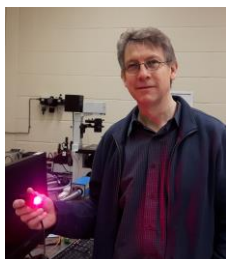


CHM 379H: BIOMOLECULAR CHEMISTRY

Course Syllabus

I TEACHING TEAM



INSTRUCTOR

Name: Prof. Andrew Woolley

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Office: LM526

Online student hours: by appt.

TAs

Name: Alex Eddenden, Max Reed, Giang Le

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Office: LM 527

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 relationship of a chemically modified 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 chemistry 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 mutagenic primers using PCR methods.
- 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 and gain hands-on experience in using SDS-PAGE and MS methods to test protein identity and purity.
- Students will learn the principles and gain hands-on experience in using CD, UV and NMR methods to characterize protein conformations.

- Students will gain practice with analyzing scientific data and 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

This course will be completely online until the end of January. The plan is to start in person labs on Friday Feb. 4th. Labs run 9-1 on Fridays. This may be subject to change if COVID restrictions require it.

COURSE SCHEDULE & RELEVANT SESSIONAL DATES:

| Wk | Mon. | Tues. 2pm | Thurs. 2 pm | Fri. 9 am to 1 pm |
|---------|---------|---|---|---|
| Part I | | | | Gene Assembly & Protein Prep |
| 1 | Jan. 10 | C- Intro to class (live online) | C- PCR etc | Using Benchling (online) |
| 2 | Jan. 17 | C- Review aa, buffers DNA, restriction enzymes (RE), ligases | C – DNA handling, Sequencing & bioinformatics | Writing/editing workshop (online) |
| 3 | Jan. 24 | C- Sequence analysis | C- Protein expression techniques | Using the PDB & PyMol (online) Writing assignment due |
| 4 | Jan. 31 | C- Chromatography | C- Electrophoresis, UV/Vis, Expassy etc. | In person lab: protein purification |
| 5 | Feb. 7 | C- protein structures (CD, FI) | C- X-ray of proteins | In person lab: protein purification |
| 6 | Feb. 14 | (review) | Test 1 Feb 10th (online) | In person lab: protein purification |
| | Feb. 21 | <i>Reading week</i> | | |
| Part II | | | | Characterization- Staggered* |
| 7 | Feb. 28 | C- NMR of proteins | C- more NMR | Mass Spectrometry/ SDS-PAGE |
| 8 | Mar. 7 | C- using NMR ViewJ | SDS-PAGE | Photoswitching (UV/Vis) |
| 9 | Mar. 14 | C- protein mass spectrometry | C- ligand binding | Conformational changes (CD) |

| | | | | |
|----|---------|-------------------------|----------------------------------|---------------------------------|
| 10 | Mar. 21 | C- protein folding | C- protein design & modification | Protein NMR |
| 11 | Mar. 28 | <i>Presentation Day</i> | <i>Presentation Day</i> | (lab) |
| 12 | Apr. 4 | <i>Presentation Day</i> | <i>Presentation Day</i> | <i>Lab report due April 8th</i> |

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 (Feb 10th in person or online if required): 1h during class time.
2. Final Exam (in exam period, in person or online if required)
3. Labs:

| | |
|---|-----|
| Formal Lab Report (due April 8 th) | 20% |
| Lab presentation | 10% |
| Lab performance and notebook (due April 8 th) | 10% |
| Writing exercise (Jan. 28 th) (paper intro) | 10% |

For students missing the term test for a valid reason, a makeup test will be offered.
Makeup labs will not be offered.

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/term tests.

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 (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. Email is preferred. The instructor will respond to email within 24 hrs. on weekdays.
- 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.
- 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 (e.g., 10% will be deducted daily).
- Policy for reweighting due to missed pieces of academic work.
- 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.vicereprovooststudents.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.