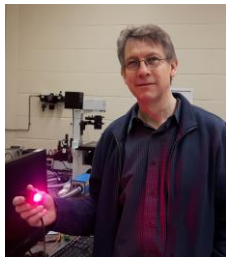


CHM 379H: BIOMOLECULAR CHEMISTRY

Course Syllabus

I TEACHING TEAM

INSTRUCTORS



Prof. Andrew Woolley
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LM526



Prof. Haissi Cui
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DB443

Office hours: Tuesday and Thursday 3-4 pm or by appt.

TAs

Giang Le	giang.le@mail.utoronto.ca
Max Reed	pmm.reed@mail.utoronto.ca
Nicole Potter	nicole.potter@mail.utoronto.ca

Student hours: by appt.

II COURSE OVERVIEW

COURSE DESCRIPTION:

This is a laboratory-based course in biological chemistry. Students will perform a complete research project to study the structure/function relationships of an engineered protein while learning many of the core techniques in the field. The lectures will discuss the theory behind the techniques and highlight how they are used in modern biological chemistry research and industry. The chemical and biochemical principles learned in earlier courses will be applied, and a basic understanding of organic and biochemistry will be assumed. This information will serve as a basis for independent research and more advanced courses in biological and biophysical chemistry.

STUDENT LEARNING OUTCOMES:

- Students will learn how to clone protein-coding genes and introduce point mutations in these genes using site-directed mutagenesis by PCR.
- Students will gain proficiency in designing primers and analyzing sequencing data to confirm mutations.
- Students will learn how to use *E. coli* for recombinant protein expression and will gain hands-on experience of purification of proteins from *E. coli* using affinity chromatography methods.
- Students will learn the principles of and gain hands-on experience in using SDS-PAGE and MS methods to test protein identity and purity.
- Students will learn the principles of and gain hands-on experience in using UV and fluorescence methods to characterize protein conformations.

- Students will gain practice with analyzing scientific data and present their results both orally (PowerPoint presentations) and as written reports.

PREREQUISITE COURSE(S):

This course assumes you have a basic understanding of introductory biological chemistry and know the chemical structures of the main components of proteins, DNA, RNA, sugars, lipids. **Prerequisite:** ([CHM247H1](#)/[CHM249H1](#) with a minimum grade of 63%), [CHM347H1](#), [BCH210H1](#)

READINGS:

"Biochemistry" by D. Voet & J. G. Voet, 4th Edition, Wiley 2011. Any other good introductory text, such as "Fundamentals of Biochemistry" by Voet, Voet, & Pratt is also fine. The Molecules of Life (used in CHM220) is also good for sections on protein structure.

III COURSE ORGANIZATION

COURSE SCHEDULE & RELEVANT SESSIONAL DATES:

Wk	Mon.	Tues. 2pm	Thurs. 2 pm	Fri. 9 am to 1 pm
Part I				<u>Gene Assembly & Protein Prep</u>
1	Jan. 9	C- Intro to class in LM123 Then, intro Pipetemen Hand-in sheet; Organize groups	C- PCR etc.	Autoclave LB Prepare Kan plates Prepare agarose gel Set up PCR; Calculations...
2	Jan. 16	Agarose gel	C- DNA, restriction enzymes (RE), ligases	Assembly reactions Heat shock transformation Writing and research skills
3	Jan. 23	Prepare agarose gel Plan RE digest	C – Benchling etc **Set up mini-prep cultures	Mini-prep DNA Quantify RE digests & Agarose gel
4	Jan. 30	C- Sequencing & bioinformatics	C- Protein expression techniques	Check sequences Heat shock of BL21(DE3) Make buffers
5	Feb.6	SDS gel on cells to check expression	C- Chromatography	Lyse cells, Centrifuge lysate, Run column Set up dialysis
6	Feb. 13	SDS-PAGE, Quantify	C- Electrophoresis, UV/Vis, Expsy etc.	<i>Presentation Day</i> [#]
	Feb. 20	<i>Reading week</i>		
Part II				<u>Characterization–Staggered*</u>
7	Feb. 27	C-Review	Test (Mar. 2)	Photoswitching (UV/Vis)

8	Mar. 6	C- protein structures (CD, FI)	C- X-ray of proteins	Mass Spectrometry
9	Mar. 13	C- NMR of proteins	C- Pymol	Denaturation (Fluorescence)
10	Mar. 20	C- protein mass spectrometry	C- ligand binding	Size-exclusion FPLC
11	Mar. 27	C- protein folding	C- protein design & modification	Presentation Day
12	Apr. 3	C-Review	C-Reports Due	

*You will rotate through these labs, so you may not be doing them in this order.

**You will have to set up the mini-prep cultures the day before your 4 h lab.

C – indicates a lecture in LM123. Labs are in Analest, LM6/7.

LABORATORY OBJECTIVES:

The labs are the central part of this course. Hands-on experience is vital for experimental biological chemistry and full attendance at labs is required. The TAs will help you by showing you how to perform specialized techniques, operate equipment, and interpret data. In preparation for each lab, you will need to read the lab manual and complete pre-lab tasks. Your lab notebook will be evaluated to encourage good record keeping.

IV EVALUATION/GRADING SCHEME

OVERVIEW:

Class test	15%
Final exam	35%
Lab total	50%

ASSESSMENT DATES & MARK BREAKDOWN:

1. Class Test (March 2nd): 1h during class time.
2. Final Exam (in exam period)
3. Labs:

Formal Lab Report (due April 6 th)	20%
Lab presentation (Feb. 17 th and March. 31 st , best out of 2)	10%
Lab performance and notebook (due April 6 th)	10%
Writing exercise (Jan. 24 th)	10%

For students missing the term test for a valid reason, a makeup test will be offered.

Makeup labs will not be offered.

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, 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 (Section VII below).
- 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 instructors. Email is preferred. The instructor will respond to email within 24 hrs. on weekdays.
- Course videos and materials belong to your instructor, the University, and/or other source depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor.
- For questions about recording and use of videos in which you appear please contact your instructor.
- Policy for late assignment submissions: 10% will be deducted daily.
- Policy for reweighting due to missed pieces of academic work: no reweighting
- Submission methods: Quercus only.
- Process for requesting re-grading of course work: speak to instructor within 1 week of receiving grade.
- Process for signaling course absences and requesting make-up tests or exams, if applicable. Speak to instructor within 1 week of event.

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 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 virtual 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 virtual 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 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 work 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 work 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

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 & 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.