

# Global Biogeochemical Cycles Syllabus

Department of Earth and Environmental Sciences  
ERTH/ENVS 3601 Winter 2023

*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.*

## Course Instructor(s)

Name	Email	Office Hours
Dr. Sian Kou-Giesbrecht (she/her)	sian.kougiesbrecht@dal.ca	Wednesday, 10am-11am, Room 4613, Ocean Wing, Life Sciences Centre
Celia Konowe (she/her)	ckonowe@dal.ca	

## Course Description

An interdisciplinary course that examines global cycles of water, carbon, nitrogen, phosphorus, and sulphur, and human impacts on these cycles, as manifested in our atmospheric, soil, freshwater, and ocean environments. This course involves discussion of the latest developments in this rapidly changing field and will provide a framework for those interested in global change.

### *Course Prerequisites*

CHEM 1011.03/ CHEM 1012.03 or equivalent, and one of ENVS 1100.03, SUST 1001.03, EARTH 1080.03, or (SCIE 1506.09 or SCIE 1507.09) and completion of 2 years of an undergraduate degree.

## Learning Objectives

The main objectives of your work in this course are to:

1. Understand the Earth system with a multidisciplinary biogeochemistry perspective and how it has changed throughout Earth's history.
2. Understand the interactions between the biosphere, hydrosphere, geosphere, and atmosphere, the major stocks and fluxes of key biogeochemical cycles, and their underlying mechanisms and drivers of change.
3. Develop a robust scientific understanding of the human impact on the Earth system, the sensitivity and robustness of the Earth system, climate change, global change, and global scale environmental problems.

After you complete the work for this course you will be able to:

1. Explain each major biogeochemical cycle; its key chemical species, stocks, fluxes, and processes; its uniqueness; its importance; its sensitivity; its spatial and temporal variability; and how it has changed throughout Earth's history.
2. Explain how humans are currently altering each major biogeochemical cycle, the impacts of these changes, and the possibilities for mitigation.
3. Describe the advantages and limitations to current methods in the field.

### *Seven key questions*

You should be able to answer the following seven key questions for each major biogeochemical cycle / element:

1. Chemical species: What are the important chemical species of the element in each sector of the Earth system (atmosphere, geosphere, biosphere, and hydrosphere)?
2. Pools and fluxes: What are the important pools? What are the important fluxes between these pools and what controls their rates?
3. Transformations: What are the important transformations among chemical species? What controls their rates?
4. Earth's history: What were the major events and changes throughout Earth's history?
5. Links with other biogeochemical cycles: What are the links between the element and other elements? What are their stoichiometric ratios?
6. Human impact: How are humans currently altering the biogeochemical cycle?
7. Response: How does the biogeochemical cycle respond to human impact?

## Course Structure

### *Course Delivery*

This course will be in-person (lectures and labs).

### *Lectures*

Wednesday and Friday 8:35am-9:55am Mona Campbell Building 1108

### *Labs*

Friday 10:05am-11:25am Sir James Dunn Building 304

## **Course Materials**

Required Textbook: *Biogeochemistry: An Analysis of Global Change*, 4<sup>th</sup> Edition, 2020. W.H. Schlesinger and Emily S. Bernhardt.

This book is available in PDF format from the [Dalhousie Libraries \(Novanet\)](#).

Assigned readings will be posted in Brightspace throughout the semester.

You will need a laptop to take the quizzes in class (described below). If this will be an issue, please email Dr. Kou-Giesbrecht. Note that Dalhousie Libraries offers laptop loans <https://libraries.dal.ca/borrow/laptop-lending.html>.

## **Student Resources**

I encourage you to ask questions – in class, online, or in office hours! If the question pertains to course material, please post on the Discussions section of Brightspace first rather than send an email so that other students can benefit from the answer as well. Office hours are listed above. If you can't make them, please send Dr. Kou-Giesbrecht an email and we will find an alternate time.

## **Assessment**

### *Overview*

- 25% quizzes
- 15% lab problem sets (2, each lab problem set is worth 7.5% of your final grade)
- 25% lab project (presentation)
- 30% final exam
- 5% participation

### *Quizzes*

There will be 9 quizzes (see the course schedule below). Each quiz will be ~20 minutes long and will be held at the beginning of the Friday lecture. The quiz will be made available on Brightspace. Each quiz will focus on the previous ~2 lectures but will build on everything that has already been covered in the course. The quizzes must be taken

in class – please bring your laptop. You can use your notes or the textbook but no other resources. The best 7 out of 9 quizzes will be counted towards your final grade; each quiz is worth ~3.5% of your final grade.

### *Lab problem sets*

There will be 2 lab problem sets. The lab problem sets will be introduced during the lab. You will have 1 week to complete each lab problem set. Problem Set 1 (PS1) will be held on Feb 9 and will be due on Feb 16 at 5pm. Problem Set 2 (PS2) will be held on Mar 1 (it will involve us walking around campus and will also take up the lecture time) and will be due on Mar 8 at 5pm. If the weather is terrible, Problem Set 2 will be rescheduled to Mar 8 and will be due on Mar 15 at 5pm. You can work collaboratively with other students. Each problem set is worth 7.5% of your final grade.

### *Lab project*

The lab project will be a group project (5 people per group). Groups will be finalized in the lab on Jan 19. You must attend this lab, and your entire group must check in with an instructor. There will also be a project check in on March 15. You must attend this lab, and your entire group must check in with an instructor. Groups will give a 10-minute presentation on their lab project in the lecture/lab on April 5 or April 8. You must attend these labs. All students will provide constructive peer feedback on these presentations. Groups will incorporate this feedback and submit updated slides by April 12 at 5pm. Each group will also submit an author contribution statement which outlines the contribution of each group member. The lab project is worth 25% of your final grade.

### *Final exam*

There will be an in-person final exam during the exam period. The exam will cover the material from the entire course. You can bring your notes to the final exam.

### *Participation*

You must attend the lectures and required labs. Lab participation is 5% of your final grade. This will be based on your presence in the required labs and on your peer feedback on the presentations.

Conversion of numerical grades to final letter grades follows the

<u>Dalhousie Grade Scale</u>			
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)	

## **Course Policies on Missed or Late Academic Requirements**

If you miss a class, you are responsible for finding out what you missed that day from your peers or TAs.

[Student Declaration of Absence Forms \(SDAs\)](#) can be used for short-term absences that are no longer than three consecutive days. Students must notify the TA and submit an SDA on Brightspace before the assignment deadline. Students can submit a maximum of two SDAs per course during a term. After the SDA is submitted, the student will have 3 extra days to submit the assignment. Late assignments without notifying the TA and submitting an SDA before the assignment deadline will receive a deduction of 10% per day the assignment is late.

SDAs do not apply to quizzes because only the best 7 out of 9 quizzes will be counted towards your final grade.

SDAs do not apply to the final exam. An alternative final exam time will only be granted for exceptional circumstances (illness with medical certificate or other mitigating circumstances). Students must email Dr. Kou-Giesbrecht before the exam to schedule an alternative final exam time if these circumstances apply.

## **Course Policies related to Academic Integrity**

Students can work collaboratively on the lab problem sets and the lab project. All other work must be completed individually. You should note that AI tools don't understand biogeochemistry very well – they produce inaccurate and incomplete information. They also may stifle your own independent thinking and creativity. You can use AI tools to assist your learning but note the aforementioned warnings. You may not submit any work generated by an AI tool as your own in this course. This is considered an academic offence. Other forms of cheating will be dealt with under relevant Dalhousie University policies.

## Course Schedule

Week	Date	Lecture topic	Lab	Quizzes	Textbook
1	Jan 10	Introduction			
	Jan 12	Fundamentals	Project introduction	No quiz	Chap 1
2	Jan 17	Origins			Chap 2
	Jan 19	Origins	Project group formation	Quiz 1	
3	Jan 24	Atmosphere			Chap 3
	Jan 26	Atmosphere	Optional project time	Quiz 2	
4	Jan 31	Geosphere			Chap 4
	Feb 2				
5	Feb 7	Geosphere / Hydrosphere			Chap 10
	Feb 9	Hydrosphere	Problem Set 1	Quiz 3	
6	Feb 14	Land			Chap 5/6
	Feb 16	Land	Optional PS1 time	Quiz 4	
	Feb 21				
	Feb 23				
7	Feb 28	Land			
	Mar 1	Problem Set 2		Quiz 5	
8	Mar 6	Wetlands			Chap 7
	Mar 8	Inland waters	Optional PS2 time	Quiz 6	Chap 8
9	Mar 13	Oceans			Chap 9
	Mar 15	Oceans	Project check in	Quiz 7	
10	Mar 20	Global C cycle			Chap 11
	Mar 22	Global C cycle	Optional project time	Quiz 8	
11	Mar 27	Global N/P cycle			
	Mar 29				
12	Apr 3	Global N/P cycle			Chap 13
	Apr 5	Global trace element cycles	Project presentations	Quiz 9	
13	Apr 8	Project presentations	Project presentations	No quiz	
	Apr 9	Review	Review	No quiz	

## University Policies and Statements

### Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or [elders@dal.ca](mailto:elders@dal.ca). Additional information regarding the Indigenous Student Centre can be found at:

[https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

### Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

### Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: [https://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](https://www.dal.ca/dept/university_secretariat/academic-integrity.html)

### Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre ([https://www.dal.ca/campus\\_life/academic-support/accessibility.html](https://www.dal.ca/campus_life/academic-support/accessibility.html)) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

## **Conduct in the Classroom – Culture of Respect**

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

## **Diversity and Inclusion – Culture of Respect**

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

## **Student Code of Conduct**

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/student-life/code-of-student-conduct.html](https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html)

## **Fair Dealing Policy**

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/fair-dealing-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html)



## **Originality Checking Software**

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html)

## **Student Use of Course Materials**

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

Faculty of Science

# Student Resources and Support

## University Policies and Programs

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

[http://www.dal.ca/academics/important\\_dates.html](http://www.dal.ca/academics/important_dates.html)

Classroom Recording Protocol:

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/classroom-recording-protocol.html](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](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](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](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](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](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](https://www.dal.ca/campus_life/academic-support/On-track.html)

Indigenous Student Centre:

[https://www.dal.ca/campus\\_life/communities/indigenous.html](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](mailto: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](https://www.dal.ca/campus_life/communities/black-student-advising.html)

International Centre: [https://www.dal.ca/campus\\_life/international-centre.html](https://www.dal.ca/campus_life/international-centre.html)

South House Sexual and Gender Resource Centre: <https://southhousehalifax.ca/about/>

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](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](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](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>