

OCEA 3004: The Last Billion Years Syllabus Fall 2024

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Welcome

This class examines major events and important biogeochemical cycles in the Earth system. The geological evidence of major events will be described, and the hypothesized causes will be examined critically in the context of that evidence. By going through this course, you will develop an understanding of how the complex and interconnected earth/ocean/atmosphere system works, how it has reacted to different perturbations in the geological past and how it will react to current perturbations in the future.

Prerequisites: OCEA 2001 and OCEA 2002, or EARTH 1080

Class meeting time and location

Wednesday, Friday, 10:05-11:25 am

Marion McCain Arts and Social Sciences Building, Rm 2130

Professor

Stephanie Kienast, stephanie.kienast@dal.ca

Life Science Center, Oceanography Wing, room 5616

Teaching Assistant

Macy Giles, macy.giles@gmail.com

Course Materials

The primary reading material is the classic and well-loved textbook "The Earth System" (3rd edition by Lee Kump, James Kasting, Robert Crane). The book is available for purchase at the Dalhousie bookstore (~ 200\$). In addition, there are two hard copies at the Killam library circulation desk reserve which you can borrow for 2-hour intervals. Additional readings will be posted on Brightspace.

Brightspace: readings & videos, assignments, announcements

Attendance

Attendance is important. It is your responsibility to find out what you missed from classmates and the course website if you were unable to be in class. The lecture files will generally be posted on Brightspace after class, but keep in mind that these files may not contain everything that was covered in class (e.g., class discussions, notes on the white board). Announcements about due dates, quizzes, etc. are also made during class time.

Office Hours:

In-person before or after class, or arrange by email

Learning Outcomes

- Explain the Anthropocene in the context of earlier perturbations in the Earth System
- Identify couplings and feedbacks in the Earth System
- Analyze and quantify the global energy balance on Earth

- Recall the age of the Earth and the timing major events in its history, such as the formation of the moon, formation of the ocean, first life, first atmosphere, and others
- Describe various hypotheses for the origins of the Earth, moon, and life
- Explain the causes, timing, and evidence for oxygenation of the atmosphere
- Summarize the major reservoirs of organic and inorganic carbon on Earth
- Explain the relationships among reservoir size, flux, and residence time
- Apply knowledge of global energy balance, inorganic carbon cycle and fractionation of carbon isotopes to the interpretation of Snowball Earth events
- Apply knowledge of stable oxygen and strontium isotopes to assess competing models for Cenozoic cooling of the planet
- Formulate a hypothesis to explain the causes and consequences of the Paleocene-Eocene Thermal Maximum
- Infer the causes of Earth's two greatest mass extinctions
- Explain the evidence for repeated occurrence of glacial periods and the orbital parameters associated with them
- Appraise orbital forcing and anthropogenic forcing in the context of future climate change
- Demonstrate knowledge of the Geological Time Scale

Grade Item	%	Anticipated due dates*
Assignment-1	10	Sept 18
Assignment-2	15	Oct 18
Assignment-3	15	Nov 20
Test 1	20	Oct 02
Test 2	20	Oct 30
Test 3 (Final Exam)	20	in exam period Dec 6-16

*Subject to change

Assignments (3, 40% total)

In the assignments, you will blend mathematical calculations with some basic assumptions to gain insight into global-scale problems. You will also provide written answers on important Earth System concepts. Tackling the assignments is where much of your learning will take place and they will take several hours to complete. Ask for help early if you are confused and make note of the anticipated due dates in the table above. Assignments are open book. If you use resources other than the course material, cite your sources (any style).

Tests (3, 60% total)

The three tests are intended to test your general understanding of the subject matter. The tests will include long & short answer questions and may include calculations. Tests are closed book. The first two tests will be written in person during regular class time. The third test will take place during the Dalhousie exam period. Do not make any final travel arrangements before the final exam schedule has been posted by the registrar's office. The third test may be cumulative. Students must receive a passing grade (50%) on the assignment average and the test average to pass the course.

Plagiarism

You are expected to know and adhere to the Regulations on Academic Integrity based on honesty, trust, fairness, responsibility, and respect, which can be found here:

https://www.dal.ca/dept/university_secretariat/academic-integrity.html.

Students are allowed to work together on assignments. However, **each student must pass in their own assignment, reflecting their own work, speaking in their own voice**. Plagiarism software will be applied (text and images). Cheating during tests will not be tolerated.

Late or missed work Assignments

September 04, 2024

10% off for each day late (24 hours). Late submissions will be accepted until the marking process is completed, typically within 7-10 days. After marking is completed, late submissions will no longer be accepted and result in 0%. In general, missed assignments cannot be made up.

All students have one "Get out of jail free card", meaning one late submission goes without penalty for the first 72 hours. No questions asked. You need to indicate if you wish to use the card for a given assignment when submitting your assignment. Use wisely.

Tests

Tests dates are pre-scheduled (see table) to allow you to effectively manage your time. If you miss a test, there will be a single make-up opportunity at a time set by the instructor. Missing the make-up date results in a zero mark. Documentation (e.g., doctor's note or equivalent) is not required for absences shorter than 5 days. Documentation is required if you miss the final test scheduled in the official exam period.

Extenuating Circumstances

If you are ill for an extended period, or find yourself in extenuating circumstances beyond your control, contact the Assistant Dean of Student Affairs at Scieasst@Dal.Ca.

Additional Course Policies

We are here to help you learn and succeed. Don't hesitate to contact us either during class, via email, or during pre-arranged office hours. While we try to respond to emails within 24 hours from Monday to Friday, please note that a question asked by email within 24 hours before a deadline may go unanswered.

Grade conversion

Numerical results will be converted to letter grades according to the Dalhousie Common Grade Scale:

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

A grade of D is a passing grade.

OCEA 3004: The Last Billion Years 2024 approximate time line				
Date		Topic		Readings
04-Sep	W	Welcome to the Anthropocene		Proposal of Anthropocene Working Group; Witze 2024
06-Sep	F	Systems		Chap. 2
11-Sep	W	Global Energy Balance I		Chap. 3, pp.36-44
13-Sep	F	Global Energy Balance II		Chap. 3, pp.44-56
18-Sep	W	Origin of Earth	<i>Assign 1 due</i>	Chap. 10, pp.190-199
20-Sep	F	Origin of Life		Chap. 10, pp.199-209
25-Sep	W	Carbon Cycle I		Chap. 8, pp.149-162
27-Sep	F	Carbon Cycle II		Chap. 8, pp.162-175 , Berner and Lasaga 1989
02-Oct	W	-	<i>Test 1</i>	
04-Oct	F	Evolution of the Atmosphere I		
09-Oct	W	Evolution of the Atmosphere II		Chap. 11, pp.210-223
11-Oct	F	Snowball Earth I		Chap. 11, pp.223-231, Hoffman and Schrag 2002
16-Oct	W	Snowball Earth II		Chap. 12, pp.233-248
18-Oct	F	Death of Cretaceous Seamounts I	<i>Assign-2 due</i>	
23-Oct	W	Death of Cretaceous Seamounts II		Chap. 12, pp.248-252, Wilson et al. 1998
25-Oct	F	PETM		Mclnerey and Wing 2011
30-Oct	W	-	<i>Test 2</i>	
01-Nov	F	Mass Extinctions I		
06-Nov	W	Cratering Lab		location: SURGE Lab, Oceanography
08-Nov	F	Mass Extinctions II		
13-Nov	W	<i>Study Break</i>		
15-Nov	F	<i>Study Break</i>		
20-Nov	W	Mass Extinctions III	<i>Assign-3 due</i>	
22-Nov	F	Cenozoic Cooling		Raymo and Ruddiman 1992
27-Nov	W	Pleistocene Ice Ages		
29-Nov	F	Pleistocene Ice Ages		
Dec 6-16			<i>Test 3</i>	

Faculty of Science

Student Resources and Support 2024/2025

University Policies and Programs

Important Dates in the Academic Year (including add/drop dates):

http://www.dal.ca/academics/important_dates.html

Classroom Recording Protocol:

https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-protocol.html

Dalhousie Grading Practices Policies:

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Grade Appeal Process: https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html

Sexualized Violence Policy: https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-violence-policy.html

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

Learning and Support Resources

General Academic Support – Advising (Halifax): https://www.dal.ca/campus_life/academic-support/advising.html

General Academic Support – Advising (Truro): <https://www.dal.ca/about-dal/agricultural-campus/ssc/academic-support/advising.html>

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html

On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): https://www.dal.ca/campus_life/academic-support/On-track.html

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Indigenous Connection: <https://www.dal.ca/about-dal/indigenous-connection.html>

Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student Centre or contact the program at elders@dal.ca or 902-494-6803:

<https://cdn.dal.ca/content/dam/dalhousie/pdf/academics/UG/indigenous-studies/Elder-Protocol-July2018.pdf>

Black Student Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre.html

LGBTQ2SIA+ Collaborative: <https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-collaborative.html>

Dalhousie Libraries: <http://libraries.dal.ca/>

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Dalhousie Student Advocacy Services: <https://www.dsu.ca/dsas?rq=student%20advocacy>

Dalhousie Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Human Rights and Equity Services: <https://www.dal.ca/dept/hres.html>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Study Skills/Tutoring: http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Faculty of Science Advising Support: <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>

Safety

Biosafety: <http://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <http://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Laser Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html>