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

Chemistry 3391B "Bioinorganic Chemistry" Jan-April, 2015

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
(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 lectures each week, Tue and Thur 11:30-12:30 Wednesdays 12:30 - 1:30 all 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 Fridays 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: Three - spread over the term in class time - you will be asked team up with a partner and prepare a rigidly-enforced, 5 - 7 - 9 -minute presentation (Powerpoint is best). The topic for the whole class will be the same - you can introduce diversity within the topic I set. The topic will be announced by email after the Thursday class and the 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. (Dates - see below).

EVALUATION: There are 3 very short, but intense and detailed presentations (5; 7, 9 mins each in teams of 2), a single mid-term test, and a final exam.

DISTRIBUTION OF MARKS:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>3 Presentations</td>
<td>30%</td>
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<tr>
<td>Term test</td>
<td>30%</td>
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<tr>
<td>Final examination</td>
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ADMINISTRATIVE INFORMATION ABOUT THE COURSE

SPECIAL DATES

(1) 1st CLASS: Tuesday, January 5th (2015) at 11:30 in ChB 9.
Last lecture: Wednesday, April 8th (2015)

(2) There is a single mid-term exam (9:30 - 12:00 pm on Saturday February, 28th, 2015 in 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.

THREE PRESENTATION DATES (topics provided by email on the date noted):

1) Wednesday, Jan 28th (topics released Jan 22nd)
2) Tuesday, Feb 10th (Feb 5th)
3) Tuesday March 24th (March 17th) *Care if you are in 4th year - this coincides with handing in your thesis used

(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, 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.

Metallo drugs: 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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<thead>
<tr>
<th>A</th>
<th>BASICS OF BIOINORGANIC CHEMISTRY - INTRODUCTION</th>
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<tbody>
<tr>
<td>A1</td>
<td>ELEMENTS IN BIOLOGICAL SYSTEMS</td>
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<tr>
<td>A2</td>
<td>SUMMARY OF THE COURSE - FROM BEGINNING TO END. THIS TAKES 2 WEEKS</td>
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<td>B</td>
<td>THE PERIODIC TABLE OF BIO-IMPORTANT METALS</td>
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<td>B1-B4</td>
<td>ESSENTIAL - TOXIC - MEDICINAL</td>
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<td>C</td>
<td>INORGANIC CHEMISTRY OF BIO-METALS - VERY SHORT - ASSUMES YOU HAVE REMEMBRED CHEM 2271a/2281b/3371f</td>
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<tr>
<td>C1</td>
<td>PERIODIC PROPERTIES - SIZES - GROUPS- TRENDS - OX. STATES - very short - assigned reading</td>
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<tr>
<td>C2</td>
<td>LEWIS ACID/BASE - HARD/SOFT METALS/LIGANDS - very short - assigned reading</td>
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<tr>
<td>C3</td>
<td>IMPORTANT COORDINATION CHEMISTRY OF METALS &amp; COMPLEXES - EQUILIBRIUM CONSTANTS - very short - assigned reading</td>
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<td>C5</td>
<td>BIO-IMPORTANT LIGANDS, INC. PORPHYRINS</td>
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<td>D</td>
<td>SOME ESSENTIAL BIOCHEMISTRY</td>
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<td>D1</td>
<td>BASIC BUILDING UNITS IN BIOCHEMISTRY</td>
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<tr>
<td>D2</td>
<td>AMINO ACIDS - PROTEINS</td>
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<tr>
<td>D3</td>
<td>ENZYMES - KINETICS - INHIBITORS - MICHAELIS-MENTEN; ETC</td>
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<td>E</td>
<td>SPECIALIST INSTRUMENTAL TECHNIQUES IN BIOINORGANIC CHEMISTRY</td>
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<tr>
<td>E1</td>
<td>ANALYSIS OF PROTEINS - USE OF ESI-MS IN METALLOBIOCHEMISTRY METAL CONCENTRATIONS - AAS</td>
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<tr>
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<td>XAS TECHNIQUES FOR BOND LENGTHS, CN, ETC (EXAFS, XANES)</td>
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<tr>
<td>F</td>
<td>MAGNESIUM - AN EXAMPLE OF EVOLUTION - THE STORY OF CHLOROPHYLL</td>
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<td>G</td>
<td>ZINC - a fantastic yet really boring element - what can a d(^{10}) metal really do? just wait. we discuss Zn-enzyme chemistry in detail</td>
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### AIMS OF THE LECTURE PART OF THE COURSE

Registrants are expected, as a result of the lectures and associated required reading:

- To understand the key chemistry important for metal-based biological chemistry;
- To understand the underlying principles of coordination chemistry as it applies to biological molecules;
- To become familiar with the common properties of metals in complexes - hard/soft metals/ligands, etc.;
- To learn about a range of biological chemistries determined by the metal content.
- To understand the choices to be made in analytical techniques to characterize metallo-biological complexes.

### 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.

**Paperback edition: 2nd Edition ONLY – Kaim/Swederski/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.SS86b 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.
- QD96.V53H37 1978: Symmetry and spectroscopy / D.C. Harris, M.D. Bertolucci
- QD471.F57 1961: Introduction to ligand fields / B.N. Figgis
Course Description and Course Outline for 2014-2015 Chemistry 3391B "Bioinorganic Chemistry"


*Special notes*  Course prerequisite: Chemistry 3371f.

Notice from the Registrar: "Students are responsible for ensuring that their selection of courses is appropriate and accurately recorded and that all course prerequisites have been successfully completed. If the student does not have the prerequisites for a course, and does not have written special permission from his or her Dean to enroll in the course, the student will be removed from the course and it will be deleted from the student's record. This decision may not be appealed. A student will receive no adjustment to his or her fees in the event that he or she is dropped from a course for failing to have the necessary prerequisites."

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.

Department of Chemistry policy on attendance at exams. "It is the policy of the Department of Chemistry that when a student takes a test or examination, they have deemed themselves fit to do so. Claims of distress or medical issues after the fact will not be considered for the basis of a grade appeal."

Policy on attending lectures and pass levels required: You are required to attend all lectures.

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.