

CHM 347H: Organic Chemistry of Biological Compounds

Course Syllabus: Fall 2023

I CONTACTS

**INSTRUCTOR**

Name: Jik Chin

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**TA(s)**

Name: Hunter J. Clark

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Office:

Office hours: TBA

Classes and Tutorials

Classes: MW 4-5pm ET (RW117 lectures and tutorials)

Tutorials: R 12:00-1:00pm ET and F 1:00-2 :00pm ET (SS1085, attend one R or F)

II COURSE OVERVIEW

COURSE DESCRIPTION:

This course is about understanding the molecules of life from amino acids to proteins and nucleic acids. Fundamental organic chemistry learned from CHM136H and CHM247H/CHM249H will be applied whenever possible to these fascinating biological reactions. In the first half of the course, chemical synthesis of amino acids, proteins and DNA will be compared with their biological synthesis. Knowledge gained from these studies will be applied to directed molecular evolution for designing bioactive molecules. Computation will be used to demonstrate stereoselective recognition and synthesis of amino acids. In the second half of this course, metabolism (catabolism and anabolism) of amino acids, sugars and fat molecules will be discussed. Oxidative breakdown of these biomolecules (catabolism) to CO₂ can be compared to burning of gasoline to generate energy. Understanding how nature converts CO₂ to biomolecules (anabolism) like amino acids, sugars and fat molecules is not only useful for developing pharmaceutical agents but also for protecting and preserving our environment through efficient recycling of CO₂.

STUDENT LEARNING OUTCOMES:

After completing the first half of the course, students are expected to know how nature makes proteins and DNA. They are also expected to know how chemists synthesize proteins and DNA using fundamental organic chemistry. They will understand how these techniques can be applied in directed molecular evolution to develop bioactive compounds. After completing the second half of the course, students are expected to understand metabolism in terms of organic chemistry reaction mechanisms. For example, students are expected to know the energy forming chemical transformation of glucose to carbon dioxide and water in terms of reaction mechanisms. Finally, students will be able to understand the utilization of CO₂ in the Calvin cycle to make carbohydrates.

PREREQUISITE COURSE:

CHM247H/CHM249H

Textbook: The required textbook for CHM347H is Organic Chemistry by John McMurry (8th or 9th edition). This book is only a starting point for many of our discussions and thus a significant amount of the course material can only be found in the class notes.

TUTORIALS:

Problem solving skills will be developed for better understanding of organic chemistry in biological reactions. TA will solve sample problems sometimes together with students. Attendance will be taken and student participation will be encouraged.

III COURSE ORGANIZATION

This course will be given in class with the following schedule.

COURSE SCHEDULE & RELEVANT SESSIONAL DATES:

DATES	UNIT/WEEK	TOPICS
Sept 11 – Sept 13	1	Intro to amino acids
Sept 18	2	Chemical synthesis of amino acids
Sept 20	2	Protein composition
Sept 25	3	Protein sequencing
Sept 27	3	Protein: chemical synthesis (a)
Oct 2	4	Protein: chemical synthesis (b)
Oct 4	4 (quiz1)	Protein: structure and function
Oct 9	5 Thanksgiving	
Oct 11	5	DNA structure

Oct 16	6	DNA replication/sequencing
Oct 18	6 Midterm test (lecture time)	
Oct 23	7	DNA chemical synthesis
Oct 25	7	Translation (biological synthesis of proteins)
Oct 30	8	Directed molecular evolution
Nov 1	8	Catabolism of fat
Nov 6, 8	9 reading week	
Nov 13	10	Carbon dioxide (CO ₂)
Nov 15	10 (quiz 2)	Glycolysis
Nov 20	11	Citric Acid Cycle
Nov 22	11	Anabolism-gluconeogenesis
Nov 27	12	Calvin cycle
Nov 29	12	Amino acid metabolism
Dec 4	13	Transketolase
Dec 6	13	Review

IV EVALUATION/GRADING SCHEME

QUIZZES (two 30min quizzes) worth 15% each during weeks 5, and 9.
 There will be one mid-term (1 hr) totaling 30% during weeks 6.
 FINAL ASSESSMENT (3 hr exam at the end of course) worth 40%
 (Term 60% Final 40% or Term 40% Final 60% whichever gives better outcome)
 Dates for the quizzes and MT are shown in the table above.
 Final exam date will be announced.

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.

FINAL ASSESSMENT

There will be a Final Assessment Period in December

V COURSE POLICIES

- Each member of this course is expected to maintain a:
 - (i) professional and respectful attitude during all course activities, including classes, laboratories, tutorials and online activity.
 - (ii) personal calendar/schedule/organizer to ensure that all course activities are completed, and due dates are met.
 - (iii) 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)
 - (iv) familiarity with the university policy on Academic Integrity (overleaf)
- 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 a Course Instructor, I 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.
- Communication with instructor (e.g., I will respond to email within 24 hrs. on weekdays).
- Privacy language and appropriate use of course materials:
<https://teaching.utoronto.ca/ed-tech/audio-video/sample-statements/>

VI TECHNOLOGY REQUIREMENTS

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

<https://www.vicereprovoststudents.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 of course sometimes things can go wrong when using them. You are responsible for ensuring that you maintain regular backup copies of your files, use antivirus software (if using your own computer), and schedule enough time when completing an assignment to allow for delays due to technical difficulties. Computer viruses, crashed hard drives, broken printers, lost or corrupted files, incompatible file formats, and similar mishaps are common issues when using technology, and are not acceptable grounds for a deadline extension.

VII INSTITUTIONAL POLICIES AND SUPPORT

ACADEMIC INTEGRITY

On 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

(<https://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 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 <https://www.academicintegrity.utoronto.ca/>).

Use of Turnitin

"Normally, students will be required to submit their course essays to Turnitin.com 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 Turnitin.com reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of the Turnitin.com service are described on the Turnitin.com web site".

COPYRIGHT

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. More information regarding this is available here: <https://teaching.utoronto.ca/ed-tech/audio-video/copyright-considerations/>

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 and 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.