must report Title IX-prohibited behavior to the Title IX office. Students can also contact the Title IX Office directly (titleix@rochester.edu or 585-275-1654). For more information, visit www.rochester.edu/sexualmisconduct.

STUDENT RESOURCES:

The University of Rochester offers a wide range of academic, health, and student life resources to support your success and well-being throughout the semester. Examples include:

- **UR Care Services:** If you need any additional help, or are concerned about another student please visit [UR Care Network](#) . You may also self-refer.

- **The Learning Center:** [The Learning Center](#) serves as the hub for academic success and achieving your learning goals. Services include peer tutoring, study groups, academic success coaching, and a study zone. Learn more and sign up at the main website.
- **Advising:** [Center for Advising Services](#)
- **Problem Resolution:** [The University Ombuds Office](#)
- **Writing and Speaking Assistance:** [Writing and Speaking Center](#)
- **Library:** [River Campus Libraries](#)

GENERAL ACADEMIC POLICIES:

Students are expected to comply with all School and University academic policies.

See: <https://www.rochester.edu/college/academics/handbooks.html>