

**I. Teaching Team**

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Instructor: Professor Jennifer Murphy      Email: [jen.murphy@utoronto.ca](mailto:jen.murphy@utoronto.ca)  
Classes: Tues (BA1170), Thurs (RW110) 14:10 – 15:00  
Student hours: Monday 12:10 – 13:00, <https://utoronto.zoom.us/j/87542323904> Pwd: CHM210  
Thursday 13:10 – 14:00 in RW109



TAs: Alex Corapi ([alex.corapi@mail.utoronto.ca](mailto:alex.corapi@mail.utoronto.ca)), Tutorials 1-6  
Olivia Driessen ([o.driessen@mail.utoronto.ca](mailto:o.driessen@mail.utoronto.ca)), Tutorials 7-12  
Tutorials: Fri (UC85 or computer labs) either 11:00-12:00, 12:00-13:00, or 15:00-16:00

Please attend the tutorial session for which you are registered on Fridays – some tutorials will take place in a student computer lab to give guidance on R-based assignments. Check Quercus for details.

Please contact Professor Murphy or a TA if you have urgent questions or problems. Email is fine for short questions, but conceptual issues are best handled in student hours or by appointment. The teaching team will endeavour to respond to emails within 24 hours on weekdays.

**II. Course Overview**

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**Course description** This course examines the fundamental chemical processes of the Earth's natural environment, and changes induced by human activity. Topics related to the atmosphere: urban air pollution, stratospheric ozone depletion, acid rain, climate change; the hydrosphere: water resources and pollution, ocean acidification; biogeochemistry, and inorganic metals in the environment. The primary goal of this class is to describe the workings of a complex chemical system using concepts such as chemical kinetics, thermodynamics and oxidation/reduction. The secondary goal is to develop a detailed understanding of a number of important environmental phenomena, such as urban smog, global climate change and heavy metal pollution.

**Student learning outcomes** Upon successful completion of this course, students will be able to:

- 1) describe the workings of a complex chemical system using concepts such as chemical kinetics, thermodynamics, and oxidation/reduction
- 2) recognize the chemical aspects of important environmental issues such as urban smog, climate change, and heavy metal pollution
- 3) perform data analysis and visualization of environmental monitoring data accessible on public databases
- 4) access and critically evaluate scientific information in the literature and provide a plain language synopsis

**Tutorial objectives** The tutorial is a critical element of this course, and weekly attendance is expected. The tutorial will provide instruction on the R software package and the programming-related aspects of Assignments 1-3 can be completed during the tutorial session itself. Tutorials will provide opportunities for guided group problem-solving, discussion of news stories related to class material, and will enhance what is covered in the class notes and textbook readings. In addition to the problems tackled during the tutorial, practice problems from the textbook and the solutions to weekly quizzes will also be discussed. A TA is present to guide discussions and answer questions, but active participation from all students is expected.

**Pre-requisite courses** CHM135H/CHM151Y, (MAT135H/MAT137Y/MAT157Y)

This course assumes you have a basic understanding of kinetics, thermodynamics and electrochemistry from first year chemistry courses, and a basic understanding of calculus from first year math courses. Please complete the self-assessment on Quercus to evaluate your level of preparation for the course. This course is a pre-requisite for CHM415 – Atmospheric Chemistry and ENV316 – Lab and Field Methods in Environmental Science.

**Required textbook** *Environmental Chemistry*, 5<sup>th</sup> edition, Colin Baird and Michael Cann, W.H. Freeman and Company (new or used at UofT bookstore). A better alternative may be to access a digital copy: [Environmental Chemistry 5th edition | 9781429277044, 9781464129001 | University of Toronto \(vitalsource.com\)](#)

Practice problems at the end of the chapters we cover are a good way to evaluate your understanding.

**Course website** is on Quercus: <https://q.utoronto.ca> (use your UTORID). You are responsible for checking this site regularly for announcements and content. Skeletal class notes are posted 24 hours prior to each class. Assignments and quizzes will be submitted electronically via Quercus.

**Technology Requirements** To complete the programming requirements in this course, you will make use of R Studio, which can be accessed via JupyterHub when online. Students who have laptops or tablets are encouraged to bring them to tutorial sessions focused on Assignments 1-3, but during those weeks we will meet in a computer lab to ensure computer access for all students.

### III. Course Organization

<b>Grading (maximum of Scheme 1 or Scheme 2 for each student)</b>	<b>Scheme 1</b>	<b>Scheme 2</b>
Assignments (due Sep 20, Oct 2, Oct 18, Oct 30, Nov 20, Dec 6)	30 %	40 %
Press Release (due Nov 15)	10 %	10 %
Pre-tutorial Quizzes	10 %	10 %
Term test (Oct 16, 18:00-20:00)	15 %	10 %
Final exam (in-person, cumulative, during finals period)	35 %	30 %

(Bonus points 0.5% each for completing self-assessment and pre and post-CDS surveys)

**Assignments (due Sep 20, Oct 2, Oct 18, Oct 30, Nov 20, Dec 6 at 5:00 pm ET)**

The assignments include a mix of qualitative and quantitative questions following the topics covered in class. Completion of the assignments should not only further your understanding of the course material but also teach you some basics of scientific computing, data visualization and analysis. You do not need pre-existing knowledge of R or computer programming, and these assignments can be completed from wherever you access the internet currently. Students are encouraged to discuss concepts and problem-solving strategies with other students in the course, but the work you submit must reflect your own *independent* understanding.

**Press Release (due Nov 15 at 5:00 pm ET)**

You will write a press release (450-550 words) about a 2023 journal article from *Environmental Science and Technology* (ES&T). The selected article should have an environmental chemistry theme and ideally be related to a topic covered in this course. Specific guidelines will be provided on Quercus and discussed in Class.

**Quizzes (due by 10 am ET Friday on most weeks)**

Quizzes will be administered via Quercus and consist of a few questions that evaluate your understanding of the class material and related problems from the previous week. Reviewing your course notes, completing the practice problems from the textbook, and actively participating in tutorials are the best way to prepare.

## **IV. Course Policies**

### **Course Etiquette**

Each member of this course is expected to maintain a:

- (i) professional and respectful attitude during all course activities, including classes, tutorials and online
- (ii) personal calendar/schedule/organizer to ensure that all course activities are completed on time
- (iii) collection of notes recorded independently based on concepts covered in course activities (students registered with Accessibility Services requiring a class note-taker will have access to this accommodation)
- (iv) familiarity with the university policy on Academic Integrity (overleaf)

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. As a Course Instructor, I will neither condone nor tolerate behaviour that undermines the dignity or self-esteem of any individual in this course and wish to be alerted to any attempt to create an intimidating or hostile environment. It is our collective responsibility to create a space that is inclusive and welcomes discussion. Discrimination, harassment and hate speech will not be tolerated. If you have any questions, comments, or concerns, we encourage you to reach out to the staff in our Equity Offices.

In keeping with this approach, when transmission rates of infectious diseases are high, I strongly encourage students to wear a mask during class and tutorial, to create a space that is safe and inclusive for others including your fellow students, their family members, and our wider community.

### **Absences**

Students who miss class or tutorial are responsible for making up the missed material, and are encouraged to ask another student to share their notes.

If your absence means you are unable to complete course work (e.g. an Assignment, Press Release, Term Test), then one of the following pieces of documentation is required:

1. [Absence Declaration via ACORN](#) (please note the limitations for eligibility)
2. [U of T Verification of Illness or Injury Form](#)
3. College Registrar's letter
4. Letter of Academic Accommodation from Accessibility Services

Students must contact Professor Murphy to provide documentation and discuss their situation as soon as possible, and certainly within five business days of the missed piece of work. This is essential action for any consideration to be granted. Screen capture recordings of classes may be available and can be requested for a class you miss due to documented illness or unavoidable absence, by emailing Professor Murphy with the subject line "CHM210 – Missed Class X", where X is the number of the class (see schedule below).

For extended absences and for absences due to non-medical reasons, make sure to contact your [College Registrar's Office](#). They can help you decide between a request for an extension or other types of academic consideration.

## **Accessibility Needs**

Students with diverse learning styles and needs are welcome in this course. If you suspect or know that you have a disability that is affecting your studies, that may require accommodations, [learn about the services and supports available through Accessibility Services](#). A disability can be physical disability, sensory disability, a learning disability, mental health disorder or a short-term disability like an injury. If you are not sure whether you have a disability, you can confidentially contact [Accessibility Services](#) with your questions.

## **Accommodations for Religious Observances**

Following the University's policies, reasonable accommodations will be made for students who observe religious holy days that coincide with the due date/time of an assignment, tutorial, class or laboratory session. Students must inform the instructor before the session/assignment date to arrange accommodations.

## **Late Penalties and Bonus Days for Assignments and Press Release**

Each student starts the semester with three 'bonus days', which they can use to incur up to three late days without being assessed a penalty. Bonus days can be spread over one or more assignment (e.g. one assignment three days late or three assignments each one day late).

After that, late submissions with no accompanying Absence or Accommodation documentation will be penalized 10 % per day of lateness, to a maximum of 7 days past the due date.

Quizzes cannot be submitted late but your lowest quiz grade will be dropped.

## **Artificial Intelligence Tools**

Students may not copy or paraphrase from any generative artificial intelligence applications, including ChatGPT and other AI writing and coding assistants, for the purpose of completing the Assignments, Press Release or Quizzes in this course.

## **V. Institutional Policies**

### **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.

On quizzes and term tests:

1. Using or possessing unauthorized aids. **Please note that the use of websites (such as Chegg.com or the course discussion board) to post quiz/term test questions or to post/access answers to questions is an academic offence**

2. Looking at someone else's answers or collaborating/discussing during a quiz or test.
3. 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/>).

#### Use of plagiarism detection software

Normally, students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (<https://uoft.me/pdt-faq>)

#### **Additional Services & Support**

The following are some important links to help you with academic and/or technical service and support:

- General student services and resources at [Student Life](#)
- Full library service through [University of Toronto Libraries](#)
- Resources on conducting online research through [University Libraries Research](#)
- Resources on academic support from the [Academic Success Centre](#)
- Learner support at the [Writing Centre](#)
- Information for [Technical Support/Quercus Support](#)

#### **Acknowledgement of Traditional Lands**

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca and, most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

**Class Schedule**

Class 1 Overview, syllabus, earth system and residence time concepts (pages xix-xxv, 216-219)

**Atmospheric Chemistry (Part I of Baird and Cann, page numbers refer to 5<sup>th</sup> edition)**

Class 2 Stratospheric chemistry, Chapman cycle (pages 1-20)  
Class 3 Stratospheric chemistry, catalytic ozone destruction (pages 20-33)  
Class 4 Stratospheric chemistry, ozone hole (pages 37-64)  
Class 5 Tropospheric chemistry, VOC oxidation (pages 69-76 and 755-771)  
Class 6 Tropospheric chemistry, smog and NO<sub>x</sub> (page 76-83)  
Class 7 Tropospheric chemistry, ozone control strategies (pages 84-101)  
Class 8 Air pollution, sulphur emissions and oxidation (pages 109-118, 771-772 and Appendix 1)  
Class 9 Air pollution, particulate matter (pages 118-130)  
Class 10 Consequences of air pollution: acid rain and human health (pages 135-152)  
Class 11 Review of atmospheric chemistry to prepare for term test

**Energy and Climate Change (Part II of Baird and Cann, page numbers refer to 5<sup>th</sup> edition)**

Class 12 Greenhouse effect and Earth's energy balance (pages 165 – 177)  
Class 13 Major greenhouse gases (pages 177 – 197) and redox review (Appendix AP1-AP2)  
Class 14 Climate impacts of aerosol and SRM geoengineering (pages 197 – 216)  
Class 15 Energy use and carbon emissions (pages 223 - 249)  
Class 16 Carbon cycle and CRM geoengineering (pages 252 - 267)

**Water Chemistry and Water Pollution (Part III of Baird and Cann, page numbers refer to 5<sup>th</sup> edition)**

Class 17 Natural waters and dissolved oxygen (pages 409-417)  
Class 18 Dissolved organic matter, sulfur and acid mine drainage (pages 419-424)  
Class 19 Redox chemistry and the pE scale (pages 424-430)  
Class 20 Water in equilibrium with carbon dioxide and carbonate (pages 431-442)  
Class 21 Water in equilibrium with carbon dioxide and carbonate, continued (pages 431-442)  
Class 22 Ions in water (calcium and aluminum) (pages 442-450)  
Class 23 Mercury biogeochemistry (pages 519-536)  
Class 24 Lead pollution in the environment (pages 537-552)