

**Faculty of Science Course Syllabus
Department of Earth and Environmental Sciences
ERTH/ENVS 3601.03 – Global Biogeochemical Cycles
Winter, 2022**

Instructor: Dr. Shannon Sterling Shannon.Sterling@dal.ca 3056 LSC (Biology Wing)
TAs: TBA, Garridan Porter

Due to public health concerns associated with the pandemic, courses will be delivered online initially for the Winter 2022 term. Subsequent changes in delivery methods may require modified elements in course syllabi.

Online Structure: This class will be delivered using a flipped structure. The assigned lectures, readings, quizzes and problem sets are posted to Brightspace and TopHat. Each week, students are required to watch the lecture videos, read the textbook chapter following the reading guide and to complete the online quiz. Synchronous class will be on Wednesdays and Friday from 8:35-9:55 am when we will go over the lectures and complete activities to deepen your learning.

Course Description

We currently face daunting environmental challenges at the global scale that are expected to worsen in the 21st century, including a global water crisis, climate change, and pollution of our waters and atmosphere; this course examines the science behind these environmental issues from the multidisciplinary framework of global biogeochemical cycling. With the global scale as the focus, this course pulls together the many disparate fields that are encompassed by the broad reach of biogeochemistry. You will learn about the processes that drive the movement of carbon, water, nitrogen, phosphorus, and sulphur through the Earth system, and the residency of these elements in the atmosphere, soils, lithosphere, oceans, and freshwaters. In the quantitative and analytical exercises you will calculate and compare the effects of industrial emissions, land clearing, agriculture, and rising population on the processes driving the Earth's chemical cycles. This course provides an excellent framework for those interested in the science of global change.

Course Prerequisites

CHEM 1011.03/ CHEM 1012.03 or equivalent, six credits from one of ENVS 1000.06, SUST 1001.06, EARTH 1080.03, EARTH 1090.03, OCEA 2000.06, OCEA2001.03, OCEA2002.03, SCIE 1502XY.21/SCIE 1504.27/ SCIE 1510XY.33, and completion of 2 years of an undergraduate degree.

COURSE OBJECTIVES/LEARNING OUTCOMES

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

- 1) develop a robust scientific understanding of global scale environmental problems using systems analysis and a multidisciplinary biogeochemistry perspective,
- 2) develop a solid understanding of the drivers of temporal and spatial variability in the Earth System, and
- 3) increase appreciation of both the sensitivity and resilience of the Earth system by learning the nature of global biogeochemical cycles, how they have changed through time, and the processes that drive the fluxes and characteristics of the major reservoirs.

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

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

Seven Key Questions

To help you organize the large amounts of detail that we cover in this course, we use the following framework of seven key questions that you need to be able to answer for each global biogeochemical cycle:

1. **Species.** What are the important chemical species of the element in each sector of the Earth System? (atmosphere, lithosphere, pedosphere, biosphere and hydrosphere)?
2. **Key transformations.** What are the key transformations among these species? What controls their rates and how might these rates change with climate change?
3. **Major pools and fluxes.** What are the major global reservoirs? What are the major global fluxes?
4. **Links with other cycles.** What are the links with other global biogeochemical cycles? What are the stoichiometric relations?
5. **Cycle in earth's history.** What are the major events of the cycle in Earth's history? When and why did certain species and transformations first appear?
6. **Human influence.** How do humans alter the global cycle?
7. **Response.** How does the global cycle respond to human alterations?

COURSE MATERIALS

- Required Textbook: Schlesinger, W.H., E.S. Bernhardt, 2013. *Biogeochemistry: an Analysis of Global Change*, Academic Press (Elsevier), San Diego, 3rd Edition, 688 pp. (available in PDF format in Dalhousie Libraries online)

COMMUNICATION

- The course syllabus, presentations, announcements, assignments, and other pertinent information will be on the course Brightspace site. You are expected to check this site regularly.
- Communications to the class regarding this course will be done via the announcements function in the Brightspace site.

Top Hat

We will be using Top Hat (www.tophat.com) for quizzes. You can visit the Top Hat Overview (<https://success.tophat.com/s/article/Student-Top-Hat-Overview-and-Getting-Started-Guide>) within the Top Hat Success Center which outlines how you will register for a Top Hat account, as well as providing a brief overview to get you up and running on the system. You can register by visiting our course website on Brightspace, and clicking on TopHat Registration in the Content section. Top Hat may require a paid subscription, and a full breakdown of all subscription options available can be found here: www.tophat.com/pricing. Should you require assistance with Top Hat at any time, due to the fact that they require specific user information to troubleshoot these issues, please contact their Support Team directly by way of email (support@tophat.com), the in app support button, or by calling 1-888-663-5491.

Course Assessment

Semester grades are based on:

- 35% Quizzes
- 25% Laboratory exercises / Problem Sets
- 40% Final exam

Component	Weight (% of final grade)	Due Date
Quizzes		
Quiz 1	2.5	5:00 pm Jan 17 th , 2022
Quiz 2	2.5	5:00 pm Jan 24 th , 2022
Quiz 3	2.5	5:00 pm Jan 31 st , 2022
Quiz 4	2.5	5:00 pm Feb 7 th , 2022
Quiz 5	2.5	5:00 pm Feb 14 th , 2022
Quiz 6	2.5	5:00 pm Feb 28 th , 2022
Quiz 7	2.5	5:00 pm Mar 7 th , 2022
Quiz 8	2.5	5:00 pm Mar 14 th , 2022
Quiz 9	2.5	5:00 pm Mar 21 st , 2022
Quiz 10	2.5	5:00 pm Mar 28 th , 2022

Problem Sets

Problem Set 1	7.5	5:00 pm Jan 28 th , 2022
Problem Set 2	7.5	5:00 pm Feb 18 st , 2022
Problem Set 3	7.5	5:00 pm March 11 th , 2022
Problem Set 4	7.5	5:00 pm March 25 th , 2022

Final Exam***Online Synchronous in assigned Final Exam time slot*****Conversion of numerical grades to Final Letter Grades follows 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 (<50)
A- (80-84)	B- (70-72)	C- (55-59)	

Course Content and Schedule¹ Material for each week will be uploaded on the Monday morning of the week. Check reading guides on Brightspace to help your preparation for quizzes.

Week	Date	Topic	Reading, Labs
W1	Jan 4-7	Introduction	Chapter 1
W2	Jan 12-14	Origins	Chapter 2
W3	Jan 19-21	Atmosphere	Chapter 3, Lab 1
W4	Jan 26-28	Lithosphere	Chapter 4
W5-6	Feb 2- 11	The Biosphere – Carbon Cycle –	Chapter 5, Lab 2
W7	Feb 16-18	The Biosphere – Biogeochemical cycling on land	Chapter 6
W8	Mar 2-4	The Hydrosphere I, II	Chapter 7, Lab 3
W9	Mar 9-11	The Oceans	Chapter 8 & 9
W10	Mar 16-18	The Global Water Cycle	Chapter 10, Lab 4
W11	Mar 23-25	The Global Carbon Cycle	Chapter 11
W12	Mar 30- Apr1	The Global Nitrogen Cycle and Perspectives	Chapter 12

Course Policies

1. Assignments submitted late and without an approved extension will be deducted 10% per day.
2. Extensions for quizzes and assignments are granted for exceptional circumstances, using the Student Declaration of Absence Form. Applications for extensions must be made in writing to Dr. Sterling 24 hours before the lab or test is due. The Student Declaration of Absence Form may be used two times this semester.
3. Missed quizzes and assignments: if you do not complete a test or assignment and do not submit a Student Declaration of Absence form for that week, your mark on the test or assignment is zero.
4. Collaboration is permitted on laboratories in groups, but each student must submit their own assignment and must identify with whom they worked on the assignment.
5. All assignments must be submitted through Brightspace. E-mailed submissions will not be accepted.

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Missed or Late Academic Requirements due to Student Absence

As per Senate decision instructors may not require medical notes of students who must miss an academic requirement, **including the final exam**, for courses offered during fall or winter 2020-21 (until April 30, 2021).

¹ Subject to change

Information on regular policy, including the use of the Student Declaration of Absence can be found here:

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html.

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of 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.

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

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.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.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

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

Statement: <http://www.dal.ca/cultureofrespect.html>

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 (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

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

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

University Grading Practices

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

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

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

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

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

Academic supports

Library: <https://libraries.dal.ca/>

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

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

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

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

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

Student Advocacy: <https://dsu.ca/dsas>

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

Safety

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

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

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

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