**CHEM 4305 (5606) – A**

**Environmental Chemistry & Toxicology**

**Winter, 2024**

**Course Outline**

**Contact Information**

Dr. Amy Rand, [amy.rand@carleton.ca](mailto:amy.rand@carleton.ca)

**OFFICE HOURS\***

I will respond to student emails and messages about **lecture material** during office hours ONLY. Any **academic accomodations and missed course work** will receive a response from me within 1 business day.



Tuesdays, 2:00 – 4:00 pm



\*In the event that I will cancel an office hour due to an infrequent scheduling conflict, the make up office hours that week will be posted on Brightspace

**COURSE DESCRIPTION**

Overview of environmental chemistry and toxicology principles including chemical sources, fate, and effects in the environment. Examining organic reactions occurring in abiotic environments and biological systems and studying aspects of toxicant disposition and biotransformation. Emphasis on contemporary problems in human health and the environment. Prerequisite(s): CHEM 2203 (or CHEM 2207), and CHEM 2800 or CHEM2103, or BIOC 3101 or permission of the department. Also offered at the graduate level, with different requirements, as CHEM 5606, for which additional credit is precluded. Lectures three hours a week.



It is the **students’ responsibility** to ensure they come to class prepared. Partial notes will be available on *Brightspace* and will consist largely of figures and reactions. If you print the slides ahead of time, and take note of what is said in class, you will be in a strong position for success. In-class time will also be dedicated to formative assessment. This type of assessment does not count for marks. Rather, it is an opportunity for you to work with the material when it is fresh in your mind and obtain feedback on areas of improvement.



This course will be supported by *Brightspace* and is the primary method of electronic communication with students outside of class. It will be used to post announcements, lecture material, assignments, and marks.



This is an in-person course: lecture material will uploaded to *Brightspace* within 24 h prior to each designated lecture. It is your responsibility to attend class, take notes, keep up to date, and be familiar with ALL dates and deadlines listed in this course outline. If this class will be online due to public health guidelines, lectures will be recorded and posted within 24 h after the designated lecture.



**LAND ACKNOWLEDGMENT**

At Carleton University, it is important that we acknowledge that the land on which we gather is the traditional and unceded territory of the Algonquin nation.

**COURSE LEARNING OBJECTIVES**

**Unit 1: Organic reactions in the abiotic environment** – Explain the environmental fate of organic chemicals we use in our everyday lives.



**Unit 2: Partitioning and distribution** – Use fundamental chemical principles to predict where we can find a chemical (e.g. the air, water, soil, humans/animals).

**Unit 3: Organic reactions in biological systems** – Describe the defense mechanisms used by an organism to protect itself from foreign chemical exposure.



**Unit 4: Toxicant mechanisms of action** – Explain fundamental mechanisms by which foreign chemicals disturb biological processes.



Environmental chemistry and toxicology applies chemical and biological theories and techniques to tackle several global health challenges such as environmental pollution, public health, and global climate change. Education in environmental chemistry and toxicology is necessary to increase students’ awareness of these challenges, and their engagement in facing these challenges. Upon completion of CHEM 4305 (5606), you will be able to apply principles drawn from foundational biochemistry, organic, and physical chemistry to assess the abiotic and biological fate of an environmental pollutant and the response from the organism. Students will also learn to critique and discuss current topics in environmental chemistry and toxicology.



**SCHEDULE**

Lectures Mondays from 2:35 pm - 5:25 pm

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **DATE** | **DAY** | **TOPIC** | **GUEST LECTURER** | **UNIT** | **DUE DATES** |
| Jan 8 | M | Introduction & syllabus |  |  |  |
| Jan 8 | M | Peer-review info/Sci communication |  |  |  |
| Jan 15 | M | Photolysis |  | 1 |  |
| Jan 15 | M | Atmospheric oxidation |  | 1 |  |
| Jan 22 | M | Aqueous oxidation |  | 1 |  |
| Jan 22 | M | Substitution and elimination |  | 1 |  |
| Jan 29 | M | **CLASS CANCELLED** |  | 1 |  |
| Jan 29 | M | Ester reactivity |  | 1 |  |
| **Feb 2** | **F** |  |  |  | **Term paper 1 – Draft 1** |
| Feb 5 | M | Reduction |  | 1 | Assignment 1 |
| Feb 5 | M | Peer-review 1 |  |  | Peer-review 1 |
| Feb 12 | M | Partition coefficients |  | 2 |  |
| Feb 12 | M | Environmental distribution |  | 2 | Term paper 1 |
| **Feb 19** | M | **WINTER BREAK** |  |  |  |
| **Feb 19** | M | **WINTER BREAK** |  |  |  |
| Feb 26 | M | Bioaccumulation/absorption |  | 2 |  |
| Feb 26 | M | Biological distribution |  | 2 |  |
| Mar 4 | M | Reductive and oxidative strategies |  | 3 | Assignment 2 |
| Mar 4 | M | Elimination, substitution, hydrolysis |  | 3 |  |
| Mar 18 | M | Chemical bioactivation |  | 3 |  |
| Mar 18 | M | Organ selective toxicity I (liver) | T. Harris, Carleton | 4 |  |
| Mar 25 | M | Organ selective toxicity II (lung) |  | 4 | Assignment 3 |
| Mar 25 | M | Case study: Inhalation exposure | J. Corbin, NRC | 4 | Incentive Program Workshops |
| **Mar 29** | **F** |  |  |  | **Term paper 2 – Draft 1** |
| Apr 1 | M | Organ selective toxicity III (kidney) |  | 4 |  |
| Apr 1 | M | Peer-review 2 |  |  | Peer-review 2 |
| Apr 8 | M | Oxidative stress |  | 4 |  |
| Apr 8 | M | Involvement with cell signaling |  | 4 | Term paper 2 |
| Apr 12 | M | Receptor toxicity |  | 4 | Assignment 4 |
| **Note: Some classes might be moved online pending unforeseen illness, etc.** | | | | | |

**TEXTBOOKS AND RESOURCES**

No textbook is mandatory, although these may be useful resources as some of the lecture material is obtained from these texts, along with additional resources:



1. D.G. Crosby. *Environmental Toxicology and Chemistry* (1998), Oxford University Press. A copy is on reserve at MacOdrum Library.
2. R. Schwarzenbach. *Environmental Organic Chemistry* (1993), Wiley Publishing. A copy is on reserve at MacOdrum Library.
3. D. Jacobs. *Introduction to atmospheric chemistry.* <http://acmg.seas.harvard.edu/publications/jacobbook/index.html> Chapter 11: Oxidizing Power of the atmosphere.
4. T. Soderberg. *Libretexts: Organic chemistry with a biological emphasis*

<https://chem.libretexts.org/Textbook_Maps/Organic_Chemistry_Textbook_Maps/Map%3A_Organic_Chemistry_with_a_Biological_Emphasis_(Soderberg)/Chapter_08%3A_Nucleophilic_substitution_reactions_I> Chapter 8: Nucleophilic substitution reactions part 1

8.1: Introduction to the nucleophilic substitution reaction

8.2: Two mechanistic models for a nucleophilic substitution reaction

8.3: More about nucleophiles

8.4: Electrophiles and carbocation stability

8.5: Leaving groups and solvent effect

1. T. Soderberg. *Libretexts: Organic chemistry with a biological emphasis* <https://chem.libretexts.org/Textbook_Maps/Organic_Chemistry_Textbook_Maps/Map%3A_Organic_Chemistry_with_a_Biological_Emphasis_(Soderberg)/12%3A_Acyl_substitution_reactions>Chapter 12: Acyl substitution reactions
2. Additional resources of use will be indicated within each lecture.

**GRADING**



|  |  |  |
| --- | --- | --- |
| **Assignment** | **Due Date** | **Grade (%)** |
| Assignment 1 | Feb 05 | 15 |
| Assignment 2 | Mar 04 | 15 |
| Assignment 3 | Mar 25 | 15 |
| Assignment 4 | Apr 12 | 15 |
|  |  |  |
| Peer review 1 | Feb 05 | 5 |
| Term paper 1 | Feb 12 | 13 |
| Peer review 2 | Apr 01 | 5 |
| Term paper 2 | Apr 08 | 13 |
|  |  |  |
| Participation | Mar 25 | 4 |
|  |  |  |
| Total |  | 100 |

**ASSIGNMENTS**

Four assignments are to be completed during the term. The assignments will consist of material relevant to the lecture material and will include short answer questions. The completed assignments must be submitted through *Brightspace* by **11:59 pm of the due date.** Each assignment is marked for the quality of its content and has a value of 15% of the total course grade.



**TERM PAPERS & PEER-REVIEW**

**Term papers** – Students will answer a broad question that synthesizes several concepts learned throughout the course. Each paper will be no more than 750 words. Further guidelines for these term papers will be provided separately. The term paper draftsmust be submitted through *Brightspace* by **11:59 pm of the due date.**



**Peer review session 1 & 2** – Draft 1 of each term paper will be peer-reviewed either during class or outside of class throughout the semester. I will assign partners or small working groups. Students will peer-review each other using provided peer-review guidance sheets. Students must participate in the peer-review, by submitting draft 1 of the term paper and by providing your peers with feedback: both quantity and quality of contributions will be evaluated and factor into the peer-review grade. Peer-reviews must be submitted through *Brightspace* by **11:59 pm of the due date**. **Failure to submit either Draft 1 or the peer-review will result in a 0/5.**



**Incentive Program Information:** This course has been registered in the Incentive Program offered through the Centre for Student Academic Support (CSAS). CSAS Learning and Writing Support Workshops are designed to help students cultivate and refine their academic skills for a university environment. To earn 4% marks towards participation, students are expected to complete 5 workshops throughout the term. The workshops must be completed by March 24, 2024to receive credit for the Incentive Program. Students will need to download a **Record of Completion PDF** for each applicable workshop and submit it to an assignment submission box within *Brightspace*.



Required incentive program workshops for CHEM 4305/5606

* Academic Integrity
* Academic Reading
* Editing and Proofreading
* Introduction to Fundamentals of Academic Writing
* Any of the listed Workshops

**ACCOMMODATIONS FOR MISSED WORK**

Notify me within 24 hours of the missed work. Carleton recognizes that students may experience unexpected, temporary incapacitation (i.e., illness, injury, or extraordinary circumstances outside of a student’s control). As a result, Carleton has put into place a protocol for students to apply for accommodations using a self-declaration form in the event of missed work. The form can be found at: <https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf> Note that these forms should be used for short-term concerns related to missed work; if you are experiencing chronic, ongoing challenges which necessitate a broader solution, I recommend reaching out to the Paul Menton Centre and/or the Care Support team.

**FEEKING SICK?**

If you feel very sick (e.g., fever, chills, stomach upset) do not come to class or campus. Missed lectures can be made up by watching the recorded lecture, which I will post on Brightspace within 24 hours after the lecture.

**MENTAL HEALTH**

If you are struggling, please do not hesitate to reach out. I am happy to listen, and/or direct you to resources that might help. In terms of class, if you need extra help or missed a lesson, don’t stress! Email me and we will set a time to meet. Remember that Carleton also offers an array of mental health and well-being resources, which can be found [here](https://carleton.ca/wellness/).

**PLAGIARISM AND CHEATING**

The University Senate defines plagiarism as “presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one’s own.” This can include:

* reproducing or paraphrasing portions of someone else’s published or unpublished material, regardless of the source, and presenting these as one’s own without proper citation or reference to the original source;
* submitting a take-home examination, essay, laboratory report or other assignment written, in whole or in part, by someone else;
* using ideas or direct, verbatim quotations, or paraphrased material, concepts, or ideas without appropriate acknowledgment in any academic assignment;
* using another’s data or research findings;
* failing to acknowledge sources through the use of proper citations when using another’s works and/or failing to use quotation marks;
* handing in "substantially the same piece of work for academic credit more than once without prior written permission of the course instructor in which the submission occurs."
* using artificial intelligence tools such as ChatGPT when your assessment instructions say that it is not permitted.

Plagiarism is a serious offence that cannot be resolved directly by the course’s instructor. The Associate Dean of the Faculty conducts a rigorous investigation, including an interview with the student, when an instructor suspects a piece of work has been plagiarized. Penalties are not trivial. They can include a final grade of "F" for the course.”

**COURSE SHARING WEBSITES**

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copy protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, and other materials, are also protected by copyright and remain the intellectual property of their respective author(s).

My lectures and course materials (including all PowerPoint presentations, outlines, and similar materials) are protected by copyright. I am the exclusive owner of copyright and intellectual property of all course materials. You may take notes and make copies of course materials for your own educational use. You may not allow others to reproduce or distribute lecture notes and course materials publicly for commercial purposes without my express written consent.



**ACADEMIC ACCOMODATIONS**

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

**Pregnancy obligation** –

Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website.

**Religious obligation –**

Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website.

**Student activities –**

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the [Senate Policy on Accommodation for Student Activities (PDF, 25KB)](https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf).

**Students with disabilities requiring academic accommodations** -

The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the [PMC website](https://carleton.ca/pmc/faculty/) for the deadline to request accommodations for the formally-scheduled exam (if applicable).”