

CHM2104HF 2023

Biological Chemistry: Design & evolution of proteins & nucleic acids

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Dates: Thursdays, 10am-12pm, starting Sept 14, continuing for 6 weeks with a break during reading week: Sept 14, 21, 28, Oct 5, gap for reading week following Thanksgiving, then Oct 19, 26.

Mode of Course Delivery: Zoom

<https://utoronto.zoom.us/j/86262589482>

Meeting ID: 862 6258 9482

Web Site: On Quercus

Topics:

Rational Design & Directed Evolution

- a. Helical structures, randomized library selections
- b. Biomolecular recognition
- c. Rational vs. nonrational design, *in vitro* and *in vivo* methods
- d. Intrinsically disordered proteins, structure and function

2-hour lectures via Zoom. I actually found that Zoom worked better than in-person: more class participation, more interaction.

1. **Protein design, randomized library selection.**
2. **Zn finger, rational design.**
3. **Intrinsically disordered structures.**
4. **Directed evolution.**
5. **Class Presentations.**
6. **Class presentations + exam.**

Reading: Papers are posted on Quercus in Modules labeled Week 1-4 reading. Papers are in pdf format with a Tips sheet for questions to consider.

Marking Scheme

Exam	40%
Oral Presentation	40%
Class Participation	20%
Total	100%

Exam: In person exam sittings will be available at UTM and St. George. Exam will focus on the principles covered in class and in assigned readings. Exam will be ~60 minutes in length; this depends on how many people enroll, so how many orals we have presentations we have.

Class Participation

The class format is discussion style. The class will be informal (that is, not lecture format), and it is a requirement for everyone to participate. Much of the course will be reading journal articles; there is no textbook. Your previous biochemistry textbook can be a useful reference. I will give you the readings in advance via Quercus/email, and you will be expected to have read the papers well and be prepared for discussion. However, I do not expect you to understand everything, and this is what we will discuss.

I expect you to come to class with questions about the readings and to have given substantial thought and effort to understanding the literature. If you do not come to class prepared, it will be noticeable. Class participation is, therefore, a very important component of your final grade. I will give 2 pts maximum for class participation points for each class. You can ask me anytime about your scores for class participation. I will also make clear at the end of class what got 2 pts for class participation, what got 0 pts, etc.

Oral Presentation

Students will choose from the short oral topics below. We will do this at the beginning of Class 2. Come prepared with several choices. The oral is intended to provide information to a 1st year grad student who is contemplating using the technique (e.g. calorimetry) to solve a research problem. The oral should not be exhaustive, but provide enough information, so a student could decide whether to pursue this technique in more depth. I recommend using a literature example of how a lab used the technique to help solve a problem. Also consider strengths, limitations of the technique. Tentatively plan for 15 min presentation + 5-10 min Q&A. Times will depend on how many students enroll.

Oral Slides Information

Referencing must occur on the slide for which the reference is used, and the reference must be clearly associated with a particular graphic, data, etc. For some reason, many students like to put a list of references on the last slide that is flashed quickly. This is improper and does not give due credit where it belongs.

Note that a standard pace for slides is ~1.5 min per slide. 1 min per slide is fast. I suggest you practice keeping your pacing within 10 min, without talking fast.

Short Oral Topics

1. Circular Dichroism (CD)
2. ESR/EPR
3. 2D NMR technique/how it works
4. 2D NMR application (including NOESY & HSQC)
5. Calorimetry (ITC & DSC)
6. Molecular Dynamics (MD)

7. X-ray crystallography
8. Fluorescence & FRET
9. Fluorescent proteins (GFP)
10. Fluorescence applications: time-resolved, cell work
11. Chromatography applications: SEC, ion exchange, HPLC.
12. Electron Microscopy (EM) (including fibrils)
13. Mass Spectrometry (MS) (including MALDI-TOF and ESI)
14. Y1H, Y2H, B1H, B2H
15. Reporter assays: β -Gal complementation, CAT, luciferase

Learning Objectives

1. Critical thinking & analytical skills
2. Reading papers.
3. Problem-solving skills.
4. Soft skills: communication, both verbal (oral presentation) and written (test).
5. Soft skills: thinking on your feet during class, developing and answering questions.
6. Transferrable skills to other fields, careers, life.

Presentation Guidelines

Grades	A	B	C	D	F
Content	Exceptional effort evident in preparation, design and content. Highly knowledgeable about the project & background literature.	Thorough preparation, design and content. Knowledgeable about project & background literature.	Good preparation, design and content. Somewhat knowledgeable about project & background literature.	Satisfactory preparation, design and content. Limited knowledge about project & background literature.	Limited investment of time in preparation, design and content. Weak knowledge about project & background literature.
Presentation	Media is employed in a highly effective manner to enrich the content of the presentation.	Effective use of media to enhance key concepts of presentation.	Appropriate use of media to present key concepts.	Limited use of media to support content.	No or inappropriate use of media to support content.
	Exceptional time management skills	Finished within allotted time.	Exceeded time allotment minimally.	Exceeded time allotment noticeably.	Unaware of the time and how to manage it.
	Highly organized and structured, excellent use of voice, engaged audience throughout the presentation	Organized and structured, good use of voice, engaged audience much of the time.	Fairly organized and structured, reasonable use of voice, attempted to engage audience throughout the presentation.	Somewhat organized, satisfactory use of voice, limited audience engagement.	Disorganized, poor use of voice, audience disengaged.
Question and answer, knowledge and thoughtfulness about the project.	Highly professional presentation that generates Q&A with audience, thoughtful answers to questions.	Professional presentation promoting Q&A with audience, good answers to questions.	Satisfactory presentation generating Q&A with audience, satisfactory answers to questions.	Somewhat satisfactory presentation generating limited Q&A with audience, limited answers to questions.	Weak presentation generating limited Q&A with audience, weak answers to questions.

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 other online activities.
- (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

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. The CHM2104HF teaching team will neither condone nor tolerate behaviour that undermines the dignity or self-esteem of any individual in this course and we 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](#).

INSTITUTIONAL POLICIES AND 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](#) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences.

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/).

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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:

- School of Graduate Studies' [Policies and Guidelines](#)
- Full library service and resources on conducting online research through University of Toronto Libraries [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.