



CHM249H: ORGANIC CHEMISTRY

Winter 2023 Course Syllabus

I TEACHING TEAM



INSTRUCTOR

Name: Prof. Mark S. Taylor

Email: marks.taylor@utoronto.ca

Research: : <https://sites.chem.utoronto.ca/mst>

Office: Lash Miller, LM 622A

Student hours (online or in person): by appointment

Instructor biography: BSc UofT 2000; PhD Harvard 2005; Postdoc MIT; Prof. at UofT since 2007. Research interests: organic synthesis, catalysis, physical organic chemistry



LABORATORY COORDINATOR

Name: Professor Barb Morra

Email: barb.morra@utoronto.ca

Research: chemistry.utoronto.ca/people/directories/all-faculty/barb-morra

Student hours (in person): Tuesdays and Thursdays 9-11 AM in LM117
or by email appointment

Instructor biography: BSc and PhD Western University; Prof. at UofT since 2012. Research interests: chemistry education (including green chemistry initiatives) and organic synthesis

II COURSE OVERVIEW

COURSE DESCRIPTION:

Welcome to CHM 249H: Organic Chemistry! We are glad that you have chosen to take this course and to study this important subject over the next few months. CHM 249H is designed for students with a continuing interest in chemistry, particularly those in any chemistry specialist or major program. In order to appreciate organic chemistry, one must consider how it has impacted the world around us. Everything from pharmaceuticals, high-tech materials, polymers, fertilizers, pesticides, personal care products, and even our food, has been impacted by organic chemistry. The utility of this subject in our world is a direct result of the powerful reactions that allow chemists to design and create useful compounds with interesting structural motifs and chemical properties. These reactions are often called 'tools' within a chemist's 'toolbox', which can be used to create elaborate target molecules through multistep syntheses.

The primary objective of the CHM 249H classes is to build on the fundamentals of organic chemistry that were previously introduced to students in CHM 151Y or CHM 136H. The course will focus on several principles that revolve around the fundamental structure and bonding of organic compounds. These topics will allow us to explore the basic reactivity and mechanistic details of organic reactions. Tools that facilitate structural elucidation will also be discussed, including NMR and IR spectroscopy. Multistep organic synthesis of complex molecules will be introduced along with topics relating to medicinal chemistry.

We sincerely hope that CHM 249H will exceed your expectations: we are all here to support your learning and are very invested in your success! We would appreciate your comments and suggestions so that we can make the course as helpful and interesting as possible: do feel free to discuss any matters with the instructor, laboratory coordinator, and laboratory teaching assistants (TAs).

STUDENT LEARNING OUTCOMES:

Upon successful completion of this course, students will be able to:

- demonstrate an understanding of and apply the structural elucidation techniques of infrared spectroscopy and nuclear magnetic resonance spectroscopy in order to determine the atom connectivity of unknown molecules.
- recognize important classes of functional groups and use knowledge of their reactivity patterns to predict the products of organic transformations.
- interpret the fundamental principles underlying the behavior of organic compounds as nucleophiles and electrophiles.
- formulate fundamental organic reaction mechanisms by appropriately describing electron flow in order to write reasonable mechanisms for new reactions.
- apply organic reactions and their conditions in order to propose synthetic pathways for given target compounds of interest.
- safely conduct chemical experiments in the laboratory using a variety of classic techniques using modern instrumentation.
- collect, record, and interpret laboratory results.
- use problem solving and critical thinking skills to combine their theoretical knowledge with their laboratory results to solve scientific problems.
- develop effective scientific communication skills through written laboratory reports.
- gain a basic appreciation of the principles of green chemistry and sustainability.

PREREQUISITE COURSE(S):

This course assumes you have a fundamental and thorough understanding of content presented in CHM 151Y (Chemistry: The Molecular Science). The combination of CHM135H (Chemistry: Physical Principles) and CHM 136H (Introductory Organic Chemistry I) – especially the latter course – is a suitable alternative prerequisite.

READINGS:

The *required* textbook for CHM 249H is "Organic Chemistry", 9th edition by J. McMurry plus the optional accompanying Study Guide and Solutions Manual. This is the same textbook as required in CHM 136H and CHM 151Y. The 8th edition of McMurry can also be used with information posted at the Quercus LEC section website that gives the translation of the

numbering of problems at the end of the chapters. A molecular model kit will be very useful for most of the course. The "Molecular Visions" kit by Darling Models is recommended for this, as well as other undergraduate organic chemistry courses at U of T, although other model kits are helpful too. Models may be used as an aid in all assessments.

III COURSE ORGANIZATION

CHM 249H has two instructional components – classes and laboratories – as well as a course discussion board. The classes will be delivered in person for the Winter 2023 semester. Please come prepared by having done any assigned reading and printed out the class notes posted on Quercus in advance. Questions are particularly welcomed both during class time and after class. Laboratories are scheduled to run in person on Tuesday or Thursday mornings (depending on your PRA section). Please see experimental schedule below.

CLASSES:

Classes will be held in person on M from 1–2 p.m. in LM159 and on TR from 3–4 p.m. in BA1170. Lecture notes will be posted prior to the classes, and a second version with the annotations from the lecture will be posted afterwards. Lecture audio will be recorded and made available for streaming. Please be aware that reading the posted class notes and/or textbook, or listening to the recorded lectures, is not a substitute for attending classes and taking an active approach to your learning! It is essential that you attend class in-person to solidify your understanding of the fundamental course material.

A list of planned topics that will be covered in class is as follows:

1. Review of 1st year organic chemistry: introductory principles
2. Spectroscopy of organic molecules (McMurry Ch. 12, 13)
3. Basic review of thermodynamics and kinetics (McMurry Ch. 6)
4. Acidity and basicity (McMurry Ch. 2)
5. Alkynes (McMurry Ch. 9)
6. Aromatic compounds (McMurry Ch. 15)
7. Electrophilic aromatic substitution (McMurry Ch. 16)
8. Nucleophilic aromatic substitution and benzynes (McMurry Ch. 16)
9. Introduction to multi-step synthesis: preparation of aromatics (McMurry Ch. 16)
10. Amines (McMurry Ch. 24)
11. Oxidation reactions (McMurry Ch. 17)
12. Aldehydes and ketones (McMurry Ch. 19)
13. Carboxylic acids and their derivatives (McMurry Ch. 20, 21)
14. Enolate chemistry (McMurry Ch. 22, 23)

LABORATORIES:

The purpose of the mandatory CHM 249H laboratories is to introduce you to classic techniques used in the organic chemistry laboratory while using modern instrumentation. This hands-on experience will allow you to safely and effectively conduct a variety of experiments, a number of which reinforce content discussed during class time. Throughout CHM 249H you will also learn about green chemistry principles, and how they can be used in the laboratory to conduct scientific work in a safe, responsible, and sustainable way. During each experiment you will generate your own scientific data that you will collect, record, and interpret. After each

experimental session you will have the opportunity to combine your theoretical knowledge with your laboratory results to solve scientific problems. These conclusions will be communicated through a series of laboratory reports. Although the majority of the reports will be relatively simple and brief, you will be given the opportunity to engage in scientific writing activities for select experiments in order to improve your scientific writing skills.

During the semester, the laboratory sessions will take place weekly on Tuesdays (section PRA0101) or Thursdays (section PRA0201) from 8:30 a.m.–1:00 p.m. in LM 113/117. Please note that laboratory reports will be due one week after each experiment is performed (i.e. at the beginning of the next experiment).

The planned schedule of experiments is as follows:

EXPERIMENT	Tues (P0101)	Thurs (P0201)
Exp. 1: Solubility, Recrystallization and Melting Point Determination	Jan 17	Jan 19
Exp. 2: Synthesis of a Hydrazone and IR/ ¹ H NMR Spectroscopy	Jan 24	Jan 26
Exp. 3: Synthesis vs. Extraction of Limonene	Jan 31	Feb 2
Exp. 4: A Fruit Juice-Catalyzed Reductive Amination	Feb 7	Feb 9
Exp. 5: Synthesis (Part A): Acetylation of 4-Aminophenol	Feb 14	Feb 16
Exp. 6: Synthesis (Part B): Synthesis of Phenacetin	Feb 28	March 2
Exp. 7: Synthesis (Part C): Bromination of Phenacetin	March 7	March 9
Exp. 8: “Unknown” Electrophilic Aromatic Substitution Reaction	March 14	March 16
Exp. 9: Exploring a New Oxidation (Part 1): Reaction Optimization	March 21	March 23
Exp. 10: Exploring a New Oxidation (Part 2): Reaction Scope	March 28	March 30
Exp. 11: Solvent-Free Aldol Condensation	April 4	April 6

***Note: There will be no labs during reading week (February 20-24)**

Important Notes:

- ALL experiments will be in person.
- if you have not yet registered for a practical section on ACORN, or if you need to switch sections, please contact Professor Morra immediately (barb.morra@utoronto.ca).
- in order to be prepared for the CHM 249H laboratory experience, please complete the “CHM 249H Laboratory Check-list” posted on your CHM 249H PRA Quercus site.

COURSE DISCUSSION BOARD:

In addition to offered student hours, we will be using the free Ed discussion platform that facilitates online questions and answers. Information on how to join the platform will be made available as an announcement at the Quercus LEC section website. You are strongly

encouraged to ask your content questions on this discussion board where all students can benefit. **The teaching team will be monitoring the discussion board and providing input as needed, although we expect students to be helping each other as much as possible.** Please note that posting quiz/laboratory report questions and/or sharing solutions to these questions is in violation of the University of Toronto's Code of Behaviour on Academic Matters (see the Academic Integrity section of the syllabus for more details).

OTHER AVAILABLE SUPPORTS:

CHM 249H is supported by the Victoria College Peer Tutoring program (www.vic.utoronto.ca/current-students/registrar-office/tutor). If you would like further support in a small-group online environment, you are also highly encouraged to investigate the Recognized Study Group (RSG) Program (<https://sidneysmithcommons.artsci.utoronto.ca/recognized-study-groups/join>). These are small, student-led study groups of up to eight classmates enrolled in the same course within the Faculty of Arts & Science. RSGs meet each week: more information will be announced during mid-January about this initiative.

IMPORTANT WINTER 2023 SESSIONAL DATES:

First Day of S classes: Monday 9th January

Family Day: Monday 20th February

Winter Reading Week (no classes): Monday 20th – Friday 24th February

Last Day to Drop S Courses: Monday 13th March

Last Day of S classes: Friday 7th April

April Final Assessment Period: Monday 10th – Friday 28th April

IV EVALUATION/GRADING SCHEME

OVERVIEW:

The course material is acquired through laboratory experiments, problem solving, classes, and course readings. The overall course grade is determined by a combination of factors based on your performance in the laboratory (including reports), in two quizzes, in two term tests, and in a final examination:

Quizzes (×2): 10%*

Laboratory: 35%

Term Tests (×2): 25%**

Final Examination: 30%

ASSESSMENT DATES & MARK BREAKDOWN:

1. Quiz 1 (5%*, in-person, Thursday 2nd February, 3:10–3:30 p.m., room BA1170, written during regularly scheduled class time).

2. Term Test 1 (15 or 10%** , in-person, Thursday 9th February, 3:10–4 p.m., room BA1170, written during regularly scheduled class time).

3. Quiz 2 (5%*, in-person, Tuesday 7th March, 3:10–3:30 p.m., room BA1170, written during regularly scheduled class time).

4. Term Test 2 (15% or 10%**, in-person, Tuesday 14th March, 3:10–4 p.m., room BA1170, written during regularly scheduled class time).

5. Final Examination (30%, in-person, April final assessment period, Monday 10th – Friday 28th April).

6. Laboratory (35%, throughout semester). Quality of practical work/results/submitted products and written laboratory reports (reports have 10% deducted per day late to a maximum of three days).

*note that if both quizzes are written, the lower grade earned on the two quizzes will be discounted.

**note that the highest test grade earned from Term Test 1 and 2 will be weighted at 15%, with the remaining term test weighted at 10%.

For students missing one term test for a valid reason, the remaining term test will be worth 10% and the final examination will be worth 45%.

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 quizzes.

Important Note about the Laboratory Assessment:

The practical skills acquired in CHM 249H are an important aspect of this course. As such, you are required to attend at least eight (8) complete experimental sessions in order to pass this class. Students who fail to attend enough practical sessions, even if justified with documentation, will not receive credit for CHM 249H since they will not have acquired the practical skills expected of a student who has completed this course.

V COURSE POLICIES

- Each member of this course is expected to maintain a:
 - professional and respectful attitude during all course activities, including classes, laboratories and online activity.
 - personal calendar/schedule/organizer to ensure that all course activities are completed, and due dates are met.
 - collection of notes recorded independently based on concepts covered in course activities (students registered with Accessibility Services requiring a class note-taker will have access to this accommodation)
 - familiarity with the university policy on Academic Integrity (overleaf)
- Course website: q.utoronto.ca (in your Quercus Dashboard, click on “CHM 249H Winter 2023”). **Please check the Quercus course website regularly for:**
 - general course information
 - all laboratory information (found in the CHM 249H PRA Quercus sites)
 - class notes

- all important announcements related to assessments and laboratories
- Email will generally be responded to within 24 hrs. on weekdays. Email will only be accepted if: (1) You send it from your utoronto.ca account; (2) You identify yourself in the email subject as a student in CHM 249H and include your name and University of Toronto student ID number. Be sure to also include your PRA section number if your inquiry is lab related; (3) No attachments are sent, unless official university correspondence is being forwarded (e.g., a letter detailing academic accommodations); (4) You are aware that organic chemistry can be talked about much more effectively through student hours rather than by email, and that sending emails is not a substitute for attending classes. The finalized student hours for each instructor will be posted at the Quercus course website and they are additionally available by appointment.

Important: be sure to email only ONE person within the CHM 249H instructional team, depending on the nature of your concern. Please do not send emails through the Quercus internal email system: the contact information for the course instructors/laboratory coordinator is listed on p. 1.

- 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. As members of the course teaching team, we 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.
- Students may not create audio or video recordings of classes with the exception of those students requiring an accommodation for a disability, who should contact the instructor prior to beginning to record classes for written permission. Students creating unauthorized audio recording of classes violate an instructor's intellectual property rights and the Canadian Copyright Act. Students violating this agreement will be subject to disciplinary actions under the Code of Student Conduct.
- Laboratory reports and all pre-laboratory quiz responses are to be submitted through the CHM 249H Quercus website only. Late laboratory reports will be deducted at 10% per day (maximum of 3 days late, **after which they will not be graded**), and quiz responses will not be accepted at all after the due date/time.
- **There are no make-up quizzes or term tests in CHM 249H, and there are no make-up laboratory sessions.** Students who are absent from class for any reason (e.g., COVID-19 illness, other illness or injury, family situation) and who require consideration for missed academic work should report their absence through the online absence declaration. The declaration is available on ACORN under the "Profile and Settings" menu. **A student who misses a scheduled quiz or term test must**

additionally contact Professor Taylor (see information on p. 1) WITHIN ONE WEEK to discuss their situation. This is a requirement to receive consideration for the missed quiz or test.

VI TECHNOLOGY REQUIREMENTS

- 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 hard-drive failures, corrupted files, lost computers, etc.

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:

In laboratory reports:

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 laboratory report material/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.**

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 written work (e.g., 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 (<https://uoft.me/pdt-faq>)".

COPYRIGHT AND LECTURE RECORDINGS

If a student wishes to copy or reproduce class presentations, course notes or other similar materials provided by instructors, he or she must obtain the instructor's written consent beforehand. Otherwise, all such reproduction is an infringement of copyright and is absolutely prohibited.

Lecture audio will be recorded, and the recordings made available for streaming via Quercus. Students may also create their own recordings of the lecture audio if they wish. Recordings are intended to permit lecture content review so as to enhance understanding of the topics presented. Audio recordings are not substitutes for attending class.

Students should note that their voice may be recorded as part of the lecture audio. Please speak to the instructor if this is a concern for you.

In accordance with the Accessibility for Ontarians with Disabilities Act, 2005, persons who have special needs will be accommodated.

Students agree to the following terms when creating or using audio recordings of lectures:

- Recordings are not to be distributed without the permission of the instructor via the Internet, using social media such as Facebook, peer-to-peer file sharing such as One Drive or Dropbox, or other distribution channels.
- Recordings are not to be shared with other classmates unless they are to be used in collaborative assignments, or if the instructor permits for other reasons.

Non-compliance with these terms violates an instructor's intellectual property rights and the Canadian Copyright Act. Students violating this agreement will be subject to disciplinary actions under the Code of Student Conduct.

ACCESSIBILITY NEEDS

Students with diverse learning styles and needs are welcome in CHM 249H. 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. If possible, please submit your accessibility letter at the beginning of the course and not immediately before laboratory report or assignment is due.

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, class or laboratory session. Students must inform the instructor **before** the 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 [Technical Support/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.