MBIO 2230: Introductory Biogeochemistry

Biogeochemistry is the study of how **bio**logical, **geo**logical and **chem**ical forces interact to influence the composition of environments. Microorganisms will be emphasized as major drivers of biogeochemical processes. Selected topics for this course include: nutrient cycles, soil organic matter formation and dynamics, biotic influences on the makeup of the atmosphere, weathering, and redox potential.

Instructor: Dr. Matthew Bakker; Matthew.Bakker@umanitoba.ca
Always use your UM email address when corresponding with professors!
Availability for discussion: Office hours will be
in person on Mondays between 3-4 pm (414B Buller Building), or
via Zoom on Tuesdays between 10-11 am
(https://umanitoba.zoom.us/j/67727189970?pwd=aWhjNmMwb3M1Y28wejFwb0EyS0tFQT09).
Appointments at other times may be arranged by e-mail.

Course credits: 3.00

Prerequisites: 1 of: MBIO 1010/1011 (Microbiology I), or
BIOL 1030/1031 (Biology 2: Diversity, Function and Interactions)
& 1 of: CHEM 1110/1111 (Intro Chem 2: Interaction, Reactivity and Chemical Properties), or
the former CHEM 1310/1311
A minimum grade of 'C' is required in each prerequisite.

Dates: 2022 September 7 – December 12

Class times: MWF 12:30-1:20 pm
Location: 217 Wallace Building

Text: *Biogeochemistry: An Analysis of Global Change. 4th edition.*
by W.S. Schlesinger & E.S. Bernhardt; ISBN 9780128146088
or e-book version; ISBN 9780128146095
Some course materials will be made available through UM Learn.

Background expected: This is a 2000 level course, which indicates that it is offered at an introductory level. Some university-level background in microbiology/biology and chemistry is required – and with more background, you will also get more out of this course!

Learning objectives: As a result of working through this course, students will be able to…

1. Demonstrate familiarity with the dominant chemical forms, and the mechanisms of exchange between chemical forms, for the major elements required by living things: carbon, hydrogen, nitrogen, oxygen, phosphorus, sulfur ('CHNOPS')
2. Demonstrate how characteristics of the atmosphere, oceans, inland freshwater bodies, and soils influence biogeochemical cycling in those environments
3. Explain the energetic constraints on the transformations between chemical forms for the major elements required by living things
4. Identify biotic and abiotic interactions and potential feedback loops involved in biogeochemical cycles
5. Apply knowledge gained in the class to examine how biogeochemical cycles are impacted by a forcing factor, whether that be anthropogenic or natural

6. Develop and articulate a thoughtful perspective on how human activities interact with biogeochemical cycling, and how or whether societies should attempt to manage these impacts

Evaluations:

Self-assessments of understanding via UM Learn (2%, scored based on completion only): I will post several short self-assessment exercises on UM Learn that you can use to help yourself gauge which topics you understand well, and which may require additional study.

Homework assignments (2 @ 10% each, 1 @ 3%): detailed instructions will be provided later. In the event that assignments are not completed, this will be considered adequate grounds for awarding an overall grade of 'F' for the course.

Midterm exam #1 (20%): will be administered during the scheduled class period on October 5th, and will include material covered up to that point.

Midterm exam #2 (20%): will be administered during the scheduled class period on November 2nd, and will include material covered after midterm exam #1.

On the midterm exams, some questions will measure recall of materials, while some will require critical thinking and integration of content from different lectures. These will be closed-book exams, meaning that you should not consult any reference sources while completing the exam.

Missed midterms will not be available for writing later. In the event that you miss a midterm, regardless of the reason, you will have to discuss with the instructor what the implications for your grade will be.

Final exam (35%): scheduling is determined by the Student Records Office. The final exam will be comprehensive across the term, but will be weighted toward material from the final 1/3 of the term.

Feedback from at least one midterm exam will be provided prior to the voluntary withdrawal date.

Letter grades will only be assigned at the end of the term. Letter grades are assigned taking into consideration the grade distribution in the class and the University of Manitoba's descriptors (see http://umanitoba.ca/student/records/grades/686.html): A+ (Exceptional), A (Excellent), B+ (Very Good), B (Good), C+ (Satisfactory), C (Adequate), D (Marginal), F (Failure).

Student responsibilities: *If you hope to learn this subject area effectively, you must take an active role in your own learning!* Students are expected to complete assigned readings, participate in class discussions, take their own notes in addition to materials supplied by the instructor, provide feedback on the learning process, hand in their assignments on time, and comply with the evaluation requirements. University policies, such as the Respectful Work and Learning Environment policy, apply to all activities associated with this course.

Reasonable Accommodation: The University of Manitoba is committed to providing an accessible academic community. Accessibility | University of Manitoba (umanitoba.ca) offers academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability

(e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact Student Accessibility Services to arrange a confidential consultation:

520 University Centre

204-474-7423

Student_accessibility@umanitoba.ca

Please review the guidance for this term from the Faculty of Science, which follows and is a component of this syllabus.

Tentative course outline:

Introduction

Cycling of Elements: Mercury

Cycling of Elements: Phosphorus, interspersed with
Earth's Environments: inland waters, rocks & soils

Cycling of Elements: Carbon, interspersed with
Earth's Environments: atmosphere, oceans

Cycling of Elements: Oxygen

Energetics & redox reactions

Cycling of Elements: Iron

Cycling of Elements: Sulfur

Cycling of Elements: Nitrogen

Human impacts & management of biogeochemical cycles

Methods in biogeochemistry