DEPARTMENT OF CHEMISTRY
THE UNIVERSITY OF WESTERN ONTARIO LONDON, ONTARIO, CANADA

Chemistry 3391b "Bioinorganic Chemistry" Jan-April, 2022

INSTRUCTOR: Dr. Martin Stillman
(Office: Chemistry Building, Room 064 - lower ground floor)
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: Martin.Stillman@uwo.ca -- always with "Chem 3391b" in the Subject
Mjs group research web site: www.stillmangroup.ca

(**revised 2021 Dec 27/30 – with online-January 2022/in-person Feb/March/April planned for all activities)**
Martin J Stillman is inviting you to a scheduled Zoom meeting. Topic: Martin Stillman's Zoom 3391b lectures in January; Time: This is a recurring meeting Meet anytime. Join Zoom Meeting; https://westernuniversity.zoom.us/j/98666327307.

Meeting ID: 986 6632 7307 Passcode: zoom3391b

IMPORTANT: IN VIEW OF THE UNCERTAINTIES CREATED BY THE ON-GOING PANDEMIC – ALL DATES, MODES OF ASSESSMENT, MODES OF INSTRUCTION HAVE TO BE CONSIDERED AS DRAFTS – ANYTHING AND EVERYTHING MAY CHANGE AS DICTATED BY THE PROVINCE OR UWO'S MANDATES. TAKING THIS COURSE MEANS YOU ACCEPT THAT ANY CHANGES TO THE DATES AND ASSESSMENTS AND LECTURE CONTENT LISTED HERE WOULD BE PREDICATED BY EXTREME UNIVERSITY CONDITIONS AS IMPOSED BY UWO OR THE PROVINCE OR BOTH. CHANGES WOULD BE MADE IN THE BEST INTERESTS OF THE CLASS PARTICIPANTS AND ACCORDING TO MANDATES FROM UWO.

CLASS COMMUNICATION: Dr Stillman will use 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")
(A) Day-to-Day information will be posted here. All course information will be posted on the course web site (above). 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.

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 the web page (see the side bar) 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 Dr Stillman 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.
NOTE new lecture arrangements: SYNCHRONOUS ZOOM JANUARY 11th to JANUARY 31ST; in-person for Feb 1st – end of term = April, 8th, 2022. **Taking this class means you accept using Zoom for the virtual, synchronous lectures when mandated by UWO.**

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 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 4 DATES

(B) PRESENTATIONS: Two. You will be asked to team up with a partner (via a Doodle selection poll) and each team of 2 will prepare two time-limited presentations:**

#1 is for a maximum of 6 minutes (Thursday February 10th, 2022 – in-person or Zoom synchronously virtual if needed) and

#2 is for 7 minutes (Thursday March 3rd, 2022; in-person or Zoom synchro virtual if required).

For both #1 and #2 the topics for the whole class will be the same, however, you will have to select a specific part of that topic from a Doodle Poll. See the web site for details and dates. Presentations will be presented in class time. You will prepare your presentation to preload on my PC laptop (Windows 10) or your Mac (but time setting up personal computers comes out of your running time!). I will grade each Presentation using advice from my research group and our class TA. The Grading Table will be available on the web site. I strongly suggest reading it. Choose your topic for your personal interest. **If the Province-mandated lockdown is extended past Jan 31st, these 2 presentations will be carried out by Zoom in class time – details will be sent by email. **Taking this class means you accept using Zoom for your presentations if mandated by UWO.**

(C) TERM TEST IN CLASS - THURSDAY 17th MARCH: 10:30-12:20 Room: TBA (xxx) 90 minutes mixed multiple choice-short answer on all material up to Thursday March 10th. **Taking this class means that you accept the use of ProctorTrack for remote proctoring if UWO mandates this test to be online. This is a mixed multiple choice-short written/drawing test format.**

(D) ACTIVE-LEARNING – METALLODRUG/TOXIC METAL UNIT WILL BE A GUIDED LEARNING MODULE. The third presentation THURSDAY April 7th, 2022, 10:30-12:20.

Each team (of 2) Will be tasked with building on one of the posters prepared last term by Chem 2211a students displayed along the Lower Ground Floor corridor (posters selected using a Doodle poll). Your team will assess the information and then present a short (7 minute) presentation on that topic. This is different from the presentations above in that the initial research has been carried out. Your task is to add to that information and to bring a 3rd year chemistry approach, which means expanding and explaining the chemistry already presented on the Chem 2211a posters.. If the Province-mandated lockdown is extended past Jan 31st to include this date, this presentation will be carried out by Zoom in class time – details will be sent by email. **Taking this class means you accept using Zoom for your presentations if mandated by UWO. The date of the presentations is THURSDAY April 7th, 2022, 10:30-12:20.**

(E) FINAL EXAM:** Cumulative but weighted more to the 2nd part of the course. 3 hrs, mixed multiple choice-short answer on all material. ** **Taking this class means you accept using ProctorTrack or equivalent if mandated by UWO for the final exam.**

EVALUATION: 3 presentations (6, 7, & 7 mins each in teams of 2), single mid-term test, and final exam.

DISTRIBUTION OF MARKS:

2 presentations (#1; Feb. 10th) 10% & (#2; March 3rd) 15%	= 25% These dates might change because of the Province-mandated lockdown – please note any date changes will be emailed to you.
Term Test (17th March; 90 mins in class time but not ChB 9)	= 32% - this is planned as in-person
Active Learning presentation (April 7th)	= 13%
Final exam (3 hours in April)	= 30%

PLEASE NOTE THAT TO PASS THIS COURSE YOU MUST PRESENT AND RECEIVE A GRADE >50% ON EACH OF THE 3 PRESENTATIONS (WITH YOUR TEAM MEMBER NORMALLY) – IN THE EVENT OF AN ACCOMMODATION YOU WILL BE REQUIRED TO GIVE YOUR PRESENTATION AT A FUTURE DATE RECEIVING A COURSE GRADE OF IPR IF TIME DOES NOT PERMIT THE PRESENTATION BEFORE THE END OF TERM. EVEN IF YOU ARE UNABLE TO PRESENT ON THE ASSIGNED DAY YOU OR YOUR TEAM PARTNER MUST SUBMIT YOUR PRESENTATION POWERPOINT FILE ON THE MORNING OF THE PRESENTATIONS – THIS FILE CANNOT BE EDITED AFTER THIS DATE NO MATTER WHEN THE PRESENTATION IS ACTUALLY GIVEN. YOU MUST ACHIEVE 50% OR MORE ON THE SUM OF THE MIDTERM TEST AND FINAL EXAM. NOTE: NOT ACHIEVING ONE OR MORE THESE MINIMUM GRADES OR ASSESSMENTS WILL RESULT IN A COURSE GRADE OF 40% NO MATTER THE ARITHMETICAL SUM.

IN THE EVENT OF ACCOMMODATION FOR THE MIDTERM EXAM, THOSE MARKS WILL BE COMBINED WITH THE FINAL EXAM (62%)..

ADMINISTRATIVE INFORMATION ABOUT THE COURSE: SPECIAL DATES/OUTLINE

The Topics for the 3 Presentations will be released about 10 days before and teams (of 2) can select their choice via a Doodle poll 8 days before – 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 Doodle url.

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

PLEASE NOTE THE EXTENSIVE EXPLANATORY INFORMATION AT THE END OF THIS COURSE OUTLINE THAT APPLIES TO THIS COURSE OFFERING.

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 deleted.

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.

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

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

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

(METALLO-DRUGS – SUBJECT OF THE 3RD PRESENTATION)

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, CN, 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

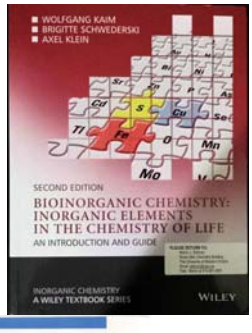
connect nutritional-sources with function
To learn about a range of biological chemistries determined by the metal content by considering a series of case studies
To explain the choices to be made in analytical techniques to characterize metallo-biological complexes
To recognize the origins of the devastating 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 as a team in rapidly, efficiently and collaboratively assembling a technical presentation;
To learn how to work with short timeframes to research, abstract, and construct a public presentation.

Recommended Text Book Will help expand and explain the concepts given in the lectures. The lectures wil be tied to the book as closely as possible but the lectures are not a reread of the book. 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 Final Exam must be obtained.
2. Obtain 50% or greater in each one of the 3 presentations (note the condition above that all 3 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 mid-term of 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.

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 website: http://www.uwo.ca/univsec/handbook/appeals/scholoff.pdf. Computer-marked, multiple-choice tests and exams may be subject to submission for similarity review by software that will check for unusual coincidences in answer patterns that may indicate cheating.

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.

A student requiring academic accommodation due to illness must use the Student Medical Certificate (https://studentservices.uwo.ca/secure/medical_document.pdf) when visiting an off-campus medical facility.

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 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.

Student Development Centre

Students are encouraged to make use of the free, study-skills courses and other services, including learning-skills counselling, provided by the Student Development Centre, http://www.sdc.uwo.ca.

"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 the midterm exam, all three presentations, and the final exam. The presentations represent critical developmental study in the bioinorganic discipline and are keyed closely to lectures and successful delivery of all three is required to pass the course.

Policy on calculators. You will want to use a simple calculator – but there is no Periodic Table allowed in exams.

Accessibility Statement

Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

[If Remote Proctoring Software is used in this course it is because of UWO OR Provincial-mandated restrictions to in-person teaching.]

Tests and examinations in this course may be conducted using the remote proctoring service, such as Proctortrack. By taking this course, you are consenting to the use of this software and acknowledge that you will be required to provide personal information (including some biometric data) and the session will be recorded. More information about this remote proctoring service is available in the Online Proctoring Guidelines at the following link:
https://www.uwo.ca/univsec/pdf/onlineproctorguidelines.pdf

Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. Information about the technical requirements are available at the following link:
https://www.proctortrack.com/tech-requirements/

[Zoom likely will be used for lectures, and presentations a mandated by UWO]

Lectures, and presentations, in this course will be conducted using Zoom if necessary. Tests and exams will use ProctorTrack as mandated by UWO.

* Please note that Zoom servers are located outside Canada. If you would prefer to use only your first name or a nickname to login to Zoom, please provide this information to the instructor in advance of the test or examination.

ProctorTrack will require you to provide personal information (including some biometric data). The session will be recorded. By taking this course, you are consenting to the use of this software.
More information about remote proctoring is available in the Online Proctoring Guidelines at the following link:
https://www.uwo.ca/univsec/pdf/onlineproctorguidelines.pdf