



# Chemistry

UNIVERSITY OF TORONTO

## CHM 437H: Bioinorganic Chemistry Winter Course Syllabus

### I Instructor

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#### INSTRUCTOR

Name: Robert Morris

Email: Robert.morris@utoronto.ca

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

**Student hours:** Davenport Labs, room 344.

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

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

### II COURSE OVERVIEW

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#### COURSE DESCRIPTION:

This course examines the use of metals in biology. Topics include naturally occurring and medicinal ligands; transport, uptake and control of concentration of metal ions; and physical methods of characterization of metal binding sites. The roles of metal ions in nature are discussed, including as structural and signaling elements in proteins, nucleic acids and DNA-binding complexes and proteins; as Lewis-acid centres in enzymes; as carriers of electrons, atoms and groups in redox proteins and enzymes; and as sources of biominerals; as 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.

Discuss the use of metals in medicine.

#### PREREQUISITE COURSES:

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.

**Corequisites:** None

**Exclusions:** CHM333H5, CHMD69H3, An equivalent course in Bioinorganic Chemistry or Inorganic Biological Chemistry

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**Recommended Preparation:** A biochemistry course and an advanced inorganic chemistry course such as CHM338H are strongly recommended, CHM347H1/CHM379H1

Exclusion:

**Credit Value:** 0.5

**READINGS:**

**Required:** Course notes and materials from the QUERCUS website.

Supplemental: Biological Inorganic Chemistry, 3rd ed., Robert R. Crichton, 2019

<https://www.sciencedirect.com/myaccess.library.utoronto.ca/book/9780128117415/biological-inorganic-chemistry>

Bioinorganic Chemistry by Dieter Rehder, Oxford University Press, 2014

ISBN: 9780199655199

Guided Tours of Metalloproteins: [The Guided Tours of Metalloproteins \(GTM\) \(utoronto.ca\)](#)

### III COURSE ORGANIZATION

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This course is organized by two classes each week (Tues. and Thurs. at 4:00 pm ET) starting on Tuesday January 9, 2024, at BL114, 140 St. George Street Bissell Bld (north bld of Robarts library).

Over the course of each week, you are expected to attend and participate in the classes and submit assignments according to the due dates/deadlines.

**COURSE SCHEDULE & RELEVANT SESSIONAL DATES:**

DATES	UNIT/WEEK	TOPICS
Jan. 9-25	1,2,3	Introduction, essential elements, biocoordination chemistry, metal ion transport
Feb. 1 Feb. 1 – Feb. 15	4,5,6	<b>Quiz 1 due on Feb. 1</b> O <sub>2</sub> transport, non-redox proteins, electron carriers, Iron sulfur proteins, cytochromes.
Feb. 19-23		Winter reading week
Feb. 27 Feb. 27, Feb. 29	7	<b>Midterm Assignment due Feb 27, 4:10 pm.</b> Copper blue proteins
Mar. 5-14 Mar. 14	8,9	Nitrogenase, respiration <b>Abstract of presentation due Mar 14, 4:10 pm.</b>
Mar. 19-28 Mar. 20	10,11	Photosynthesis, metals in medicine. <b>Quiz 2 due on Mar. 20</b>
Apr. 2,4 Week of Apr. 1-5	12	<b>Student presentations in class</b> <b>Evening poster session -time to be announced (TBA)</b>
Apr. 5		Classes end
Apr. 10-30		<b>Final assessment period.</b>

## IV EVALUATION/GRADING SCHEME

Assessment	Percent	Details	Due Date
Quiz	10%	Best mark of the two quizzes. 1 hour, to be written anytime within a 24-hour window between 12:00 a.m. – 11:59 p.m. ET.	2024-02-01
Midterm assignment	20%	Due Tuesday February 27 at 4:10 pm.	2024-02-27
Presentation abstract	5%	Select a topic from the list provided or one approved by Prof. Morris and make an abstract of the presentation. Due Thursday March 14th at 4:10 pm.	2024-03-14
Quiz	10%	Best mark of the two quizzes. 1 hour, to be written anytime within a 24-hour window between 12:00 a.m. – 11:59 p.m. ET.	2024-03-20
Student presentation	30%		2024-04-01,2024-04-02,2024-04-03,2024-04-04,2024-04-05
In-Person Final Exam	35%		Final Exam Period

\*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 two quizzes.

## V COURSE POLICIES

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- 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.
- If you are absent from your studies due to illness or other reasons and unable to complete course work (the assignment or presentation) then a piece of written documentation is required. The following four items are the recognized forms of documentation:
  1. [Absence Declaration via ACORN](#)
  2. [U of T Verification of Illness or Injury Form](#)
  3. College Registrar's letter
  4. Letter of Academic Accommodation from Accessibility Services

Students who complete the ACORN Absence Declaration form must additionally contact me/the course coordinator/the course administrator to discuss their situation within five business days of the missed piece of work. This is essential action for any consideration to be granted.

For extended absences and for absences due to non-medical reasons, make sure to contact your [College Registrar's Office](#). They can help you decide between a request for an extension or other types of academic consideration.

If you suspect or know that you have a disability that is affecting your studies, [learn about the services and supports available through Accessibility Services](#). A disability can be physical disability, sensory disability, a learning disability, mental health disorder or a short-term disability like an injury. If you are not sure whether you have a disability, you can confidentially contact [Accessibility Services](#) with your questions.

- The use of generative artificial intelligence tools or apps for the assignment and presentation in this course, including tools like ChatGPT and other AI writing assistants, is prohibited..
- I will respond to email within 24 hrs. on weekdays.

- The course materials provided by Prof. Robert Morris should only be used by students of this course and should not be uploaded or shared with others without the permission of Prof. Morris.
- 10% per day will be deducted for a late assignment.
- For students missing the presentation for a valid reason, the presentation will be made individually with Prof. Morris at a mutually agreed upon date before April 26. For students missing the assignment for a valid reason, the mark will be based on the individual performance on the quiz and presentation marks weighted 10/40 and 30/40, respectively.
- Assignments should be handed to Prof. Morris in person in class.
- Work will only be regraded for a valid reason. A request for regrading must be made within 7 days of the due date of the assignment.

## **VI TECHNOLOGY REQUIREMENTS**

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- 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**

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### **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](http://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 \(https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019\)](https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019). If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, please reach out to me. Note that you are expected to seek out additional information on academic integrity from me or from other institutional resources. For example, to learn more about how to cite and use source material appropriately and for other writing support, see the U of T writing support website at <http://www.writing.utoronto.ca>. Consult the Code of Behaviour on Academic Matters for a complete outline of the University's policy and expectations. For more information, please see [A&S Student Academic Integrity \(https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity\)](https://www.artsci.utoronto.ca/current/academic-advising-and-support/student-academic-integrity) and the [University of Toronto Website on Academic Integrity \(https://www.academicintegrity.utoronto.ca\)](https://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.

### **ACCESSIBILITY NEEDS**

Students with diverse learning styles and needs are extremely 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.

### **QUERCUS INFORMATION**

This Course uses the University's learning management system, Quercus, to post information about the course. This includes posting readings and other materials required to complete class activities and course assignments, as well as sharing important announcements and updates. New information and resources will be posted regularly as we move through the term. To access the course website, go to the U of T Quercus log-in page at <https://q.utoronto.ca>. SPECIAL NOTE ABOUT GRADES POSTED ONLINE: Please also note that any grades posted are for your information only, so you can view and track your progress through the course. No grades are considered official, including any posted in Quercus at any point in the term, until they have been formally approved and posted on ACORN at the end of the course. Please contact me as soon as possible if you think there is an error in any grade posted on Quercus.

### **MENTAL HEALTH AND WELL-BEING**

As a student, you may experience challenges that can interfere with learning, such as strained relationships, increased anxiety, substance use, feeling down, difficulty concentrating and/or lack of motivation, financial concerns, family worries and so forth. These factors may affect your academic performance and/or reduce your ability to participate fully in daily activities. Everyone feels stressed now and then – it is a normal part of university life. Some days are better than others, and there is no wrong time to reach out. There are resources for every situation and every level of stress.

There are many helpful resources available through your College Registrar or through Student Life (<http://studentlife.utoronto.ca> and <http://www.studentlife.utoronto.ca/feeling-distressed>). An important part of the University experience is learning how and when to ask for help. Please take the time to inform yourself of available resources.

### **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 [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.