CHM 310S: Environmental Chemistry

Introduction

This course considers the chemistry of carbon in the environment, by studying its many chemical forms and the environmental effects associated with those compounds. We will focus on three important environmental issues that currently challenge global society:

1. Climate change – primarily driven by increasing levels of carbon dioxide in the atmosphere:
   - What determines the temperature of our planet?
   - Is our climate changing and how will it change in the future?
   - How does carbon dioxide play a role?
   - What chemistry governs where this carbon comes from and where it will eventually go?
2. Energy supplies and geoengineering – the World's energy supply is largely fossil fuel-based:
   - What is the chemistry of fuel sources currently being used?
   - What role does chemistry play in the development of alternate fuels?
   - Can (and should) we purposefully modify the climate of the planet?
3. Organic Pollutants – most of the toxic contaminants in our environment are organic:
   - What forms of organic compounds exist in the environment?
   - What factors determine how their partitioning in the environment?
   - What chemical factors determine their reactive fate in the environment?

Learning Outcomes

At the end of this course, you will be able to use fundamental concepts in first-year chemistry (e.g. thermodynamic, kinetic, electrochemical) to describe the above phenomena and issues. You will learn how to borrow concepts from physics, biology and engineering as we move along. By so doing, you will be able to critically assess environmentally important issues using a scientific focus. Science communication is important, and so the course gives you opportunities to improve your communication skills, both orally and in a written form. Science is also highly collaborative, and you will gain practice providing useful feedback to other students in your tutorial.

Lecturer	Jon Abbatt, jonathan.abbatt@utoronto.ca
JA's Office Hours	Friday, 11:00 am to 12:00 pm. Please look for the BB Collaborate link. Note that I would prefer videos on for office hours but I will not require it. Office hours are not recorded.
TAs	Stephanie Schneider, steph.schneider@mail.utoronto.ca Zilin Zhou, zilin.zhou@mail.utoronto.ca
Lectures	T/Th 2:10-3:00. Lectures will be via BB Collaborate in Quercus. Please go to the BB Collaborate page of the course website for the scheduled sessions. Lectures will be recorded and posted in BB Collaborate (click on the three horizontal bars to find them), but I encourage you to watch them live. The learning experience is better if you listen to a live lecture; it is too tempting to lose attention if you watch asynchronously. Plus, it is good to have some structure in your weekly schedules.
Grading Scheme	1. Mid-term and Final online assessments – 45% total, weighted (midterm/final) as 15%/30% or 20%/25% depending on which combination gives you the top mark. You will have 24 hours to complete the assessments but the actual length will be roughly what you would have completed in either 1 hour (midterm) or 2 hours (final) if conducted in-person in a classroom. 2. Problem Sets (you need to complete 3 of 4; completing the 4th does not improve your grade) – 15% 3. Science Brief Exercise – 20% for written submission, 10% for oral presentation, 10% for tutorial participation (see details below), 2% bonus if you submit an early, optional 10-line description of your Science Brief topic.

Textbook	Environmental Chemistry, Colin Baird and Michael Cann, 5th Edition Please use the textbook as a reference. You are only responsible for material that we cover in class. Also, we do not necessarily cover the material in the same manner as does the book.
Prerequisites	First year Chemistry and Math. CHM 210H is not a pre-req. CHM 210H and 310H cover different material but share a few topics, e.g. pH of natural waters. Together CHM210H and 310H cover all of Baird and Cann, and they provide a comprehensive introduction to the field of environmental chemistry.
Quercus	I will post slides on Quercus before each lecture. All scheduling announcements will be on Quercus. I will sometimes give tips on how to solve problems or to prepare for the assessments in the lectures, but not necessarily in Quercus. I will try to remember to record each lecture but let me know if I forgot to start the recording!
Absences/Late	Problem Sets: Because you only need to complete 3 of 4, late problem sets are not accepted. An exception is a personal issue that will not allow you to do 3; please contact Jon Abbatt within 24 hours of the due date in that case. Science Briefs: Late written Science Briefs will lose 10%/24 hours late, i.e. what would have been worth 80% will get 70% if up to 24 hours late. Assessments: There are no make-up mid-term assessments; instead, with appropriate documentation, I will pro-rate the other elements of the course. Oral Presentation: You will receive zero for your presentation if it is not ready on the scheduled day. To not lose any credit for a late written Science Brief, or a missed assessment/presentation, you must hand in a medical (or equivalent) justification to Jon Abbatt, no later than a week after the due date.
Help Sessions	Prior to a problem set deadline, the TAs will hold online Q&A sessions open to anyone in the class. They will be held during the Arts and Science scheduled tutorial times. As well, they will hold a help session on what makes a good oral and written Science Brief assignment.
Science Brief	It is important to learn to critically assess scientific information. To do this, you will assume the role of a science advisor in a federal or provincial Department of the Environment. As an advisor, your job is to study the state of the environment and to make scientifically supported assessments/recommendations to the Minister. Your Brief should be on a specific environmental issue. For example, "climate change" is far too broad, so is "water quality". Instead, the assessment of a specific, currently unregulated toxic chemical recently discovered in the environment would form the basis of an excellent briefing document. Your Brief may be on an issue/chemical already being addressed/regulated, in which case you should assess how well the approaches/regulations are working and whether they should be strengthened or relaxed. Or, you may want to make a proposal to the Minister related to a new environmental concern. *Length*: 800 -1000 words of text. Please provide a word count. More words than 1000 lowers the mark! References are on top of this limit. *Figures allowed*: Yes, up to 2 cut/pasted from the scientific literature. Appropriate attribution is required to not plagiarize. *References*: Required, up to 10, from the scientific literature (not popular press). The Minister has an excellent science background, so they need to be convinced! *Is this a science or policy document?*: It is a science document. However, there could be a one- or two-sentence statement of environmental policy on the issue.

How will the Brief be assessed: 1. Topic: Is the topic of current environmental importance? 2. Scientific content: Is the scientific background material provided accurate, balanced, and convincing? 3. Clarity: Is the issue clearly described, with succinct statements of the issue, assessment, and recommendations? 4. Presentation quality: Correct grammar and spelling? Clear structure to the report? Good use of figures?
Incorrect Content: The briefing will be graded poorly if it is a policy document, or if it should be passed to the Minister of Health (i.e. it is largely on biology).

Tutorials

Tutorials are oriented around the Science Brief Exercise. Your sections will not correspond to that which you signed up for officially and you will not meet every week. Rather, during weeks 2 to 3, we will schedule groups of nine students to meet four times during the semester. Besides giving you an opportunity to make an oral presentation, a goal of the tutorial is to provide you with opportunities to provide/receive feedback to/from other students on your Science Brief.

During the 1st tutorial meeting you will introduce yourself, briefly describe your Science Brief topic, and then solicit any questions from the tutorial on that topic (5 minutes total per student). The goal is that this short discussion will make your formal presentation better. Your introductions are not graded. **All discussion in the tutorials must be respectful of others.**

During the 2nd to 4th tutorial meetings you will each give short (8 minutes, maximum) oral presentations (5 powerpoint slides, maximum), followed by 5-7 minutes of discussion during which tutorial members will make suggestions, give constructive criticism, or ask questions that will help you to write your Science Brief. **All discussion in the tutorials must be respectful of others.**

Your presentation will be graded. A good presentation is clear, well-timed, has good graphics, places your topic in context, promotes discussion, and focuses on the main points. A poor presentation is not well organized, not clear, too long, or does not emphasize the main points of the science. It is hoped that the questions asked and the ensuing discussion will help you write your Science Brief.

There is a participation grade associated with the Tutorials. Good participation raises the level of discussion in the tutorial. This can be done by asking good questions or by making constructive feedback. Poor participation includes saying nothing, poor or late tutorial attendance, disrespectful comments, or domination of the discussion. I strongly encourage you to turn your videos on during the tutorials, but this is not required.

Dates

Mid-term assessment: Thursday Feb 25, starting at 6:00 pm for 24 hours
Final assessment: Time-to-be announced during the final assessment period
Introduction of your Science Brief Topic to the tutorial: Week of March 1
Oral Presentations of your Science Brief: Weeks of March 8, 15, 22
Written Science Brief: Friday April 9 at 6:00 pm.
Submission of 10-line Science Brief Topic: by Friday February 5, 6:00 pm.

Course Policies

University statement regarding a positive learning environment: "*The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities*."

This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session.

Guidance from the *U of T Vice-Provost, Students* regarding student technology requirements is available here: https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/. In particular, this course requires the use of computers, and of course sometimes things can go wrong when using them. You are responsible for ensuring that you maintain regular backup copies of your files, use antivirus software (if using your own computer), and schedule enough time when completing an assignment to allow for delays due to technical difficulties. Computer viruses, crashed hard drives, lost or corrupted files, incompatible file formats, and similar mishaps are common issues when using technology, and are not acceptable grounds for a deadline extension.

Academic Integrity

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In papers and assignments:

1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any assignment.

During assessments:

1. Using or possessing unauthorized aids.
2. Misrepresenting your identity.

In academic work:

1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required by the University.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see https://www.academicintegrity.utoronto.ca/).

Copyright

If a student wishes to copy or reproduce lecture presentations, course notes or other similar materials provided by instructors, he or she must obtain the instructor's written consent beforehand. Otherwise all such reproduction is an infringement of copyright and is prohibited. More information regarding this is available here: https://teaching.utoronto.ca/ed-tech/audio-video/copyright-considerations/

Accessibility Needs

Students with diverse learning styles and needs are welcome in this course. The University of Toronto is committed to accessibility: if you require accommodations for a disability, or have any other accessibility concerns about the course, please contact Accessibility Services as soon as possible.

Specific Topics (Chapters 5-9, 13-15 of Baird and Cann):

A. Introduction – True/False, Formation of the Global Environment (2 lectures)

B. The Chemistry of Climate (8 lectures)
   i. Climate System, Greenhouse Effect
   ii. Greenhouse Gases – Sources and Fate
   iii. Aerosols and Clouds – Climate Effects
   iv. Carbon Cycle, including Ocean Chemistry
   v. Predictions and Observations of Climate Change

C. The Chemistry of Energy (6 lectures)
   vi. Introduction – Global trends, Thermodynamic Efficiency, Heat Engines
   vii. Conventional Fuels – Fossil Fuels and Nuclear Fission
   viii. Alternative Energy Sources – Biofuels, Photoelectric, H_2, Fusion
   ix. Solutions – Geoengineering, Carbon Burial, Aerosol Modification

D. The Chemistry of Organics in the Environment (7 lectures)
   x. Partitioning – Vapor Pressure, Solubility
   xi. Organics in Soil and Water
   xii. Organics in the Atmosphere, Reactions
   xiii. A Toxic Tour