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

Chemistry 3391b "Bioinorganic Chemistry" Jan-April, 2019
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 web sites: stillmangroup.ca

(revised 2019 Jan 2nd --r19-de)

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 dates
and times.

Course Web Page: instruct.uwo.ca/chemistry/3391b Day-to-Day information will be posted here. Only
Grade Marks will be posted on the Owl site for Chem 3391b. All other 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.

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. You will be asked to team up with a partner (via a Doodle selection poll) and
prepare two time-rigidly-enforced presentations: #1 5 minutes (January 24th) and #2 (Feb 5th/7th) 8 minutes
(February 5th and 7th – because the longer time will need more class time to complete the whole class). 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. The Grading Table
will be available on the web site. I strongly suggest reading it. Choose your topic for your personal interest.

TERM TEST IN CLASS - THURSDAY 7TH MARCH: 10:30-12:20 Room: TBA (not ChB 9) 90 minutes mixed
multiple choice-short answer on all material up to Thursday March 1st.

EVALUATION: 2 presentations (5, 8 mins each in teams of 2), a single mid-term test, and a final exam.

DISTRIBUTION OF MARKS:
2 presentations (#1; Jan 24th) 15% & (#2; Feb 5 & 7) 20% = 35%
Term test (7th March; 90 mins in class) = 25%
Final exam (3 hours in April) = 40%

ADMINISTRATIVE INFORMATION ABOUT THE COURSE: SPECIAL DATES/OUTLINE
The Topics for the 2 Presentations will be released 8 days before and teams (of 2) can select their choice via a Doodle
poll 6 days before – it is imperative that you are able to receive XXX@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
Bioinorganic chemistry, or the biochemistry of metals, is the systematics of the biologically important chemistry of metals.

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

Encompassing vital roles of: energy storage, respiration, nerve impulse, muscle action; actually all of Life’s processes depend on metals (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 - Hg²⁺ readily binds to RSH.

Metallodrugs are the new frontier: 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.

| 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 2271/2281/3371f |
|   | 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 |
| D | SPECIALIST INSTRUMENTAL TECHNIQUES IN BIOINORGANIC CHEMISTRY |
|   | 1 ANALYSIS OF PROTEINS - USE OF ESI-MS IN METALLOBIOCHEMISTRY |
|   | METAL CONCENTRATIONS - AAS |
|   | XAS TECHNIQUES FOR BOND LENGTHS, CN, ETC (EXAFS, XANES) |
| E | MAGNESIUM - AN EXAMPLE OF EVOLUTION - THE STORY OF CHLOROPHYLL - mixing spectroscopic properties with redox energy - photosynthesis does all that! |
| F | COBALT - AN EXAMPLE OF ENZYMES IN ACTION: VIT B12 |
| G | ZINC - a fantastic yet really boring element - what can a d¹⁰ metal really do? just wait. we discuss Zn-enzyme chemistry in detail |
| I | IRON - THIS METAL IS DISCUSSED IN MORE DEPTH |
| J | METALLO-DRUGS |
| K | TOXIC METALS - this is a pretty challenging section - especially when we look at the effects on populations - studied in some detail |
| L | SUMMARY - CLOSING REMARKS |
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 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 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/Schwederski/Klein

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 Jan-April, 2019 Chemistry 3391B "Bioinorganic Chemistry"

QD96.V33H37 1978: Symmetry and spectroscopy / D.C. Harris, M.D. Bertolucci
QD471,F57 1961: Introduction to ligand fields / B.N. Figgis
QP95,I663 1999: Inorganic electronic structure and spectroscopy / eds. Solomon, Lever

*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 "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/pdf/academic_policies/appeals/accommodation_illness.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 Presentation component and to the Final Exam (Presentations = 40%, Final exam = 60%).

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, the presentations 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.

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