McGill University
Department of Geography

GEOG 505 Global Biogeochemistry 2022

Instructors: Tim Moore, BH626, 398-4961, tim.moore@mcgill.ca
Christian von Sperber, BH613B, 398-7501, chris.vonsperber@mcgill.ca

Class time: Monday 2:35 to 5:25 pm, nominally BH426
Office hours: By appointment

Outline and Format

This is a provisional course outline, given the uncertainty on the number of students taking the course and the pandemic. The course is planned to be taught in-person, though the structure of the course may change depending on events.

This course will focus on biogeochemistry, with an emphasis on biogeochemical cycling at two different scales: plot to catchment, and the globe. We shall examine the storage and pathways of major elements and chemical species, their role in controlling catchment and global systems and the effect of human activity on these cycles. At the global scale, we will focus on carbon; at the catchment to plot scale, we will focus on nitrogen and phosphorus.

The course comprises three lectures leading into six student-led discussions reviewing recent journal articles, such as those in *Global Biogeochemical Cycles*, *Biogeochemistry*, *JGR-Biogeosciences*, *Ecosystems*, *Nature* and *Science*. Students will be responsible for critically summarizing 3 papers over the duration of the course. Each student will lead a 10 to 15 minute discussion of the papers they are assigned. This entails an introduction to the paper and its context, the scientific questions asked, the important findings and conclusions and the points of debate (e.g., contradictions with other results etc.). Students are expected to read all the papers reviewed each week and contribute to the discussion.

There will be a group project (~4 students/group) where the groups will attempt to resolve an elemental or chemical species cycle at the global scale, drawing upon the primary literature, and presenting their findings to the class. Each member of a group will produce a written report describing their subcomponent of the global cycle and contribute to a collective executive summary where an attempt is made to resolve the global budget. The individual subsections and executive summary should be collated and submitted as a single group report. The subsections should be short and concise (maximum length of 6 pages, typed, double spaced, excluding tables and diagrams). The executive summary should be a maximum length of 5 pages (typed, double spaced, including tables and diagrams). The executive summary should also include a statement on the sources of uncertainty and where biogeochemists should invest their efforts to improve the budget. In class on February 14, we will take time to review the progress of the group budgets, and again on March 7 when you should have your first approximation of the values of the stores and fluxes of your component of your group's budget ready. On March 14, each group will have 40 minutes to present their major findings (5 minutes for each subsection, 5 minutes for the presentation of the summary, and 10 minutes for questions). The written submission is due March 21, 2022.

Finally, each student is required to write a major paper (maximum length of 15 pages, typed, double spaced, excluding diagrams and tables) on an aspect of biogeochemistry that is of personal interest. The topic for the paper needs to be approved by an instructor. The paper should be an in-depth, critical synthesis of the primary literature of the subject area. On April 11, each student will present a 'virtual' poster on the subject of their major paper to the rest of the class, as would be the case in a poster session at a conference. The paper is due by 16:00, April 18, 2022.

The course is open to graduate and advanced undergraduate (with permission) students.

Readings

Three books are of value for an overview of the material presented in the course:

Aber, J. and J. Melillo 1993. *Terrestrial Ecology*. Saunders College Press.

Jacobson, M. C., R. J. Charlson *et al*. (eds.) 2003. *Earth System Science: From Biogeochemical Cycles to Global Change*. International Geophysics Series. San Diego, Academic Press.

Schlesinger, W.H. and E.S. Bernhardt. 2013. *Biogeochemistry: An Analysis of Global Change*. 3rd edition. Elsevier. (available as an e-book through the McGill Library: https://www.sciencedirect.com/science/book/9780123858740)

The main readings will be a series of papers, accessible through *MyCourses*.

Grading

Paper summaries 30% (powerpoint presentation)
Group project 30% (written subsection, executive summary and seminar presentation)
Term paper 30% (paper and presentation)
Class participation 10% (quality and contributions to the discussion)

Schedule and Topics

Jan. 10 Wk 1 Overview and introduction to global biogeochemical cycles
Jan. 17 Wk 2 Foundational papers (TRM & CvS)
Jan. 24 Wk 3 Global carbon cycle lecture; allocation of papers to present
Jan. 31 Wk 4 Carbon cycling 1: (student discussions); assemble budget groups
Feb. 07 Wk 5 Carbon cycling 2: (student discussions)
Feb. 14 Wk 6 N cycle lecture (TRM) and work on budget projects
Feb. 21 Wk 7 N cycling 1 (student discussions)
Feb. 28 Reading week
Mar. 07 Wk 8 N cycling 2 (student discussions), review budget group progress
Mar. 14 Wk 9 Group biogeochemical 'budget' presentations
Mar. 21 Wk 10 P cycle lecture (CvS), submit group budget reports
Mar. 28 Wk 11 P cycling 1: (student discussions)
Apr. 04 Wk 12 P cycling 2: (student discussions)
Apr. 11 Wk 13 Student symposium: presentation of term papers

McGill Statements

Language of Submission

In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded. This does not apply to courses in which acquiring proficiency in a language is one of the objectives. (Approved by Senate on 21 January 2009 - see also the section in this document on Assignments and Evaluation.)

Conformément à la Charte des droits de l'étudiant de l'Université McGill, chaque étudiant a le droit de soumettre en français ou en anglais tout travail écrit devant être noté (sauf dans le cas des cours dont l'un des objets est la maîtrise d'une langue)

Academic Integrity

McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/ for more information). (Approved by Senate on 29 January 2003)

L'université McGill attache une haute importance à l'honnêteté académique. Il incombe par conséquent à tous les étudiants de comprendre ce que l'on entend par tricherie, plagiat et autres infractions académiques, ainsi que les conséquences que peuvent avoir de telles actions, selon le Code de conduite de l'étudiant et des procédures disciplinaires (pour de plus amples renseignements, veuillez consulter le site www.mcgill.ca/students/srr/honest/).

Course Communications

On January 1, 2004, McGill University instituted a policy that e-mail will be the official channel of communication (see http://www.mcgill.ca/email-policy/). Each student is assigned a unique e-mail address on registration and the instructors will use this address to periodically communicate important information to students. If you do not use the McGill e-mail either arrange to have your messages forwarded to the address you use or inform the instructors of an alternative e-mail address.

In GEOG 505, the instructors use the McGill University *MyCourses* system. You will find the course outline and the reading list on the GEOG 505 course page. The instructors will also post announcements on the course home page so it is important that you regularly check the home page.

Course Evaluations

Course evaluations at McGill University are now done on-line through the Mercury system. Completing the evaluation is voluntary but the results of the evaluation are extremely useful to the instructors and can provide guidance for student who may wish to take this course in the future. We encourage you to participate in the evaluation of this course. The instructor will notify you when the evaluation period opens and will remind you periodically during the evaluation period of the value of completing the evaluations. Thank you.