Fall 2024

Principles of Toxicology

BIOC 4708A/BIOL6402F/CHEM5708F

Course Instructor: Daniel Grégoire

How to address me: Daniel

Gender Pronouns: (he/him/his) (learn more)

Email: DanielGregoire@cunet.carleton.ca

Note: If you have question or would like to talk with me, you can send an email, approach me during class time, or set up an appointment to talk. I will do my best to answer emails within 48 hours, Mon-Fri, 9AM-5PM.

Phone: (613) 520-2600 ext. 3883

Drop-in Hours: Please email to set up an appointment.

What are 'Drop-in Hours'?
Drop-in hours are dedicated times through the week for the course instructor to meet with YOU. Pop in to introduce yourself, ask questions, or discuss content from the course.

Office Location: 419 Steacie Building

Click here for visual directions.

Course Modality: In person

Class Location: Tory Building 236

Click here for visual directions.

Class Times: Tuesday & Thursday, 2:35 PM - 3:55 PM

Prerequisites:

For B.Sc.: BIOC 3101 (General Biochemistry I) and fourth-year standing or permissions of the Institute.

For M.Sc./Ph.D. taking BIOL6402: Permission of the director or associate director of OCIB.

Welcome to this Course!

Course description

Basic theorems of toxicology with examples of current research problems. Toxic risk is defined as the product of intensive hazard and extensive exposure. Each factor is assessed in scientific and social contexts and illustrated with many types of experimental material.

Includes: Lectures, case studies, written assignments, quizzes, presentations, and a proposal (for graduate students)

Course objectives

My priority is to provide students with a solid understanding of key mechanistic concepts in toxicology and transferrable skills to pursue a career in the public or private sector. This class is divided into three major sections. The first section will focus on historical events in the field of toxicology before summarizing the mechanisms through which chemicals interact with cells and the human body. The second section will highlight the tools that are used in toxicology research and how scientific evidence informs regulatory toxicology. The third section examines how diet, the microbiome, genetics, and geographic location contribute to different responses to toxicants. Importantly, this section will draw attention to how people from marginalized communities are disproportionately impacted by environmental pollution. The major concepts seen throughout these sections will be synthesized in a biomarker study that students will propose to assess population level responses to specific chemicals.

The **learning outcomes** for the course are based on skills that are critical to the completion of a Chemical Toxicology degree at the undergraduate and graduate level.

LO1. Evaluates multidisciplinary issues using chemical toxicology knowledge and skills	• Applies concepts of mathematics, biochemistry, biology, and chemistry to toxicology scenarios • Integrates knowledge from regulatory science and policy to chemical toxicology • Works effectively and equitably with a diverse and multidisciplinary team • Integrates theoretical and practical knowledge of subdisciplines of chemistry to solve complex chemistry problems.
LO2. Describes major biochemical pathways targeted by toxicological hazards	• Describe major biochemical pathways (e.g., cellular energy metabolism, primary and secondary metabolism) and their regulation • Describe the role of biochemical defense mechanisms (e.g., DNA repair, Phase I/II metabolism, redox biology, etc)
LO3. Relates physicochemical properties of chemicals to principles of absorption, distribution, metabolism, and excretion (ADME)	• Define and describe major concepts of toxicology (e.g., ADME, pharmacokinetic models) and their mechanisms as they relate to toxicant disposition • Describe how toxicants disrupt homeostasis, change biochemical processes, and interact with major classes of biomolecules • Explain the data requirements to derive dose-response curves • Describe the role of defense mechanisms in maintaining homeostasis and associations with ADME • Explain variations in toxicant response amongst subpopulations and model systems • Describe the history as it relates to public policy of key historical events in toxicology, the related toxicant, and mechanism of toxicity behind the event • Describe how diet, the gut microbiome, and epigenetics affects individual response to a chemical hazard • Explain how hazards modulate major biochemical pathways • Recognize and compare systemic and organ-specific toxic effects on humans and other experimental models
LO4. Applies risk analysis framework to toxicological problems	• Describe and apply a risk analysis framework (risk assessment, management and communication) • Describe the contributions of both scientific and non-scientific considerations in risk analysis • Evaluate uncertainty within the risk assessment framework
LO5. Strengthens scientific communication and evidence synthesis	• Effectively communicates the results of research to chemists and non-chemists in both oral and written form using a variety of formats. • Critically assesses and quantifies uncertainties in measurements and limitations in methodologies • Applies scientific literacy skills to locate, retrieve, interpret, and assess chemical scientific information • Works effectively as a team member in a diverse group • Explains the interrelationships between chemistry and other systems, including industrial, environmental, biological, human, and regulatory • Identifies situations in which EDI has impacted chemistry research and learning

Community Guidelines

In our course, we will seek to behave according to the International Center for Academic Integrity*.

	As students, we will…	As a teacher, I will…
Honesty	• Honestly demonstrate our knowledge and abilities on assignments and exams • Communicate openly without using deception, including citing appropriate sources	• Give you honest feedback on your demonstration of knowledge and abilities on assignments and exams • Communicate openly and honestly the expectations and standards of the course through the syllabus
Responsibility	• Complete assignments on time and in full preparation for class • Show up to class on time, and be mentally/physically present • Participate fully and contribute to team learning and activities	• Give you timely feedback on your assignments and exams • Show up to class on time, and be mentally & physically present • Create relevant assessments and activities
Respect	• Speak openly with one another, while respecting diverse viewpoints and perspectives • Provide sufficient space for others to voice their ideas	• Respect your perspectives even while we challenge you to think more deeply and critically • Help facilitate respectful exchange of ideas
Fairness	• Contribute fully to collaborative work, so that we are not freeloading off of others • Not seek unfair advantage over fellow students in the course	• Create fair assignments and exams, and grade them in a fair, and timely manner • Treat all students equitably
Trust	• Be open and transparent about what we are doing in class • Not distribute course materials to others without authorization	• Be available to all students when we say we will be • Not modify the expectations without communicating with everyone in the course
Courage	• Say or do something when we see actions that undermine values above • Accept a lower or failing grade or other consequences of upholding and protecting the above values	• Say or do something when we see actions that undermine any of the above values • Accept the consequences (e.g., lower teaching evaluations) of upholding and protecting the above values

[2] This class statement of values is adapted from Tricia Bertram Gallant, Ph.D.

Inclusive teaching statement

Equity, diversity, and inclusion are crucial to driving innovation by bringing people with diverse lived experiences together. I am committed to fostering an environment for learning that is inclusive for everyone regardless of gender identity, gender expression, sex, sexual orientation, race, ethnicity, ability, age, class, etc. I welcome emails or in-person communications to let me know your preferred name or pronoun. I will continually strive to create inclusive learning environments and would therefore appreciate your support and feedback.

Land Acknowledgement

Here 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.

Learning Materials

Technology Checklist:

- ☐ An internet-enabled computer (laptop/desktop)
- ☐ Wooclap installed on your computer or phone (https://carleton.ca/brightspace/instructors/wooclap/)
- ☐ Access to a video camera for recording purposes (webcam, phone, etc).

Options exist for students who do not have access to these resources. Options include financial aid from Carleton, inexpensive options for technology (Best Buy refurbished products, Kijiji), & single workspaces available for student use on campus.

Assessment in this Course

Research about learning strongly suggests that the most important factor in learning is doing the work of reading, writing, recalling, practicing, synthesizing, and analyzing. Learning happens best when people actively engage with material on a consistent basis, and that is why we have high standards in this course. We are confident that, with appropriate effort, you **all** can meet those standards.

We also make an effort to reduce unintentional bias in grading by, for example and when possible, grading assignments one question at a time (grading all of question 1 before grading any of question 2), grading anonymously, and using rubrics.

Grade Breakdown

Assignment name	Individual or group work/submission	%	Grade or SAT/UNSAT	Due Date
Toxicology quizzes	Individual (time in class)	20%	Grade	Quiz 1: Sept 24th Quiz 2: Oct 1st Quiz 3: Oct 10th
Fact sheet on a toxicant	Individual	20%	Grade	Oct 15th
Briefing note to a policymaker	Individual	10%	Grade	Oct 31st
Case studies on diet and the microbiome	Individual or group (time in class)	7.5%	SAT/UNSAT	Nov 5th
Case studies on epigenetics and genetic polymorphisms	Individual or group (time in class)	7.5%	SAT/UNSAT	Nov 19th
Biomonitoring proposal outline	Individual	5%	SAT/UNSAT	Nov 28th
Biomonitoring proposal presentation	Individual	15%	Grade	December 21st
Biomonitoring proposal document (Graduate)	Individual	15%	Grade	December 21st
Participation (Undergraduate)	Individual	15%	Grade	

All times for when assignments are due will be posted on Brightspace alongside assignment instructions unless they are submitted at the end of class. These times may be subject to change depending on progress made in the class.

Assignments

This course is designed to give students time in class to complete short assessments to ensure they are engaging with the material and meeting the key learning outcomes. Students who complete readings in advance of class, participate in discussions, and work through their assignments as we go through course material will be positioned for success. There is no cumulative final exam but there is a final assignment due during the exam period. **You must submit all assignments for grading to pass this class.**

Toxicology quizzes

Understanding the absorption (A), distribution (D), metabolism (M), and excretion (E) mechanisms for different chemicals is one of the key learning outcomes to achieve in this course. Students will be given short sets of question they can work through to understand core technical concepts in toxicology. Time will be allotted in class so students can answer specific questions keyed to each lesson and responses will be due on the dates listed in the table above and on Brightspace. Questions will include short answers to solidify key concepts and long form answers to build complex problem-solving skills in toxicology.

Fact sheet on a toxicant

You will write a fact sheet on a toxicant of your choice in the style of public-facing documents found on government websites. This assignment will require you to research and synthesize complex information on toxicant exposure and modes of toxicity in a format that is accessible to a broad audience. Examples will be provided through Brightspace to give you a sense of what information is typically included in this type of written communication. The purpose of this assessment is to take complex mechanistic information and disseminate it to a general audience. This is a key skill required to inform the public of hazards and risks tied to different chemicals.

Briefing note to a policymaker

You will write a briefing note based on a case study that highlights issues related to human toxicant exposure seen in class. A briefing note is a common way for regulatory and industry scientists to present evidence to decision makers. This may be a new form of communication for many students, but it is a valuable tool used in regulatory toxicology. The purpose of this assignment is to hone your ability to synthesize information for a general audience, communicate uncertainty, and consider the socioeconomic impacts of chemicals and why they require regulation.

Case studies on diet, the microbiome, epigenetics, and genetic polymorphisms

You will answer questions in groups or individually based on case studies seen in class. There will be two separate sets of case studies that will focus on how diet, the gut microbiome, epigenetics, and population level genetic polymorphisms are considered in the field of toxicology. Students will have dedicated time in class to complete case studies and answers will be due at the end of class. The threshold for demonstrating satisfactory completion of this assignment will be more stringent compared to formative case studies seen earlier in class because students will have had several opportunities to practice critically evaluating toxicology studies. This assignment will focus on exposing students to the broad subdisciplines in toxicology while building teamwork skills. Students working in groups must clearly indicate their contributions to the case study answers to demonstrate everyone is working collaboratively on this assignment.

Biomonitoring proposal

Students will present a proposal for a biomonitoring study on a chemical of their choice that is distinct from the one used for the fact sheet. Students will be able to draw from the different study designs, analytical techniques, and endpoints used to measure toxicity seen throughout the class. Students are expected to synthesize research on biomarker specificity for a given toxicant, how a chemical elicits a response for the chosen biomarker, measurement methods for biomarkers, and the political and economic impacts of a given toxicant to present a compelling case to a government or private sector collaborator or funding agency. The main components of a proposal and scientific presentation will be discussed in advance in class. Students will submit an outline of their presentation in advance to receive feedback on whether key information is missing prior to submitting the final version of their assignment. Dedicated time has been put aside in class for students to practice their presentations and receive peer review on a first come, first serve basis. Graduate students are expected to submit a formal proposal document alongside their presentation in the style of a short NSERC Alliance style grant that would be done in partnership with a government body or private company of their choice. A template for the NSERC Alliance style grant will be provided in advance and graduate students are encouraged to revise each other's written proposals prior to submission.

Participation

One of the objectives of this course is to increase your job readiness. This includes learning to be a team player, developing transferrable skills, and participating in discussions about scientific research. Attendance and active participation are therefore expected from all students. For undergraduates, your participation will be measured through group discussions linked to case studies in class, engaging with active learning tools such as polls tied to lecture material, working in teams on problem solving exercises in class, and participating in collegial peer review. Additional participation marks will be considered for students who actively engage in question periods during class. Accommodations will be made for absences on a case-by-case basis. Graduate students are expected to lead by example and actively engage with the material in class, as such, no marks are being allotted to graduate student participation.

Course Outline

Week	Dates	Title	Summary	Learning activities	Assignments
1	Sept 5th	What will we learn in principles of toxicology?	This is class will summarize Dr. Grégoire's experience in toxicology and the course learning outcomes.	Lecture with polls to discuss interests in toxicology.	
2	Sept 10th	How did we go from epidemiology to toxicology?	This class will summarize key events in epidemiology that laid the foundation for toxicology. Reading will be assigned for a case study for next class.	Lecture followed by group discussion about historical examples.	
2	Sept 12th	What makes a good toxicology study?	This class will summarize the Bradford-Hill criteria used to evaluate toxicology studies. This class will introduce the key concept of dose-response curves.	Think pair share followed by a case study applying the Bradford Hill criteria to an arsenic study.	Assign quiz 1
3	Sept 17th	How do chemicals get into cells and move through the body (1)?	This lesson will introduce key concepts in toxicokinetics: Absorption mechanisms for chemicals in cells.	Lecture with practical demonstrations of Swiss ADME software.	**Time will be provided to work on quiz questions.**
3	Sept 19th	How do chemicals get into cells and move through the body (2)?	This lesson will highlight how absorption routes interact with distribution pathways for chemicals in the body.	Lecture with problem solving to predict the fate of chemicals in the body.	**Time will be provided to work on quiz questions.**
4	Sept 24th	What happens when chemicals are metabolized?	This class will provide an overview of quiz 1. This class will then focus on biotransformation pathways that control the physicochemical properties of chemicals and their modes of toxicity.	Lecture with group discussions.	Quiz 1 due Assign quiz 2
4	Sept 26th	What can happen when toxicants damage DNA (1)?	This class will focus on how DNA is damaged through toxicant exposure, mechanisms for DNA repair, and how toxicant exposure can lead to cancer.	Lecture and a case study on the model carcinogen benzo[a]pyrene.	Assign fact sheet
5	Oct 1st	What can happen when toxicants damage DNA (2)?	This class will review questions from quiz 2 and the responses to the case study on benzo[a]pyrene.	Group discussion about case study.	Quiz 2 due
5	Oct 3rd	How do toxicants leave the body?	This class will discuss how cell metabolism facilitates excretion and why excretory organs are targets for toxicity. This class will also provide a conceptual overview of physiology-based pharmacokinetic models.	Lecture followed by problem solving for pharmacokinetic model outputs.	Assign quiz 3 **Time will be provided to work on quiz questions.**
6	Oct 8th	How do we study toxicology?	The key safety thresholds derived from dose response curves will be reviewed alongside a summary of different *in vivo* and *in silico* techniques used in toxicology.	Lecture, group discussion, and problem solving for dose response curves.	
6	Oct 10th	How can we use adverse outcome pathways in toxicology? (**guest lecture from Dr. Carole Yauk**)	This class will highlight adverse outcome pathways as a tool in toxicology that is being used in policy making decisions.		Quiz 3 due
7	Oct 15th	What makes a good briefing note?	This class will start with an overview of quiz 3. This class will breakdown the essential components and purpose of a	Lecture, group discussion, and reading for next class.	Fact sheet due (20%)

			briefing note geared towards regulators.		Assign briefing note
7	Oct 17th	In-class time to work on briefing notes	This class is reserved so students can critique example briefing notes and then work on their own submissions.	Group discussion.	**Time will be provided to work on briefing notes.**
8	**BREAK**				
9	Oct 29th	Why consider diet in toxicology (**guest lecture from Dr. Jayadev Raju**)	Dr. Raju will summarize different examples of how foodborne toxins influence policies on food safety in the government.	Lecture interspersed with group discussion.	
9	Oct 31st	What's going on in your gut?	This lecture will summarize how the gut microbiome can directly and indirectly control the response to toxicants in the body.	Lecture interspersed with group discussion.	Briefing notes due (10%) Assign case studies on diet and microbiome
10	Nov 5th	Case studies on diet and gut health	This time is reserved for students to work on case studies.	Group or individual work on case study responses **due at the end of class.**	Submit case study on diet or microbiome (7.5%)
10	Nov 7th	Case studies on diet and gut health	This class will summarize case studies from the previous class and provide an overview of the biomonitoring assignment.	Group discussion and overview of proposal outline and template.	Assign biomonitoring proposal
11	Nov 12th	How do toxicants modify the expression of our genes?	This lecture will introduce epigenetic modifications to DNA's structure and how these modifications impact gene expression following toxicant exposure.	Lecture interspersed with group discussion.	
11	Nov 14th	How do genes affect toxicant response in different subpopulations?	This class builds on the previous lecture and examines the impact of genetic polymorphisms at the population scale.	Lecture interspersed with group discussion.	Assign case studies on epigenetics and genetic polymorphisms
12	Nov 19th	Case studies on epigenetics and genetic polymorphisms	This time is reserved for students to work on their case studies.	Group or individual work on case study responses **due at the end of class.**	Submit case study on epigenetics or genetic polymorphisms (7.5%)
12	Nov 21st	Case studies on epigenetics and genetic polymorphisms	This class will summarize case studies from the previous class. This class will also provide an overview of the briefing note evaluations time permitting.	Group discussion.	
13	Nov 26th	What makes a good biomarker?	This class will provide an overview of biomarkers seen in previous classes and the methods used to monitor them. Time is reserved for students to ask questions about the proposal project.	Short lecture followed by think pair share to provide peer review for proposal outlines.	
13	Nov 28th	In class time to work on biomonitoring assignment	This class is reserved for students to work and receive feedback on their biomonitoring project outlines.		Submit biomonitoring outline (5%)
14	Dec 3rd	Biomonitoring presentations	This class is reserved for students to practice their presentations	Presentation in class with option for peer-review.	
14	Dec 5th	Biomonitoring presentations	This class is reserved for students to practice their presentations.	Presentation in class with option for peer-review.	
	Dec 21st				Submit presentation (undergraduate and graduate) and written proposal (graduate).

Feeling Sick?

Remaining vigilant and not attending work or school when sick is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

If you cannot attend a class, I will do my best to accommodate your absence and share course materials with you in an accessible format to make sure you are up to date. I try to share all slides in advance of class and provide presenter notes that contain the key message for every slide. I can also send a zoom link in advance on a case-by-case basis to make sure my class is accessible remotely.

Note About 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. I'll work with you, I promise. Remember that Carleton also offers an array of mental health and well-being resources, which can be found here.

University Policies

In accordance with the Carleton University Undergraduate Calendar Regulations, the letter grades assigned in this course will have the following percentage equivalents:

A+ = 90-100	B+ = 77-79	C+ = 67-69	D+ = 57-59
A = 85-89	B = 73-76	C = 63-66	D = 53-56
A- = 80-84	B- = 70-72	C- = 60-62	D- = 50-52

F = <50
WDN = Withdrawn from the course
ABS = Student absent from final exam
DEF = Deferred
FND = (Failed, no Deferred) = student could not pass even with 100% on final exam

Academic Accommodations, Regulations, Plagiarism, Etc.

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes, including information about the Academic Consideration Policy for Students in Medical and Other Extenuating Circumstances, are outlined on the Academic Accommodations website (students.carleton.ca/course-outline).

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:

https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/

Academic Accommodations for Students with Disabilities

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC 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 your instructor as soon as possible to ensure accommodation arrangements are made. For more details, visit the Paul Menton Centre website.

Addressing Human Rights Concerns

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the Department of Equity and Inclusive Communities at equity@carleton.ca.

Religious Obligations

Please contact me with 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, please review the Student Guide to Academic Accommodation (PDF, 2.1 MB).

Survivors of Sexual Violence

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/sexual-violence-support/

Accommodations for Missed Work

Carleton recognizes that students may be experiencing greater stress and other life factors that are not in their control. As a result, Carleton has put into place a protocol for students to apply for accommodations using the Academic Consideration for Coursework form which can be found at: https://carleton.ca/registrar/academic-consideration-coursework-form/. These forms should only 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.

My personal policy for this class is that **you can hand in one assignment 48 hours after the due date with no penalty and no questions asked.** Please note that **this policy does not apply to the quiz questions,** which must be answered by the deadlines listed on Brightspace because they will be reviewed promptly in class. Please note that **this policy does not apply to the biomonitoring presentations and written proposals**, which must be submitted by the end of exam period to ensure grades are submitted on time. **10 % of the total marks for each assignment will be removed for every week an assignment is late, up to a maximum of two weeks, after which point submissions will not be accepted.**

For Pregnancy

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, please see the Student Guide to Academic Accommodation (PDF, 2.1 MB).

Accommodation for 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).

Statement on Chat GPT/Generative AI usage

Minimal Use - Basic Assistance Only

AI Use in this course: Students may use AI tools for basic word processing and formatting functions, including:

- Grammar and spell checking (e.g., Grammarly, Microsoft Word Editor)
- Basic formatting and design suggestions (e.g., Microsoft Word's formatting tools, PowerPoint Design editor)

Documenting AI Use: It is not necessary to document the use of AI for the permitted purposes listed above. If you have questions about a specific use of AI that isn't listed above, please consult your instructor.

Why have I adopted this policy? This policy ensures that student voices and ideas are prioritized and authentically represented, maintaining the integrity of the work produced by students while allowing basic support to enhance clarity, correctness, layout, and flow of ideas. The goal of adopting a limited use of AI is to help students develop foundational skills in writing and critical thinking by practicing substantive content creation without the support of AI.

Limitations. Students may not use AI for the following tasks:

- EX1: Answering quiz questions. Although many of the quiz questions draw on real-world chemicals and examples, the parameters defined within the questions are specific to content seen in class. This is by design to ensure you're applying your critical thinking to recall course material and solve complex problems in toxicology.
- EX2: Answering case study questions seen in class. These assessments are designed to assess your ability to extract key information from scientific literature and some of the questions are open ended to evaluate your critical thinking skills. Using AI to try and answer them may result in missing the mark.

- EX3: Summarizing key technical information related to a chemical for your fact sheet and proposal assignments. These assignments will require that you carry out your own research and synthesize information on toxicology in accessible language geared towards a broader audience. These ideas also need to be connected to original proposal ideas to demonstrate the importance of proposed research on biomarkers. Using AI to carry out this writing will preclude you developing critical skills in literature review and evidence synthesis required in scientific communication.

Academic Integrity

Academic Integrity is upholding the values of honesty, trust, respect, fairness, responsibility, and courage that are fundamental to the educational experience. Carleton University provides supports such as academic integrity workshops to ensure, as far as possible, that all students understand the norms and standards of academic integrity that we expect you to uphold. Your teaching team has a responsibility to ensure that their application of the Academic Integrity Policy upholds the university's collective commitments to fairness, equity, and integrity.
(Adapted from Carleton University's Academic Integrity Policy, 2021).

Examples of actions that do not adhere to Carleton's Academic Integrity Policy include:

- Plagiarism
- Accessing unauthorized sites for assignments or tests
- Unauthorized collaboration on assignment and exams

Please review the checklist linked here to ensure you understand your responsibilities as a student with respect to academic integrity and this course.

Sanctions for Not Abiding by Carleton's Academic Integrity Policy

A student who has not upheld their responsibilities under Carleton's Academic Integrity Policy may be subject to one of several sanctions. A list of standard sanctions in science can be found here. Additional details about this process can be found on the Faculty of Science Academic Integrity website. Students are expected to familiarize themselves with and follow the Carleton University Student Academic Integrity Policy. The Policy is strictly enforced and is binding on all students.

Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the 7 Rights and Responsibilities Policy for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Student Concerns

If a concern arises regarding this course, **your first point of contact is me**: Email or drop in during student hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):

Note: You can also bring your concerns to Ombuds services.

Assistance for Students

Academic and Career Development Services: http://carleton.ca/sacds/

Writing Services: http://www.carleton.ca/csas/writing-services/

Peer Assisted Study Sessions (PASS): https://carleton.ca/csas/group-support/pass/

Math Tutorial Centre: https://carleton.ca/math/math-tutorial-centre/

Science Student Success Centre: https://sssc.carleton.ca/