



Chemistry

UNIVERSITY OF TORONTO

CHM437S: BIOINORGANIC CHEMISTRY

2023 Spring Semester Course Syllabus

I Instructor



Prof. Robert H. Morris

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Office: Davenport Labs, room 344, 80 Saint George St.

In person student hours: 4-5 pm Mondays Feb.-Apr. or by appointment arranged by email.

Research: <https://www.chemistry.utoronto.ca/people/directories/all-faculty/robert-morris>

II COURSE OVERVIEW

COURSE DESCRIPTION:

Essential elements, harmful elements, naturally occurring ligands, chelating ligands, ligands used in chelate therapy, functions of metals, principles of bioinorganic coordination chemistry, template effect, spontaneous self-assembly, properties of biological molecules, transport of metal ions, control and utilization of metal-ion concentrations, DNA binding, enzymes exploiting acid catalysis, developing artificial hydrolytic metalloenzymes, zinc fingers, electron transfer and energy sources for life, iron-sulfur proteins, Mossbauer spectroscopy, hydrogenases, nitrogenase, atom and group transfer chemistry, redox enzymes, biomineralization, metals in medicine, radiopharmaceuticals

STUDENT LEARNING OUTCOMES:

Recognize how the fundamental principles of inorganic chemistry apply to bioinorganic systems.

Appreciate how Nature acquires and places trace elements for use in life processes.

Understand the application of specialized methods used to study bioinorganic molecules.

Discuss the chemistry and biology of specific bioinorganic systems and model metal complexes.

PREREQUISITE COURSE(S):

This course assumes you have a basic understanding of transition metal coordination chemistry from a full year course in introductory inorganic chemistry such as CHM238Y/CHM236+CHM237 and a knowledge of biochemistry. CHM236+CHM237 may not be taken concurrently with CHM437S. A biochemistry course and an advanced inorganic chemistry course such as CHM338H are strongly recommended.

Exclusion: Equivalent course in Bioinorganic Chemistry or Inorganic Biological Chemistry

READINGS:

Required:

Course notes and materials from the QUERCUS website.

Textbook: Bioinorganic Chemistry by Dieter Rehder, Oxford University Press, 2014
ISBN: 9780199655199

Supplemental: Guided Tours of Metalloproteins: [The Guided Tours of Metalloproteins \(GTM\) \(utoronto.ca\)](http://www.utoronto.ca/~gtr/gtm/)

III COURSE ORGANIZATION

This course is organized by:

Two classes each week (Tues. and Thurs. at 4:00 pm ET) starting on Tuesday January 10, 2022 at Lash Miller 157.

COURSE SCHEDULE & RELEVANT SESSIONAL DATES:

WINTER DATES	WEEK	TOPICS
Jan. 10-26	1,2,3	Introduction, essential elements, biocoordination chemistry, metal ion transport
Feb. 2 Feb. 2 – Feb. 18	4,5,6	Quiz 1 due on Feb. 2 O ₂ transport, non-redox proteins, electron carriers, Iron sulfur proteins, cytochromes.
Feb. 20-24		Winter reading week
Feb. 28 Feb. 28, Mar. 2	7	Midterm Assignment due Feb 28, 4:10 pm. Copper blue proteins
Mar. 7-16 Mar. 16	8,9	Nitrogenase, respiration Abstract of presentation due Mar 16, 4:10 pm.
Mar. 21-30 Mar. 30	10,11	Photosynthesis, metals in medicine. Quiz 2 due on Mar. 30
Apr. 4,6 Week of Apr. 4-7	12	Student presentations in class Evening poster session.
Apr. 6		Classes end
Apr. 11-28		Final assessment period.

IV EVALUATION/GRADING SCHEME

OVERVIEW:

QUIZZES (two in total, best mark of the two) worth 10%

MIDTERM ASSIGNMENT (due Feb. 28) worth 20%

PRESENTATION ABSTRACT (due Mar. 16) worth 5%

STUDENT PRESENTATION (in class talk or poster presentation) due Apr. 4-7 worth 30%

FINAL ASSESSMENT during Apr. 11-28 (to be announced). Worth 35%

TOTAL: $10\%+20\%+5\%+30\%+35\%=100\%$

ASSESSMENT DATES & MARK BREAKDOWN:

1. Quiz 1 (10%*, Thursday 2nd February): 1 hour, to be written anytime within a 24-hour window between 12:00 a.m. – 11:59 p.m. ET.
2. Midterm assignment (20%, due Tuesday February 28 at 4:10 pm).
3. Abstract of presentation (5%, due Thursday March 16th at 4:10 pm)
4. Quiz 2 (10%*, Thursday 30th March): :1 hour, to be written anytime within a 24-hour window between 12:00 a.m. – 11:59 p.m. ET.
5. Student Presentation (30%, during the week of April 4-7): done in class or during an evening poster session TBA.
6. Final assessment (35%, in the Final Assessment period April 11-28): 3 hours, location and date to be announced.

*note that if both quizzes are written, the higher grade earned on the two quizzes will be counted. Each quiz will be multiple-choice in nature.

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, 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/>
- Policy for late assignment submissions: 10% will be deducted daily
- Policy for reweighting due to missed pieces of academic work (for valid reason). The average of marks for the other assignments of the course will be used to determine the mark for the missed work. Contact Prof. Morris by email immediately if you miss assigned work.
- Submission methods: Tutorial problem answers on paper will be handed to the tutor at the end of the tutorial.
- Process for requesting re-grading of course work. Provide it to the tutor at the next tutorial after the one where you received back the graded work.

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 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 presentations and assignments:

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 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/).

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.
