

# Introduction to Green Chemistry (CHMD89H) – Fall 2023

## University of Toronto at Scarborough

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Welcome to CHMD89! This course will introduce you to the growing field of green chemistry – an interdisciplinary approach to chemistry that strives to develop environmentally benign chemical reactions and processes. The course will begin by introducing the twelve principles of green chemistry followed by the use of green chemistry metrics for quantifying ‘greenness.’ In this context, we will move on to explore major areas of green chemistry research including alternative solvents, catalysis and renewable feedstocks. Examples from industry and from the current literature will be used to reinforce the material and highlight recent advances. The topics covered will be multidisciplinary in nature and will draw on aspects of organic, inorganic, polymer/materials, and analytical chemistry. Considering this is a D-level course with a small class size, I’d like to strive to make this a more discussion-based class relative to courses you may have taken in the past, so attendance will be important through this term. Furthermore, many of the topics we discuss are continuing to evolve in literature as we engage in these discussions.

Please take a few minutes to read through this document. It contains important information that will help ensure your success in this course.

***Instructor:***

Dr. Kris Kim

EV560

Email: [kris.kim@utoronto.ca](mailto:kris.kim@utoronto.ca)

Virtual Office Hours: by appointment (email me to set something up!)

***Lecture Schedule:***

Wednesdays 9 am - 12 pm (in-person in MW264)

***Proposed Lecture Topics (subject to change):***

- The 12 principles of green chemistry
- Green chemistry metrics
- Life cycle analysis
- Persistence and toxicology
- The solvent problem
- Green solvent solutions
- Advances in catalysis
- Renewable feedstock chemicals
- Green analytical chemistry

***Text:***

There is no required text for this course; readings will be taken from the primary literature and will be posted on Quercus one week before each lecture.

**Method of Evaluation:**

Course grades will be calculated as follows. More detailed descriptions for each item can be found in the sections which follow.

Problem Set (x1)	15%
Quizzes (x3)	15%
Critical Review	30%
Peer Reviews	15%
Presentation	15%
Self-Reflection	10%
<b>Total</b>	<b>100%</b>

**Problem Set:**

There will be a single problem set due in the 4<sup>th</sup> week of classes (specific deadlines and details will be posted on Quercus). Its purpose is to help solidify your understanding of the foundational knowledge in green chemistry needed to complete the critical review due later in the course. You are welcome to collaborate with your peers while working through the questions; however, each student is expected to submit their own original work for grading.

**Quizzes:**

There will be three quizzes during the semester, each worth 5% of your final grade. The questions will be based on lectures and readings from prior weeks; however, the dates of the quizzes will not be announced in advance. Quizzes will take place in-person, during lecture time. They will always happen at the start of lecture.

**Critical Review:**

Over the course of the semester, students will work toward completing a critical review of a recent research article in the field of green chemistry. With guidance from the instructor, students will select a green chemistry themed paper outlining a new and/or improved chemical reaction or analytical process. Using tools learned in the first part of the course, the published green procedure will be compared and contrasted to an earlier published version of the same reaction or process. As part of the review, students will also be asked to formulate their own ideas for future research directions in the area.

The grade for this assignment will be made up of two components as follows:

10% – Written proposal & one-on-one discussion with Dr. Kim

25% – Final paper

In addition to the proposal and final paper, students will be expected to submit a draft of their assignment for peer review (see below).

**Peer Review:**

To help students get some early feedback on their critical reviews, students will review drafts of each other's work using the Peer Review tool in Quercus. Students will be required to submit a draft of their critical review to Quercus two weeks before the final due date. Each draft will

then be randomly assigned to three students in the course for anonymous peer review. Using the rubric provided by the course instructor, students will provide formative feedback on three draft assignments. These reviews will be graded by the instructor for their depth and quality of feedback. Note that students who do not submit a **complete** draft of their assignment will not be assigned any peer reviews and will get zero for this portion of the course grade.

**Presentation:**

Working in pairs or individually, students will select a Canadian researcher working in Green Chemistry (it can be any subdiscipline of chemistry; i.e., organic, inorganic, analytical, materials, etc.) to profile during the last week of classes. Presentations will cover the major research interests of the researcher, as well as a summary of a recently published article.

**Self-Reflection:**

As your final assignment, you will be asked to write a brief reflection on your experience with learning about Green Chemistry and its various facets and applications. A template will be provided on Quercus. Details related to the due date will also be released on Quercus.

**Late or Missing Work:**

Late work is subject to a penalty of -10% per day. Missing work will result in a grade of zero. Exceptions to this policy may be possible where extenuating circumstances can be demonstrated. Conflicts with other courses do NOT count as “extenuating” circumstances.

**Accessibility:**

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office as soon as possible. I will work with you and AccessAbility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff (located in AA142) are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations (416) 287-7560 or [ability@utsc.utoronto.ca](mailto:ability@utsc.utoronto.ca).

**Academic Integrity:**

Academic integrity is one of the cornerstones of the University of Toronto. It is critically important both to maintain our community which honours the values of honesty, trust, respect, fairness and responsibility and to protect you, the students within this community, and the value of the degree towards which you are all working so diligently. According to Section B of the University of Toronto's Code of Behaviour on Academic Matters <http://www.governingcouncil.utoronto.ca/policies/behaveac.htm> which all students are expected to know and respect, it is an offence for students to:

- To use someone else's ideas or words in their own work without acknowledging that those ideas/words are not their own with a citation and/or quotation marks, i.e. to commit plagiarism.
- To include false, misleading or concocted citations in their work.
- To obtain unauthorized assistance on any assignment.

- To provide unauthorized assistance to another student. This includes showing another student completed work.
- To submit their own work for credit in more than one course without the permission of the instructor.
- To falsify or alter any documentation required by the University. This includes, but is not limited to, doctor's notes.
- To use or possess an unauthorized aid in any test or exam.

There are other offences covered under the Code, but these are by far the most common. Please respect these rules and the values which they protect. Offences against academic integrity will be dealt with according to the procedures outlined in the Code of Behaviour on Academic Matters.

***Original:***

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>)

***Kindness policy:***

CHMD89 is an inclusive and accepting space. The course is a fourth-year course with lots of opportunities for students to engage in conversation, discussion, and critiques. There will be zero tolerance for inappropriate behaviour of any kind. This includes your peers and instructor. My expectation is that we all treat each other with kindness and respect in all facets of the course. Remember we are all here to learn together, and we do not know what other people are going through in their lives.