DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Earth Sciences
ERTH/ENVS 3601.03 – Global Biogeochemical Cycles
Winter, 2020

Instructor:	Dr. Shannon Sterling	Shannon.Sterling@dal.ca	3056, 3rd floor LSC Biology Wing
TAs	Caitlin McCavour	caitlin.mccavour@dal.ca	

Lectures:	Tues/Thurs 10h05-11h25	Studley LSC-COMMON AREA C208
Tutorial:	Thursday 8h35-9h55 (Mandatory)	Studley LSC-COMMON AREA C208

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 calculate and compare the effects of industrial emissions, land clearing, agriculture, and rising population on the processes driving the Earth's chemical cycles. Journal readings for discussion in laboratory group cover the latest developments in this exciting and rapidly changing field. This course provides an excellent framework for those interested in the science of global change.

Structure: Each week there will be 4.5 hours of class time with 3 hours of lecture and 1.5 hours of tutorial.

COURSE PREREQUISITES

CHEM 1011.03/ CHEM 1012.03 or equivalent, six credits from one of ENVS 1000.06, SUST 1001.06, ERTH 1080.03, ERTH 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 from a multidisciplinary biogeochemistry perspective,
2) understand and apply the analytical tools of this field in problem solving,
3) develop a solid understanding of the drivers of temporal and spatial variability in the Earth System, and
4) increase appreciation of both the sensitivity and resilience of the earth system by solidly learning the nature of global biogeochemical cycles, including 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. critically analyze recent scientific literature on changes to global biogeochemical cycles;
2. 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;
3. describe how humans are currently altering each major global biogeochemical cycle, and to describe the impacts of these changes, and possibilities for mitigation; and
4. 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 email function in the Brightspace site.

TOP HAT

We will be using the Top Hat (www.tophat.com) classroom response system in class. You will be able to submit answers to in-class questions using Apple or Android smartphones and tablets, laptops, or through text message.

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:

25% In-class quizzes

15% Participation during lectures via TopHat questions

20% Participation in tutorials via TopHat questions

40% Take home final exam

Component	Weight (% of final grade)	Date
Quizzes. *Quizzes will be delivered via TopHat in class.*		
Quiz 1	2.3%	January 14th, 2020, 10h05
Quiz 2	2.3%	January 21st, 2020, 10h05
Quiz 3	2.3%	January 28th, 2020, 10h05
Quiz 4	2.3%	February 4th, 2020, 10h05
Quiz 5	2.3%	February 11th, 2020, 10h05
Quiz 6	2.3%	February 25th, 2020, 10h05
Quiz 7	2.3%	March 3rd, 2020, 10h05
Quiz 8	2.3%	March 10th, 2020, 10h05
Quiz 9	2.3%	March 17th, 2020, 10h05
Quiz 10	2.3%	March 24th, 2020, 10h05
Quiz 11	2.3%	March 31st, 2020, 10h05
Take Home Final exam	*40%*	*Due April 6th, 2020, 4:30 pm*

DALHOUSIE UNIVERSITY

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 Policies

This course is governed by the academic rules and regulations set forth in the University Calendar and the Senate (https://www.dal.ca/dept/university_secretariat/policies.html#)

1. Spend approximately three hours a week on your textbook chapter readings.
2. Bring your laptop to the Thursday tutorial.
3. Attend all lectures and labs.
4. No laptops in class. Classroom time is for discussion and application and taking notes. See results from a study on what happens to your learning when you use laptops in lectures: ttp://www.theglobeandmail.com/life/parenting/back-to-school/laptops-in-class-lowers-students-grades-canadian-study/article13759430/
5. Problem sets are to be done with a partner. http://www.economist.com/news/books-and-arts/21613167-why-greatest-feats-creativity-come-pairs-it-takes-two
6. Missed assignments. Make up exams will only be given in the case of documented medical or family emergencies. If you miss a test for any reason other than documented medical or family emergency grounds, your mark on the test or exam is zero.
7. The Student Declaration of Absence policy will be followed in this course. Notification of absence must occur **before** the assignment or graded activity takes place (https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html).

DALHOUSIE UNIVERSITY

COURSE SCHEDULE[1]

Lect-ure	We-ek	Date	Topic	Reading
1	W1	Tues Jan 7	Course overview.	
Processes and reactions				
2	W1	Thurs Jan 9	**Introduction -** Lecture	Chapter 1
3	W2	Tues Jan 14	**Origins** – Lecture and Quiz #1 on Chapter 1	Chapter 2
4	W2	Thurs Jan 16	**Origins** – Lecture	
T1	W2	Thurs Jan 16	**Origins** – Mandatory tutorial	
5	W3	Tues Jan 21	**Atmosphere** – Lecture and Quiz #2 on Chapter 2	Chapter 3
6	W3	Thurs Jan 23	**Atmosphere** – Lecture	
T2	W3	Thurs Jan 23	**Atmosphere** – Mandatory tutorial	
7	W4	Tues Jan 28	**Lithosphere** –Lecture and Quiz #3 on Chapter 3	Chapter 4
8	W4	Thurs Jan 30	**Lithosphere** – Lecture	
T3	W4	Thurs Jan 30	**Lithosphere** – Mandatory tutorial	
9	W5	Tues Feb 4	**Lithosphere and The Biosphere – Carbon Cycle** – Lecture and Quiz #4 on Chapter 4	Chapter 5
10	W5	Thurs Feb 6	**The Biosphere – Carbon Cycle** – Lecture	
T4	W5	Thurs Feb 6	**The Biosphere – Carbon Cycle** – Mandatory tutorial	
11	W6	Tues Feb 11	**The Biosphere – Biogeochemical cycling on land** – Lecture and Quiz #5 on Chapter 5	Chapter 6
12	W6	Thurs Feb 13	**The Biosphere – Biogeochemical cycling on land** – Lecture	
T5	W6	Thurs Feb 13	**The Biosphere – Biogeochemical cycling on land** Mandatory tutorial	
Feb 17-21: Study Break				
12	W7	Tues Feb 25	**The Hydrosphere I, II** – Lecture and Quiz #6 on Chapter 6	Read Chapter 7 & 8
13	W7	Thurs Feb 27	**The Hydrosphere I, II** – Lecture	
T6	W7	Thurs Feb 27	**The Hydrosphere I, II** – Mandatory tutorial	

[1] Subject to change

14	W8	Tues Mar 3	**The Oceans** – Lecture and Quiz #7 on Chapter 7&8	Chapter 9
15	W8	Thurs Mar 5	**The Oceans** – Lecture	
T7	W8	Thurs Mar 5	**The Oceans**– Mandatory tutorial	
Global Cycles				
16	W9	Tues Mar 10	**The Global Carbon Cycle** – Lecture and Quiz #8 on Chapter 9	Chapter 11. Take home final exam assigned.
17	W9	Thurs Mar 12	**The Global Carbon Cycle** – Lecture	
T8	W9	Thurs Mar 12	**The Global Carbon Cycle** – Mandatory tutorial	
18	W10	Tues Mar 17	**The Global Nitrogen Cycle** – Lecture and Quiz #9 on Chapter 11	Chapter 12
19	W10	Thurs Mar 19	**The Global Nitrogen Cycle** – Lecture	
T9	W10	Thurs Mar 19	**The Global Nitrogen Cycle** – Mandatory tutorial	
20	W11	Tues Mar 24	**The Global Water Cycle** – Lecture and Quiz #10 on Chapter 12	Chapter 10
21	W11	Thurs Mar 26	**The Global Water Cycle** – Lecture	
T10	W11	Thurs Mar 26	**The Global Water Cycle** – Mandatory tutorial	
22	W12	Tues Mar 31	**Other Element Cycles** –Lecture. Quiz #11 on Chapter 10	Chapter 13 and 14
23	W12	Thurs Apr 2	**Perspectives** – Lecture	
T11	W12	Thurs Apr 2	**Tutorial** – Review for Take Home Exam	

DALHOUSIE UNIVERSITY

WRITING RESOURCES

Quality of writing is important in this class, and for your career. For help with scientific writing on your journal article question assignments, you can visit www.writingcentre.dal.ca. Writing expectations at Dalhousie may be higher than you will have expected. The Writing Centre is a Student Service academic unit that supports your writing development. Make an appointment to discuss your writing. Learning more about the writing process and discipline-specific practices and conventions will allow you to adapt more easily to your field of study.

ACCESSIBILITY

The Student Accessibility Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students on the Halifax campus who request accommodation as a result of: a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (NS, NB, PEI, NFLD).

If there are aspects of the design, instruction, and/or experiences within this course that result in barriers to your inclusion please contact: · the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro.

· the Student Success Centre in Truro for courses offered by the Faculty of Agriculture (https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html)

Please note that your classroom may contain accessible furniture and equipment. It is important that these items remain in the classroom, undisturbed, so that students who require their use will be able to fully participate.

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. 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. (read more: http://www.dal.ca/dept/university_secretariat/academic-integrity.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. (read more: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/student-life-policies/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. Dalhousie is strengthened in our diversity and dedicated to achieving equity. We are committed to being a respectful and inclusive community where

everyone feels welcome and supported, which is why our university prioritizes fostering a culture of diversity and inclusiveness. (read more: https://www.dal.ca/cultureofrespect.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. (read more: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html)

LINKS TO UNIVERSITY POLICES AND PROGRAMS

- Important Dates in the Academic Year (including add/drop dates) http://www.dal.ca/academics/important_dates.html
- Dalhousie Grading Practices Policy 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 http://www.dal.ca/dept/safety/programs-services/occupationalsafety/scent-free.html

LEARNING AND SUPPORT RESOURCES

The following campus services are available to help students develop skills in library research, scientific writing, and effective study habits. The services are available to all Dalhousie students and, unless noted otherwise, are free.

Service	Support Provided	Location	Contact
General Academic Support - Advising	Help with - understanding degree requirements and academic regulations - choosing your major - achieving your educational or career goals	**Killam Library Ground floor** Rm G28 ***Bissett Centre for Academic Success***	In person: Killam Library Rm G28 By appointment: - e-mail: advising@dal.ca - Phone: (902) 494-3077 - Book online through MyDal https://www.dal.ca/campus_life/academic-support/advising.html

	- dealing with academic or other difficulties		
Dalhousie Libraries	Help to find books and articles for assignments Help with citing sources in the text of your paper and preparation of bibliography	**Killam Library Ground floor** Librarian offices	In person: Service Point (Ground floor) By appointment: Identify your subject librarian (URL below) and contact by email or phone to arrange a time: http://dal.beta.libguides.com/sb.php?subject_id=34328
Studying for Success (SFS)	Help to develop essential study skills through small group workshops or one-on-one coaching sessions Match to a tutor for help in course-specific content (for a reasonable fee)	**Killam Library 3rd floor** Coordinator Rm 3104 Study Coaches Rm 3103	To make an appointment: - Visit main office (Killam Library main floor, Rm G28) - Call (902) 494-3077 - email Coordinator at: sfs@dal.ca or - Simply drop in to see us during posted office hours **All information can be found on our website: www.dal.ca/sfs**
Writing Centre	Meet with coach/tutor to discuss writing assignments (e.g., lab report, research paper, thesis, poster) - Learn to integrate source material into your own work appropriately - Learn about disciplinary writing from a peer or staff member in your field	**Killam Library Ground floor** Learning Commons & Rm G25	To make an appointment: - Visit the Centre (Rm G25) and book an appointment - Call (902) 494-1963 - email writingcentre@dal.ca - Book online through MyDal We are open six days a week **See our website: writingcentre.dal.ca**

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.