DEPARTMENT OF CHEMISTRY

THE UNIVERSITY OF WESTERN ONTARIO LONDON, ONTARIO, CANADA

Chemistry 3391b "Bioinorganic Chemistry"
January - April, 2025

INSTRUCTOR: [redacted]

CONTACT: By appointment, in class or by e-mail

Office Hours: by appointment via e-mail is most efficient. Dropping by my office is always possible.

E-mail: [redacted] -- always with "Chem 3391b" in the Subject

(**revised 2024 Dec 16 Jan 01-4-F)**

DATES:

[redacted]

Attendance at lectures in mandatory (see below) so just write to me if you have a conflict

CLASS COMMUNICATION: I will use Announcements from Brightspace via e-mail (only your JaneDoe@uwo.ca address) as the primary means of alerting you to changes in schedules – or to request information from you. Not checking this @uwo.ca e-mail address is not an acceptable excuse for missing important information, up to and including changes in test locations, dates and times.

Course Web Page: instruct.uwo.ca/chemistry/3391b (www not required usually and "b") and the OWL site n**ow on Brightspace.**

(A) Day-to-Day information will be posted here. In addition, special class communications will be in class or via your @uwo.ca email. Please make sure you forward all messages with Subject: "Chem 3391b" to your normal email address.
All course material will be posted to OWL: https://westernu.brightspace.com/

You are responsible for checking the course OWL site (https://westernu.brightspace.com/) regularly for news and updates.

If you need assistance with the course OWL site, seek support on the OWL Brightspace Help page. Alternatively, contact the Western Technology Services Helpdesk, by phone at 519-661-3800 or ext. 83800**.**

LECTURES: 3 lecture hours each week, (1) Tue 11:30 - 12:30 and (2 & 3) Thur 10:30 -12:30 in ChB 9.
Lecture notes are posted on OWL/Brightspace about 1 week before they are to be used. Please download.

Marked Up text will be posted at the end of each unit.
Attendance at lectures is mandatory and missing information given at lectures is not an acceptable excuse for missing evaluation of other details. Please e-mail me if you have to miss a class because you are ill and he will tell you what you have missed and alert you to check that section after the Marked-Up version is uploaded.

PROBLEM SETS: There are no specific problem sets, but problems or questions to consider over the weekend based on the previous week's lectures will be given out on some Thursdays in class. The answers will be available at the next Tuesday's class - you are expected to contribute to the answers in class on Tuesdays. These problems will cumulatively serve for revision for the Term Test and Final Exam.

COURSE ACTIVITIES AND ASSESSMENTS (A-D) **PLEASE CAREFULLY RECORD THESE DATES**

(A) PRESENTATIONS: Two. You will be asked to prepare two time-limited presentations selecting the topics from my list:

#1 is for a maximum of 8 minutes (Thursday January 23rd; topics posted and selected Jan 10th). Note the short time for preparation – you need to be ready to research and prepare your presentation – there are 2 weekends you need to plan to use both.

#2 is for 10 minutes (Thursday February 13th ; topics posted Jan 24th; selected on Jan 27th)

(B) For both #1 and #2 the overall topics for the whole class will be the same, however, you will have to select a specific part of that topic from a Poll. See the web site for details and dates. Presentations will be presented in class time. Your presentations will be uploaded to OWL on the day before the presentation day and that copy will be used for grading. You will prepare your presentation to preload onto my PC laptop (Windows 10/11) or your Mac. I will grade each Presentation using advice from my research group and our class TA. The Grading Table/Rubric will be available on the web site. I strongly suggest reading it. Choose your topic for your personal interest,

(C) TERM TEST IN CLASS - THURSDAY 6th MARCH: 10:30-12:20 Room: TBA (xxx)
105 minutes mixed multiple choice-short answer on all material up to Thursday February 28th.

(D) FINAL EXAM: Cumulative but weighted more to the 2nd part of the course. 3 hrs, mixed multiple choice-short answer on all material.

EVALUATION: 2 presentations (8, 10 mins), single mid-term test, and final exam.

DISTRIBUTION OF MARKS:

2 presentations (#1; Jan 23rd) 14% & (#2; Feb 13th) 16%	= 30% .
Term Test (6th March; 105 mins in class time but not in ChB 9)	= 30% -
Final exam (3 hours in April)	= 40%

ADMINISTRATIVE INFORMATION ABOUT THE COURSE: SPECIAL DATES/OUTLINE

The Topics for the 2 Presentations will be released about 10 days before and you will select your choice via a selection poll about 8 days before the Presentation Dates– it is imperative that you are able to receive MyMail@uwo.ca email messages as this is the only method of notifying you of the poll url.

There will be a Review session available before the Final exam in the April exam period.

Chemistry 3391b Course Outline

Bioinorganic chemistry, or the biochemistry of metals, is the systematics of the biologically important chemistry of metals.

A draft lecture sequence - the order of some topics may be changed and some topics may be omitted.

A	BASICS OF BIOINORGANIC CHEMISTRY – An Extensive INTRODUCTION
1	ELEMENTS IN BIOLOGICAL SYSTEMS
2	SUMMARY OF THE COURSE - FROM BEGINNING TO END. THIS TAKES 2 WEEKS
B	INORGANIC CHEMISTRY OF BIO-METALS - VERY SHORT - ASSUMES YOU HAVE REMEMBERED CHEM 2271a/2281b/3371f
1	PERIODIC PROPERTIES - SIZES - GROUPS- TRENDS - OX. STATES - very short – partly assigned reading
2	LEWIS ACID/BASE - HARD/SOFT METALS/LIGANDS - very short – partly assigned reading
3	IMPORTANT COORDINATION CHEMISTRY OF METALS & COMPLEXES – EQUILIBRIUM CONSTANTS - very short – partly assigned reading – a section that many have forgotten about!
4	BIO-IMPORTANT LIGANDS, INC. AMINO ACIDS - PORPHYRINS these have to be memorized
5	ESSENTIAL - TOXIC – MEDICINAL metals
C	SOME ESSENTIAL BIOCHEMISTRY
1	BASIC BUILDING UNITS IN BIOCHEMISTRY; AMINO ACIDS – PROTEINS; emphasis on the typical donor atoms in amino acids that bind metal ions.

PLANNED END OF LECTURE MATERIAL FOR THE TERM TEST

D ZINC - a fantastic yet really boring element - what can a d10 metal really do? Just wait. We will discuss Zn-enzyme chemistry in detail

E COBALT - AN EXAMPLE OF ENZYMES IN ACTION: VIT B12 AND THE FOLATE CYCLE.

F MAGNESIUM – AN EXAMPLE OF EVOLUTION - THE STORY OF CHLOROPHYLL – mixing spectroscopic properties with redox energy – photosynthesis does all that!

G TOXIC METALS - this is a pretty challenging section - especially when we look at the effects on populations - studied in some detail

H IF THERE IS TIME - SPECIALIST INSTRUMENTAL TECHNIQUES IN BIOINORGANIC CHEMISTRY
ANALYSIS OF PROTEINS - USE OF ESI-MS IN METALLOBIOCHEMISTRY METAL CONCENTRATIONS – AAS, XAS TECHNIQUES FOR BOND LENGTHS, ETC (EXAFS, XANES)

I SUMMARY - CLOSING REMARKS

LEARNING OUTCOMES

AIMS OF THE LECTURE PART OF THE COURSE

Participants are expected, as a result of the lectures, case studies and associated required reading to be able:

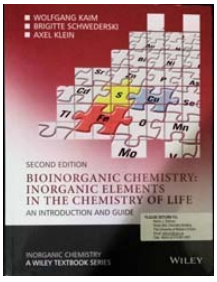
To explain the key chemistry important for metal-based biological chemistry by assessing the inorganic chemistry common in biological molecules;
To identify the underlying principles of coordination chemistry as it applies to biological molecules by considering a series of cases that show the chemical properties of metalloprotein
To become familiar with the common properties of metals in biomolecular complexes - hard/soft metals/ligands, etc., by reviewing inorganic chemistry of the main and transition metal groups
To understand the differences between metal content; and metal requirements; meta-based function and connect nutritional-sources with function
To learn about a range of biological chemistries determined by the metal content by considering a series of case studies
To explain the choices to be made in analytical techniques to characterize metallo-biological complexes
To recognize the origins of the devastating effects of toxic metals from consideration of a series of case studies

AIMS OF THE PRESENTATION PART OF THE COURSE

Participants are expected, as a result of the presentations:

To be able to describe in their own words chemistry important for metal-based biological chemistry;
To be able to read and, abstract and assemble published data, concepts and models.;
To work rapidly and efficiently in assembling a technical presentation;
To learn how to work with short timeframes to research, abstract, and construct a public presentation.
To deliver a succinct verbal report and then answer probing questions from the assessor.

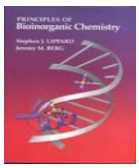
Recommended Text Book Will help expand and explain the concepts given in the lectures – there is no requirement to purchase any of these text books. In fact, Prof Stillman is able to loan you some of them for use in the course and the library has most on heavy demand. The book will be very useful as a launching point for preparing the presentations. **Paperback edition: 2nd Edition ONLY – Kaim/Schwederski/Klein Bioinorganic chemistry:** Inorganic elements in the chemistry of life. Wiley.

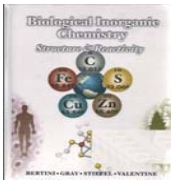


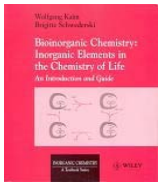
Inorganic Chemistry texts -

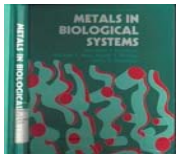
Inorganic chemistry / D.F. Shriver, P.W. Atkins. 5th Edn - most inorganic lectures are keyed to this book
Shriver, D. F. (Duward F.) **Location:** Taylor
Inorganic chemistry / Catherine E. Housecroft and Alan G. Sharpe.

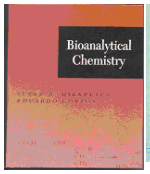
and with a strong bioinorganic flavour…

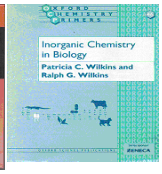


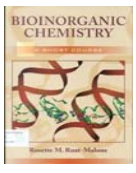


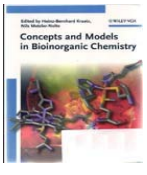












Bioinorganic chemistry : a short course by Roat-Malone - 2nd edition (On heavy demand (2-hour loan) at the Taylor Library.)
Bioinorganic chemistry : inorganic elements in the chemistry of life : an introduction and guide by Kaim and Schwederski. (On heavy demand (2- hour loan) at the Taylor Library.)
The biological chemistry of the elements -: the inorganic chemistry of life by da Silva and Williams. QU4.S586b 2001 (On heavy demand (1-day loan) at the

Taylor Library.) A rather different book in which the evolution of biological materials that incorporate metal ions is discussed in details. A very good read.
Biological Inorganic Chemistry – Structure and Reactivity by Bertini, Gray, Stiefel, and Valentine (2007) TAYSTK QU ??? 2007. (On heavy demand (2-hour loan) at the Taylor Library.) An exceptional book if you are planning on 4th year research or graduate work on topics that involve metals in biology. Has no chapters on toxic metals; very brief on metals in medicine. .
Concepts and Models in Bioinorganic Chemistry by Kraatz and Metzler-Nolte. TAYSTK QU ??? 2006. Very interesting description of the key metal-ligand regions by discussing small molecule models of biological molecules.

QP531.P47 2000: Physical methods in bioinorganic chemistry / ed. L. Que, Jr. QD462.C653 2000: Computational molecular spectroscopy / ed. P. Jensen and P. Bunker QD95.I486 1999: Inorganic electronic structure and spectroscopy / eds. Solomon, Lever QP531.L55 1994: Principles of bioinorganic chemistry / eds. Lippard, Berg
QP531.B543 1994: Bioinorganic chemistry / eds. Bertini, Gray, Lippard, Valentine

*Special notes Course prerequisite: Chemistry 3371f.

In order to obtain credit for the course, all of the following requirements must be met:

1. Obtain a minimum weighted average of 50% on the Midterm Test and the Final Exam. In the case of a missed Midterm Test, a minimum of 50% on the 70% Final Exam must be obtained.
2. Obtain 50% or greater on the aggregate grades of the two presentations (note the condition that both presentations must be made to pass this course). The presentations are critical components of this course.
3. Obtain a minimum of 50% on the overall course grade. Students who meet this requirement, but fail to meet one or more of the above requirements, will receive a course grade of 40% as described above.

None of the components will be "dropped" and it is not possible to have the components reweighted **There is no Periodic Table provided for either the Mid-term or Final exam. You will be required to memorize the key metals and non-metals that impact bioinorganic chemistry**. Prof Stillman will be very clear on what to memorize.

Missed Course Components
If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or supporting documentation to the Academic Counsellors of their home faculty as soon as possible. For further information, please consult the university's medical illness policy at http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf.

Students seeking academic accommodations based on medical (physical or mental) illness should begin by contacting the Academic Counsellors of their home faculty. Please visit the following link for policy on Accommodation for Illness:
http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_illness.pdf

Missed Presentation
If you are unable to present your work in one of the presentations (1, 2) at the proscribed time and day, you will submit with everybody else your pptx presentation file at the time required and your presentation date will be moved forward after the accommodation information has been received by Dr Stillman. Your presentation will take place in class time in front of the class the same as all other presentations.

Missed Midterm Test or Final Exam
There is no make-up midterm test. If the Dean's Office has approved your circumstances, the value of the midterm test will be shifted to the Final Exam.
If you miss the Final Exam, contact your Dean's Office as soon as possible. They will assess your eligibility to write the Special Exam (SPC).
Mandatory Notice from the Registrar
Unless you have either the prerequisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.
Accessibility
Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 ext. 82147 if you have questions regarding accommodation.
"Students who are in emotional/mental distress should refer to Mental Health@Western http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help."
Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site: http://www.uwo.ca/univsec/handbook/appeals/scholoff.pdf
Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Office Policy in the Western Academic Calendar).
Communications with Dr Stillman: Missing information about the course or test rooms/dates/times/syllabus because you do not check your UWO e-mail is not grounds for appeal.
Policy on attending lectures and pass levels required: You are required to attend all lectures. Attendance is mandatory. Missing important information by being absent without contacting Dr Stillman will not be grounds for appeal.
Policy on what is required to pass the course: To pass this course you must pass (>50%) of the average of the midterm and final exams, and achieve >50% of the average grade for the two presentations. The presentations represent critical developmental study in the bioinorganic discipline and are keyed closely to lectures and successful delivery of both is required to pass the course.
Essential Learning Requirements. **Even when Academic Considerations are granted for missed coursework, the following are deemed essential to earn a passing grade.** THE TWO PRESENTATIONS ARE ESSENTIAL LEARNING REQUIREMENTS IN THIS COURSE AND MUST BOTH BE PRESENTED AND A PASSING GRADE ACHIEVED TO OBTAIN A PASS IN THE COURSE (ALTERNATIVE DATES AND TIMES WILL BE OFFERED IN THE EVENT OF APPROVAL BY THE DEAN'S OFFICE).

Use of electronic devices: Only scientific calculators are permitted in the term test or final exam. All other electronic devices (cell phones, laptops, tablets, cameras, etc.) are prohibited. Students found in possession of prohibited devices will receive a mark of ZERO for the entire assessment.

STATEMENTS REQUIRED BY THE FACULTY OF SCIENCE THAT CONCERN THIS COURSE

General information about missed coursework

Students must familiarize themselves with the University Policy on Academic Consideration – Undergraduate Students in First Entry Programs posted on the Academic Calendar:
https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf,

This policy does not apply to requests for Academic Consideration submitted for attempted or completed work, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage:
https://registrar.uwo.ca/academics/academic_considerations/

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

All Academic Consideration requests normally must include supporting documentation; however, recognizing that formal documentation may not be available in some extenuating circumstances, the policy allows students to make one Academic Consideration request without supporting documentation in this course. However, the following assessments are excluded from this, and therefore always require formal supporting documentation:

Examinations scheduled during official examination periods (Defined by policy)

When a student mistakenly submits their one allowed Academic Consideration request without supporting documentation for the assessments listed above or those in the Coursework with Assessment Flexibility section below, the request cannot be recalled and reapplied. This privilege is forfeited.

When a student misses the Final Exam and their Academic Consideration has been granted, they will be allowed to write the Special Examination (the name given by the University to a makeup Final Exam). See the Academic Calendar for details (under Special Examinations), especially for those who miss multiple final exams within one examination period.

Academic Policies: The website for Registrar Services is https://www.registrar.uwo.ca/.

In accordance with policy: https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.