

CHM209H1S: Science of the Modern Kitchen

Winter 2023 Course Syllabus

I TEACHING TEAM

INSTRUCTORS



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LM452

Picture it! Toronto, 2023. A band of friends walked into a small ramen restaurant on one dank, blustery winter evening. The first thing that greeted them was the rich aroma of the ramen broth, simmering in the pots. They each ordered a bowl of ramen, and the rest was history... Food connects people and defines cultures. In this course, we wish to provide you the “ingredients” to understand the science behind many kitchen phenomena. Throughout this journey, you can explore and create your own path in the kitchen through the lens of science!



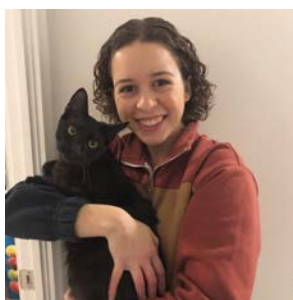
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LM452

An avid “foodie” myself, I am excited to be one of your instructors for CHM209! I hope you are all ready to experience food through chemistry. My goal is for all of you to leave this course and think the next time you’re in the kitchen or just ordered some food, “hmm, what’s the chemistry behind this?”

TEACHING ASSISTANTS



Alicia Battaglia



Yong Jia (Jamie) Bu

II COURSE OVERVIEW

COURSE DESCRIPTION

CHM209 is intended for non-science majors who wish to acquire an understanding of fundamental chemistry principles relevant to our daily lives and, in particular, food and cooking. It can be used to satisfy breadth requirements in Category 5 (The Physical and Mathematical Universes).

We will examine topics such as the scientific method, molecular structures and interactions, and the nature of chemical reactions. We will discuss the chemical properties of many different types of foods, and how they can be manipulated to achieve desirable transformations in appearance, taste, smell, and texture. Each class is accompanied by a demonstration focusing on a particular ingredient, recipe or technique in food preparation which illustrates concepts covered in lecture.

STUDENT LEARNING OUTCOMES

Broadly speaking, we hope students will leave this course having developed a greater appreciation for the physical and chemical processes at work on the microscopic level which contribute to what we experience macroscopically. We aim to equip you with foundational chemistry knowledge that would allow you to do more in-depth research into any food chemistry or molecular gastronomy-related topic of your own interest. You will also practice applying the Scientific Method to everyday problem-solving, and learn to critically examine the vast expanse of food and cooking-related information that is available digitally.

Specific to the chemistry concepts covered in CHM209, upon course completion students should be able to:

- Understand and explain the nature of and relationships between elements, atoms, molecules, ions, and chemical compounds
- Understand the characteristics of different states of matter, and what is required for interconversion between these states
- Explain the chemical basis of smell, taste, and colour
- Describe bonding and interactions in water, and understand its implications for food chemistry

- Understand the nature of and interactions between acids and bases
- Understand what is happening at the molecular level during processes of diffusion, emulsification, phase separation, gelation, and how these processes are useful in food preparation
- Recognize chemical reactions alongside their kinetics and chemical equilibria
- Understand the roles of enzymes in nature and how we can harness their properties to carry out transformations in food chemistry
- Apply molecular concepts in relation to the cellular metabolism of microorganisms
- Apply the chemistry concepts to predict the behaviour and properties of chemical reactions and more complex systems in the kitchen
- Formulate hypothesis and methods to probe scientific questions
- Review and evaluate scientific information and literature on selected topics
- Work collaboratively in group project and clearly present scientific knowledge to a diverse audience in written and visual formats.

PREREQUISITE COURSE(S)

CHM209 has no prerequisites, and may be taken by students with no science background (beyond compulsory science education in high school).

Student feedback from past years, however, suggests that the course load for CHM209 is most appropriate for those who have taken grade 11 chemistry. We will provide all necessary introductory information needed to succeed in the course, but concepts will grow in complexity at a rapid pace and thus present a greater learner curve to those without senior highschool level science background.

EXCLUSIONS

Students may not receive credit for this course if they have already passed any of the following: CHM135H1/CHM136H1/CHM138H1/CHM139H1/CHM151Y1, or if they have obtained a credit for an exclusionary course from a different department.

READINGS

There is no required text for this course. Lecture notes will be posted to the class Quercus site ahead of each class, along with virtual demonstration videos and other supplementary materials. The lecture notes and demonstrations contain all content that we expect students to understand and which we consider testable. The references listed below are simply suggestions should you desire to check your understanding using other sources.

A good reference text is **“The Science of Cooking”** by Provost, Colabrov, Kelly, and Wallert (published by Wiley). This is available online through the UofT Libraries catalogue. The guided assignments in the text are useful practice questions, and you do not need to read through entire chapters to work through them. Where relevant,

some guided assignments from this text will be posted as practice problems on Quercus.

“The Kitchen as Laboratory”, edited by Vega, Ubbink, and van der Linden is another good reference on molecular gastronomy, also available through UofT libraries.

Other good references which are available through public libraries: **“On Food and Cooking - The Science and Lore of The Kitchen”** by Harold McGee, **“The Food Lab - Better Home Cooking Through Science”** by J. Kenji Lopex-Alt, **“Culinary Reactions - The Everyday Chemistry of Cooking”** by Simon Quellen Field, and **“Cooking for Geeks - Real Science, Great Hacks, and Good Food”** by Jeff Potter.

III COURSE ORGANIZATION

CHM209 is organized into weekly units. With the exception of Reading Week (Feb 20-24), and the week during which the Midterm Assessment takes place (Feb 27 – Mar 3), **class will be held each Wednesday from 1:00 to 3:00 PM in LM158**. The course will be fully in-person according to university guidelines. Should there be changes in in-person lectures and course organization, we will do our best to notify you at the earliest possible moment.

We highly encourage you to attend the lecture and participate in activities, work through practice problems given in class, and to ask questions if something is unclear. Lecture slides will be uploaded to Quercus prior to each week's class. **Lecture recordings will be available after class for two weeks and will be removed afterward**. If the university should decide to transition back to online classes, we may choose to change the format and availability of lecture recordings.

Post-class assignments for each week will be available on Quercus. These take the form of 10 multiple choice questions pertaining to the key concepts of each week's class, and are intended to keep you on track as concepts covered later in the course rely on understanding of concepts introduced in earlier classes. Each assignment opens immediately after class (Wednesday at 3:00 PM) and closes at the start of the following week's class (Wednesday at 1:00 PM), with the exception of due dates that would fall during Reading Week or Final Exam Period. See course schedule on following pages for full list of assignment due dates.

Students will also work in **groups of 5 in a Term Project**. This is an opportunity to research a food/cooking-related question of your choice, and to apply the concepts learned in class to a specific topic which interests you. The results of this literature search will then be distilled into an infographic. Documents containing details on the Term Project can be found on Quercus. We have set deadlines for various aspects of the project throughout the term (choosing a topic, finding key references, etc) which can also be found in the schedule on the following pages.

COURSE SCHEDULE & RELEVANT SESSIONAL DATES:
(All times listed are Toronto (Eastern Standard) Time +/- Daylight Savings)

WEEK	CLASS DATE	CLASS TOPICS Deadlines and Reminders
1	Jan 11	Introduction to molecular gastronomy Atoms, ions, and molecules Form groups of 5 for term project (ASAP) and brainstorm project topics
2	Jan 18	The chemistry of water Polar covalent bonds and hydrogen bonds States of matter Assignment 1 due Jan 18 at 1:00 PM
3	Jan 25	Drawing molecular structures Chemical basis of smell and taste Stereochemistry Assignment 2 due Jan 25 at 1:00 PM Term Project: finalized topic approved by Jan 25, 11:59 PM
4	Feb 1	Fats and Oils Van der waals and dispersion forces Hydrophobicity, phase separation, and emulsification Assignment 3 due Feb 1 at 1:00 PM
5	Feb 8	Acids and Bases Assignment 4 due Feb 8 at 1:00 PM Term Project: list of references due Feb 8, 11:59 PM
6	Feb 15	Bonding in conjugated molecules Electronic transitions The chemical basis of colour Assignment 5 due Feb 15 at 1:00 PM
-	-	<i>READING WEEK</i>
-	Mar 1	MIDTERM ASSESSMENT (either in class or on-line; no new material this week) Assignment 6 due Mar 1 at 1:00 PM or immediately prior to beginning of online midterm window
7	Mar 8	Carbohydrates Gels and Foams

8	Mar 15	Protein structure and folding Introduction to thermodynamics Assignment 7 due Mar 15 at 1:00 PM
9	Mar 22	Chemical reactions Assignment 8 due Mar 22 at 1:00 PM Term Project: draft for peer-to-peer review due Mar 22, 11:59 PM
10	Mar 29	Enzymes Assignment 9 due Mar 29 at 1:00 PM Term Project: Peer-to-peer review comments due Mar 29, 11:59 PM
11	Apr 5	Fermentation Assignment 10 due Apr 5 at 1:00 PM Term Project: Final Project due Apr 9, 11:59 PM Assignment 11 due Apr 9 at 11:59 PM*** (Officially, no due dates can be set after exam period begins on Apr 10. We will, however, set up Quercus to accept submissions without penalty until the date of the final assessment.)

Classes 1-6 taught by Wayne Law; classes 7-11 taught by Stephanie Sebastiampillai.

IV EVALUATION/GRADING SCHEME

Inform us at the earliest possible moment if extenuating circumstances have prevented or will prevent you from completing coursework/assessments. We will evaluate the situation on a case-by-case basis to determine what make-up/grade redistribution strategies may be appropriate.

OVERVIEW

Assignments (x11; only highest-scoring 10 will be counted): 20%

5% completion (automatic if assignment is opened and submitted)

15% accuracy of answers

Group project: 35%

5% approval of topic by instructors before deadline

5% list of references

5% peer-to-peer review (contingent on submission of draft for review)

20% completed infographic

Midterm and Final Assessments: 45% total

15% Midterm + 30% Final OR 20% Midterm + 25% Final

ASSESSMENT DATES AND MARK BREAKDOWN

Midterm Assessment: to be held during the week of Feb 27 – Mar 3

15 or 20% of course grade; combination of multiple choice and short answer questions.

If in person, a 2-hour assessment will be held during regular class time on Wednesday, Mar 1, 1:00 – 3:00 PM.

If online, students will be required to log-on to Quercus on Wednesday, Mar 1, 1:00 – 3:00 PM to complete the assessment.

Midterm debrief will be held outside of class time. Date and time to be chosen by popular vote. A recording will be made available on Quercus if necessary.

For students who miss the Midterm Assessment for valid reasons, the weight of the Midterm will be transferred to the Final Assessment (ie. the Final Assessment will contribute to 45% of the student's final grade). If the Midterm Assessment is online, you may choose between transferring the weight to the Final Assessment or arranging an alternate writing time.

Final Assessment: to be held during exam period (date TBD)

25 or 30% of course grade; combination of multiple choice and short answer questions.

If in-person, a 2-hour assessment will be held at a specified time and place.

If online, students will be required to log-on to Quercus at a designated time, in the same manner as the Midterm, for a 2-hour Final Assessment.

As with the Midterm Assessment, an online Final Assessment missed due to valid reasons may be rescheduled by contacting the instructors. A missed, in-person Final Assessment, however, will require rescheduling through the Faculty Registrar Services.

IMPORTANT: if an unexpected technical issue occurs with a university system (e.g., Quercus services, network outage) that affects availability or functionality, it may be necessary to revise the timing or weighting of the assessments.

V COURSE POLICIES

Each member of this course is expected to maintain:

- (i) a professional and respectful attitude during all course activities;
- (ii) a personal calendar/organizer to ensure that all tasks are completed on time;
- (iii) a collection of independently recorded notes on class material (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

The University of Toronto is committed to equity, human rights and respect for diversity. All members of this course should strive to create an atmosphere of mutual respect where individuals are welcome to express themselves and engage with others. Behaviour that undermines the dignity or self-esteem of any individual in this course will not be tolerated, nor will discrimination, harassment, or hate speech. As instructors, we wish to be alerted of any attempt to create an intimidating or hostile environment. It is our collective responsibility to create a space that is inclusive and fosters discussion. If you have any questions, comments, or concerns, we also encourage you to reach out to the staff in our Equity Offices.

Communication with Instructors

The best way to reach us online is using the email function in Quercus (Inbox > Compose a new message > Course: CHM209 > Recipient: Teachers). Efforts will be made to respond to all emails within 24 hours on weekdays.

If for some reason the Quercus Inbox function fails, you may send emails to the instructor's mail.utoronto.ca addresses (listed in Section I). Include "CHM209" in the subject line to ensure that your email does not get filtered out as spam.

Late Submission Policy

A penalty of 10% per day is applied to all coursework (Quercus assignments as well as Term Project components), for a maximum late submission period of 5 days, after which the assignment will receive a grade of 0. For example, a submission on the 3rd day after the original deadline results in a maximum grade of 70%.

Policy for Reweighting Due to Missed Pieces of Academic Work

Inform the instructors and your group members as soon as possible if you are unable to complete coursework for an extended period of time. Missed weekly Quercus assignments can be reweighted to weeks where assignments were completed. Depending on the situation, missed project components may be reweighted onto other components where you have contributed.

Reweighting of assessment grades will depend on the assessment format (see Section IV).

Submission Methods

Weekly assignments take the form of Quercus quizzes and thus must be submitted through Quercus. If online, the Midterm and Final Assessments will also be submitted through Quercus.

Components of the Term Project vary in submission format. Details can be found in the Term Project Guidelines document.

Process for Requesting Re-grading of Coursework

Weekly assignments are automatically graded by Quercus. If you believe there is an error, please email us. We will assess whether a grade adjustment (applicable to the entire class) is warranted.

Non-multiple choice questions on the Midterm and Final Assessments are manually graded according to answer keys containing specific grading schemes. Answer keys will be made available to you (format TBD). *You may request a regrade, but the regrade occurs on an all-or-none basis. A request for regrade of a single question will result in the entirety of the assessment being regraded.* Alerting us of arithmetic errors in tallying of scores does not constitute a regrade request.

VI TECHNOLOGY REQUIREMENTS

Specific guidance from the U of T Vice-Provost, Students regarding student technology requirements is available here:

<https://www.vicprovoststudents.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/>

This course requires the use of computers, and technical issues are possible. When working on a piece of academic work, students are responsible for scheduling enough time to allow for reasonable delays due to technical difficulties to be overcome, so such issues will not be acceptable grounds for deadline extension. Particularly, maintaining an up-to-date, independent, backup copy of your work is strongly recommended to guard against situations such as hard-drive failures, corrupted files, and lost computers.

VII INSTITUTIONAL POLICIES & SUPPORT

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 (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:

On 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 report. **Please note that the use of websites (such as Chegg.com or the course discussion board) to post assignments or to post/access answers to questions is an academic offence under the University of Toronto's Code of Behaviour on Academic Matters. Alleged instances of this nature are forwarded to the Faculty of Arts & Science Student Academic Integrity office.**

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 under the University of Toronto's Code of Behaviour on Academic Matters. Alleged instances of this nature are forwarded to the Faculty of Arts & Science Student Academic Integrity office.**
2. Looking at someone else's answers or collaborating/discussing answers during a quiz or term test.
3. Misrepresenting your identity.

In general 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 www.academicintegrity.utoronto.ca/).

Plagiarism Detection

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>).

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This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session.

For questions about recording and use of videos in which you appear please contact your instructor.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation, and are protected by copyright. **Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor.**

ACCESSIBILITY NEEDS

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.

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 [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.