Chemistry 3391B "Bioinorganic Chemistry" Jan-April, 2017

(revised 2017 Jan 2nd)

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 web sites: stillmangroup.ca and www.facebook.com/stillmanbioinorganicgroup)

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 the e-mail address you provide or not providing an e-mail address is not an acceptable excuse for missing important information, up to an including changes in test dates and times.

Course Web Page: instruct.uwo.ca/chemistry/3391b/ Day-to-Day information will be posted here.

Only Marks will be posted on the Owl site for Chem 3391b.

LECTURES: 3 lecture hours each week, Tue 11:30 - 12:30 and Thur 10:30 - 12:30 in ChB 9. Lecture notes are posted on the web 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 provide you a copy of the lecture notes if needed prior to uploading the Marked-Up version.

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.

PRESENTATIONS: Two - spread over the term in class time - you will be asked team up with a partner and prepare two rigidly-enforced, 5 minutes (Feb 2nd) and 8 minutes (March 21st and 23rd) presentations. The overall topic 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 on the next Tuesday and part of Wednesday (to accommodate all the teams). You will prepare your presentation to preload on my PC laptop (Windows 7) 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.

(Dates - see below).

EVALUATION: There are 2 very short, but intense and detailed presentations (5, 8 mins each in teams of 2), a single mid-term test, and a final exam.

DISTRIBUTION OF MARKS:

2 presentations - 15 & 20% = 35%))
Term test: 25%
Final examination 40%

ADMINISTRATIVE INFORMATION ABOUT THE COURSE

SPECIAL DATES

(1) 1st CLASS: Thursday, January 5th (2017) at 10:30 in ChB 9.
Last lecture: Tuesday, April, 7th (2017)
(2) There is a single mid-term exam (in class 10:30-12:20 on Feb 16th; location TBA). If you have an academic conflict I will be happy to discuss options. There will be no make up test. Please alert Dr Stillman to any academic conflicts on this day before 19th January.

(3) Lectures cancelled: Monday 16th - Friday 20th Feb. (Reading Week).

(4) Presentations. Please block the weekend before for preparation - the teams are formed for each presentation by 'voting' on DOODLE - each URL to be provided in the Friday class. TWO PRESENTATION DATES (topics provided by email on the date noted):

1) Thursday, Feb 2nd (topics released Jan 24th - with url available 6 pm Jan 27th)

2) March 21st and 23rd*Care if you are in 4th year - this coincides with handing in your thesis see the web site for dates.

(5) There is a three-hour final in the Final Examination period (cumulative, but weighted in favour of the latter part of the course). Time, day, place: TBA

A review session will be arranged once the Final Exam date is known.

Chemistry 3391B Course Outline

Bioinorganic chemistry, or the biology of metals, is to some extent rather an artificial subdivision of study. However, the origins are clear to see, the systematics of the chemistry of metals require considerable detail beyond that already described for carbon.

The biological role of metals includes a wide range of chemically-specific tasks:

- Ionic balance: Na/K
- 3D alignment through coordination: Mg
- Structural component: Ca
- Ligand binding: Zn, Fe
- Enzymatic chemistry: Fe, Zn, Co,, etc.
- Redox chemistry: Fe, Mo, Co
- Photochemistry: Mg

In the vital roles of: energy storage, respiration, nerve impulse, muscle action, everything (for plants, of course, photosynthesis).

What goes wrong? With such a palette of metals, substitution of one by an unexpected element can cause chaos - As for P; Cd for Zn; Pb for Ca. Also binding of an inactive metal in place of the target metal can produce toxic effects - Hg\(^{2+}\) readily binds to RSH.

Metallodrugs: for example the anticancer properties of cisplatin

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

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<td>ELEMENTS IN BIOLOGICAL SYSTEMS</td>
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<td>2</td>
<td>SUMMARY OF THE COURSE - FROM BEGINNING TO END. THIS TAKES 2 WEEKS</td>
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<td>B</td>
<td>INORGANIC CHEMISTRY OF BIO-METALS - VERY SHORT - ASSUMES YOU HAVE REMEMBERED CHEM 2271a/2281b/3371f</td>
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<td>PERIODIC PROPERTIES - SIZES - GROUPS- TRENDS - OX. STATES - very short - assigned reading</td>
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<td>LEWIS ACID/BASE - HARD/SOFT METALS/LIGANDS - very short - assigned reading</td>
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<td>IMPORTANT COORDINATION CHEMISTRY OF METALS &amp; COMPLEXES - EQUILIBRIUM CONSTANTS - very short - assigned reading</td>
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<td>BIO-IMPORTANT LIGANDS, INC. Porphyrins</td>
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<td>ESSENTIAL - TOXIC - MEDICINAL</td>
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<td>C</td>
<td>SOME ESSENTIAL BIOCHEMISTRY</td>
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<tr>
<td>1</td>
<td>BASIC BUILDING UNITS IN BIOCHEMISTRY</td>
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<td>ENZYMES - KINETICS - INHIBITORS - MICHAELIS-MENTEN; ETC</td>
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LEARNING OUTCOMES

AIMS OF THE LECTURE PART OF THE COURSE
Registrants are expected, as a result of the lectures, case studies and associated required reading:

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 complexes - hard/soft metals/ligands, etc., by reviewing inorganic chemistry of the main and transition metal groups
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
Registrants 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 will 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.


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...
**Course Description and Course Outline for 2014-2015 Chemistry 3391B "Bioinorganic Chemistry"**

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.

QD96.V53H37 1978: Symmetry and spectroscopy / D.C. Harris, M.D. Bertolucci
QD471.F57 1961: Introduction to ligand fields / B.N. Figgis

*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% (30 out of 60) on the Final Exam must be obtained.
2. Obtain a minimum of 50 out of 100 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 no greater than 40 out of 100.

None of the components will be “dropped” and it is not possible to have the components reweighted unless they were legitimately missed.

There is no Periodic Table provided for either 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.

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](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](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](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](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 poster component and to the Final Exam as described in the table shown on the previous page.

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.

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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, the presentation and the final exam.

Policy on missing mid-term test, presentations or final exam: Contact the counselors in the Faculty of Science office with a medical certificate and with their direction your marks will be averaged over the other evaluated items.

Policy on calculators. You can use a 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.