CHM1410H Analytical Environmental Chemistry
Course Syllabus: Fall 2023

Instructor and Laboratory Coordinator: Prof. Jessica D'eon, jessica.deon@utoronto.ca

Classes: Tuesdays and Thursdays 4-5 PM in UC 261

Student Hours: TBD

I want to mention explicitly that I enjoy student hours tremendously and that this is time I have set aside to answer your questions about the lab or class, or to just chat about your research or decisions you are making post-graduation. I want to be clear that I am looking forward to speaking with you, so please attend! Helping you be successful in this class is my job!

Laboratory: Friday 9:00 AM – 12:30 PM or Friday 1:00 – 4:30 PM

The laboratory sessions will be held in person in LM6 (ANALEST). If you are unable to come to lab for illness, or any other reason, be sure to complete the ACORN self-declaration and get in touch with Prof. D'eon as soon as possible.

Course Goals

This course seeks to produce analysts with a basic conceptual understanding of a broad range of modern analytical equipment and data analysis strategies relevant to trace environmental analysis. The lab component is designed to provide practical knowledge of sample collection and analysis, as well as data interpretation and visualization involved in environmental analysis.

Student Learning Outcomes

Upon successfully completing CHM410H-1410H, students will be able to design an environmental analysis starting with a literature search through experimental design and data analysis.

To complete this task students must be able to:

1. Search the scientific literature for relevant background information and methodologies.
2. Make educated decisions related to analytical methodology and instrumentation.
3. Assess and communicate analytical data quality.
4. Analyze, interpret, and effectively visualize analytical data.
5. Confidently ask for help or advice.

Discussion Topics

Unit 1: Chemical Partitioning, Sample Preparation and Quality Control. These techniques ensure the concentrations we observe in the lab reflect the concentrations present in the environment.

Unit 2: Chromatography. Chromatography is relevant both as a separation technique to separate chemicals of interest from each other and possible interferences, as well as an effective means of delivering the compound of interest to the chosen detector.

Unit 3: Mass Spectrometry Instrumentation and Scan Types. we will discuss the major types of mass spectrometers and how their various abilities to scan mass-to-charge ratios affects their applications to different environmentally-relevant chemical analyses.

Unit 4: Ionization for Mass Spectrometric Analysis. We will discuss a variety of ways gas phase ions are produced for analysis by mass spectrometry and how these processes are optimized for environmental applications.

Grading Scheme

R-introduction	2%
Lab 1: Kinetics of Dye	
Pre-Lab Exercise	1%
Lab Report	20%
Lab 2: Field Trip	
Pre-Lab Exercise	1%
Report Outline	4%
Lab Report	20%
Lab 3: Analysis of Honey by NMR	
Pre-Lab Exercise	1%
Mini-report	4%
Lab 4: Student-Directed Projects	
Group Proposal	5%
Group Presentation	10%
Report for Future Students	5%
Client Deliverable	5%
Personal Refection	4%
In-Class Participation*	3%
Final Oral Exam	
Reflection	2%
Oral Exam	13%

*Note on in-class participation: This component of your grade relates specifically to participation during the graduate student presentations at the end of term. Current Environmental Chemistry graduate students will present their current research so we can see how the content from the class fits within the larger environmental chemistry context. In addition to the results they present, it is useful to hear about how they designed their experiments, the pitfalls they encountered, and their approach to troubleshooting. They are also open to discussing their career trajectories so far. I would like to inspire and reward you for engaging these presenters in a lively discussion and so participation grades will be handed out as follows:

0% – 0 questions or comments

2% – 1 question or comment

4% – 2 questions or comments

5% – 3 or more questions or comments

The number of questions or comments is a cumulative number for all the presentations over the course of the semester. If you are unable to attend any of the presentations, please complete the ACORN self-declaration (if appropriate) and contact Prof. D'eon to discuss accommodations if necessary.

Final Oral Exam

This year CHM410H-1410H will not include any typical tests or exams. Instead, the class will include a final 20-minute individual oral exam with Prof. D'eon which will be held during the first week of the final exam period (December 11-15, 2022). 48-hours before your scheduled exam you will submit a short Quercus quiz

that provides some details about one of the graduate student presentations during the semester. Your reflection will serve as the starting point for the discussion; however, the discussion can move to any topic discussed in the class.

Class and Lab Schedule

Week 1+	Sept	7	R	Class and Lab Introduction	
	Sept	12	T	Lab 1 Kinetics refresher	
	Sept	14	R	Lab 1 Planning and Start Unit 1	
	Sept	15	F	**Lab 1: Kinetics 1**	
Week 2	Sept	19	T	Unit 1: Chemical Partitioning	
	Sept	21	R	Unit 1: Sample Extraction and Cleanup	
	Sept	22	F	**Lab 1: Kinetics 2**	**Deadline** – R Introduction 1
Week 3	Sept	26	T	Lab 3 Field Trip Discussion	
	Sept	28	R	PFAA discussion and context	
	Sept	29	F	**Lab 2: Field Trip**	**Deadline** – R Introduction 2
Week 4	Oct	3	T	Unit 1: Quality Control	
	Oct	5	R	Unit 2: Introduction to Chromatography	
	Oct	6	F	**Lab 2: Field Trip in lab Analysis**	**Deadline** – Lab 1: Kinetics
Week 5	Oct	10	T	Unit 2: GC and LC discussion	
	Oct	12	R	Unit 3: Mass Spectrometry I	
	Oct	13	F	**Lab 3: Analysis of Honey and Syrups Using NMR**	**Deadline** – Lab 4: Project Proposals
Week 6	Oct	17	T	Unit 3: Mass Spectrometry II	
	Oct	19	R	Unit 4: Introduction to MS Ionization	
	Oct	20	F	**Lab 2: Field Trip Data Analysis**	**Deadline** – Lab 3: NMR of Honey
Week 7	Oct	24	T	Unit 4: GC-MS Ionization Interfaces	
	Oct	26	R	Unit 4: LC-MS Ionization Interfaces	
	Oct	27	F	**Lab 4: Student Directed Projects 1**	
Week 8	Oct	31	T	Project Check in	
	Nov	2	R	MS Applications - Non-target Analysis	
	Nov	3	F	**Lab 4: Student Directed Projects 2**	**Deadline** – Lab 2: Field Trip Outline
	Nov	7	T		
	Nov	9	R	**Fall Break**	
	Nov	10	F		
Week 9	Nov	14	T	Project Check in	
	Nov	16	R	Graduate Student Presentation and Discussion	
	Nov	17	F	**Lab 4: Student Directed Projects 3**	**Deadline** – Lab 2: Field Trip Report
Week 10	Nov	21	T	Project Check in	
	Nov	23	R	Graduate Student Presentation and Discussion	
	Nov	24	F	**Lab 4: Student Directed Projects 4**	
Week 11	Nov	28	T	Project Check in	
	Nov	30	R	Graduate Student Presentation and Discussion	
	Dec	1	F	**Student Directed Projects Presentations**	
Week 12	Dec	5	T	MS Applications - DIA	**Deadline** – Lab 4: Report, Client Deliverable and Reflection
	Dec 11 – 15			Final oral exam during the final Assessment Period	

Technological Requirements

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, broken printers, 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.

Specific 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/

Advice for students more broadly regarding online learning is available here: https://onlinelearning.utoronto.ca/getting-ready-for-online/

Etiquette, Online and In-Person

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. 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.

Textbook or Readings

There is no textbook requirement for CHM 410H-1410H. As this course aims to present current topics in environmental analytical chemistry, primary scientific literature resources are provided when appropriate and can be accessed via Quercus.

Email Policy

I look forward to communicating with you and welcome your emails. I will try my best to respond to your emails within 24 hours on weekdays.

Late Policy

Anything handed in late, in the lab or the class, will be docked 10% per day including the weekend. If you require an extension on course work contact Prof. D'eon by email.

Academic Integrity

I want you to feel supported in your learning and so you are welcome to seek guidance from the TAs and instructors. You are also welcome to work constructively with your peers on the general content and understanding of the material. However, all reports and assignments submitted in this class MUST represent your own independent work and comprehension. 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: Using someone else's ideas or words without appropriate acknowledgement; Submitting your own work in more than one course without the permission of the instructor; Making up sources or facts; Obtaining or providing unauthorized assistance on any assignment.

On tests and exams: Using or possessing unauthorized aids; Looking at someone else's answers during an exam or test; Misrepresenting your identity.

In academic work: Falsifying institutional documents or grades; 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 Generative AI Tools

Generative Artificial Intelligence (AI) can create writing, computer code, and /or images using minimal human prompting, are proliferating and becoming ubiquitous. This includes not only GPT-4 (and its siblings ChatGPT and Bing), but many writing assistants that are built on this or similar AI technologies. There are now hundreds of these systems that are readily available. We will discuss the use of these tools in class and specific details on how they may, or may not, be used will be provided on Quercus for each assessment.

Accessibility

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.

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.

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.

Additional Services and 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.

Website and Online Interfaces

All material for both class and lab will be provided through Quercus. You are responsible for checking this site regularly. Any online synchronous classes and labs will be conducted over Zoom. Specific details for each meeting will be provided on Quercus.

Class Recording and Copyright
Some aspect of this course might be recorded and made available to students for viewing remotely. If a session is being recorded, you will be notified on the day. Course videos and materials belong to the instructors and TAs and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the specific instructor. For questions about recording and use of videos in which you appear please contact Prof. D'eon.

Laboratory Objective
The CHM410H-1410H laboratory provides students with practical experience in the analysis of environmental contaminants. When the labs are presented in person, mastery of the lab skills necessary to perform these high-level analyses is a clear learning objective of the lab. However, this has only ever been a minor objective of the laboratory. The major objective is to solidify the in-class learning by handling, manipulating and visualizing data.

Laboratory Groups
Each session will be divided into three lab groups (morning – Groups A, B, C and afternoon – Groups D, E, F), each with a maximum of six students. Lab groups will be assigned by Prof. D'eon using the results of the introductory survey. The students in each lab group will work together to complete the physical work of each lab. You are encouraged to work together and form a cohort who moves together through the class.

Lab Preparation
You are required to come to each lab session prepared to discuss the relevant topic. Specific preparation for each lab will be outlined on Quercus and each lab module will include a per-lab assignment on Quercus that is due prior to your lab period (9 am for the morning session and 1 pm for the afternoon session). Any questions about the pre-lab material should be directed to Prof. D'eon.

Lab Participation
If for any reason you are unable to attend any lab period, please let the lab coordinator know as soon as possible.

Plagiarism Detection Tool (Ouriginal)
Normally, students will be required to submit their lab reports 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.

Laboratory Teaching Assistants
We have a fantastic teaching team in CHM 410H-1410H that includes amazing graduate student teaching assistants. All the TAs are graduate students in our environmental chemistry program and have either taken the class or TAed it (or both) in the past, and they are looking forward to working with you. This being said, the TAs work on contract with very specific hour allocations for contact with the CHM 410H-1410H students and if you require assistance outside the lab meeting time it is best practice to attend student hours or send an email to the lab coordinator, Prof. D'eon.

Laboratory Content
Over the course of CHM410H-1410H you will complete five experiments. Detailed instructions and deliverables for each experiment are provided on Quercus.

Lab 1: Advanced Oxidation of an Organic Dye
Lead TA: Will Fahy, william.fahy@mail.utoronto.ca

Lab 1 involves a kinetic evaluation of the oxidation of dye by hydrogen peroxide. This two week lab will allow you to explore how to conduct a kinetic experiment and analyze the data.

Lab 2: Analysis of Perfluoroalkyl Acids in Lake Niapenco
Lead TA: Jillian Downey, j.downey@mail.utoronto.ca

Lab 2 involves a field trip for the collection of water, sediment and biological (fish, shrimp, snails, bugs…) samples, with subsequent matrix-specific extraction and analysis for four perfluoroalkyl acids (PFAAs). Outside of the practical aspects, this lab provides students with an opportunity to synthesize data from a range of PFAAs in a wide range of sample matrices within the same ecosystem.

Lab 3: NMR as a Tool for Quality Control in the Food Industry
Lead TA: Will Fahy, william.fahy@mail.utoronto.ca

Lab 3 involves the analysis of honey using nuclear magnetic resonance spectrometry. Using your generated spectra, you will identify and quantify the sugars present and then compare your entire spectra to previous samples using principal component analysis (PCA) to try to identify honey from different regions or samples that may be adulterated.

Lab 4: Student-Directed Group Projects
Lead TAs: Andrew Folkerson andrew.folkerson@mail.utoronto.ca
Holly Barrett holly.barrett@mail.utoronto.ca
Maggie Wang maggiewyt.wang@mail.utoronto.ca

In this lab you will work with a TA mentor to design and implement a project of your choosing. Since the inception of these projects in fall 2014, groups have been coming up with their own project topics, but we're going to try something a bit different this year. The analytical chemistry skills we are developing in this class are not typically applied independent of a specific objective and so this year I've solicited projects from members of the community where they have an issue or question that we can try to tackle. Here are the projects lined up for this year:

1. The TDSB sustainability office is interested in characterizing the air quality and environmental benefits of having kids walk or bike to school as opposed to being driven by a caregiver.
2. The Trinity College Garden are currently only planting in above ground beds and are interested in characterizing potential toxins in the soil so they feel confident about planting in the ground.
3. The Trinity College Garden is interested in understanding potential hazards of re-purposing used coffee grounds and newsprint for growing mushrooms to use in their cafeteria.

Groups are also welcome to decide not to pursue one of these objectives and come up with their own study, if this is the case you might want to consider one from the four project research streams (details on Quercus).

Remember, like life, these projects are about the journey not the destination and so it is the experience of planning, executing, and iterating an analysis that is important here, not the final product you are able to produce.