

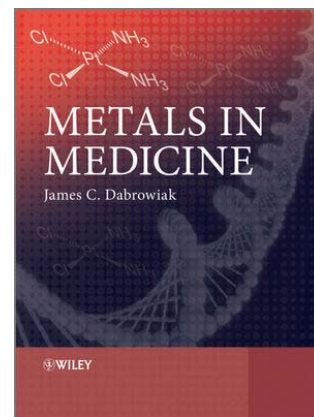
# METALS IN BIOLOGY AND MEDICINE

CHEM 4230/6230  
Spring 2012

**Instructor:**  
Aimin Liu

**Duration:** Jan 09 – May 01, 2012

**Office Hours:**  
by appointment  
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Phone: 404-413-5532



**Prerequisites:** Biochemistry I (grade B or better)

**Course Objectives:** Metal ions play critical roles in over one third of all enzymes. They are involved in oxygen activation and a number of important biosynthetic pathways. Moreover, metal ions control many diseases. This course is an overview of the roles of metals in biology and medicine, focusing on the metal-binding ability of proteins and nucleic acids and their relations to various disease states. After completing this course, students should have a good grasp of the role of metals in biology and medicine, and in particular, oxygen activation by metal ions, mechanism of metal-dependent enzymes, the production of reactive oxygen species in biological systems, metal uptake and toxicity, metal-assisted production of amino acid radicals, metal toxicity, and metals in medicine as well as metal-based diagnostic agents.

**Course Assignments:** The assigned reading materials will be posted at uLearn as PDF files. There is no assigned textbook for this course. However, the following books are highly recommended for further reading.

- 1) Biological Inorganic Chemistry by Robert R. Crichton, Elsevier 2008
- 2) Metals in Medicine by James C. Dabrowiak, John Wiley & Sons Inc, 2009

## Grading Policy:

Three 2-hour Middle Term Exams (100 points each) 300  
Homework 200  
Total 500

A+: 96-100%  
A: 90% < 96%  
A-: 86% < 90%  
B+: 82% < 86%  
B: 79% < 82%

B-: 76% < 79%  
C+: 72% < 76%  
C: 69% < 72%  
C-: 60% < 69%  
D: < 60%

## Exam Dates:

Exam 1: 2/14; Exam 2: 3/22; and Exam 3: 4/24

# Metals in Biology and Medicine



## Tentative Topics (PPT Lectures):

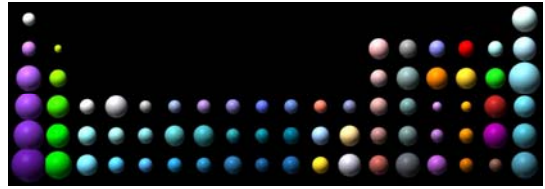
Course Design, Metals in Biology & Medicine Overview, Lecture Topics  
Molecular Orbital Theory  
Metallic Bonding & Redox Equations  
Molecular Oxygen & Intermediates  
Production of Reactive Oxygen Species by Metal Ions  
Metals and Oxidative Stress Responses  
Biological Ligands for Metal Ions  
Mononuclear Non-heme Iron Enzymes -  
Dioxygenases  
 $\alpha$ KG- and Fe-dependent enzymes  
Binuclear Non-heme Iron Enzymes  
Crystallography combined with Spectroscopy  
Sulfite Oxidizing Enzymes  
Heme Iron Enzymes  
Mammalian Peroxidases  
Transition Metal Nitrosyls  
EPR Spectroscopy

Iron-sulfur Metalloclusters in Biology  
Metal Transporter and Regulator Dynamics at the Single-Molecule Level  
Metallothioneins  
The Role of Metal ions in Free Radical Production and Radical Enzymology  
Metal-Dependent Posttranslational Modification: Tyr  
Zinc in Biology and Medicine  
Metalloregulatory Proteins  
Respiratory Complex: Correlations between  $H^+$ ,  $e^-$ , and  $O_2$   
Molybdenum in Biology  
Nickel in Biology  
Calcium in Biology  
Platinum Anticancer Drugs  
Vanadium, Copper and Zinc in Medicine  
Metal Toxicity  
Arsenic in the Environment

**Note:** The course syllabus provides a general plan for the course—deviations may be necessary.

**Attendance Policy:**

It is required to attend all the exams and at least 80% lectures.



**Make-up Examination Policy:**

No make-up examination is allowed unless obtaining prior permission from the instructor (Dr. Liu). The class starts to meet on January 10th and ends up May 1st. The last day to withdraw from this course is February 24th, 2012.

**Academic Honesty**

Students will be expected to maintain the highest standards of academic honesty. With respect to homework assignments, it is expected that no student will turn in work that is not his or her own by copying the work of another student or by using the work or solutions from this course given in previous years. Discussion of approaches to solving the homework problems after attempting to work the problems independently, however, is permitted and encouraged.

It is expected that during a test or examination, a student will not:

- 1) Accept or use information of any kind from other students.
- 2) Represent the work of another student as his or her own.
- 3) Use aids to memory other than those expressly permitted by the examiner.

Following a test or examination, a student will not try to deceive teachers or graders by misrepresenting or altering his or her previous work. In advance of a test or exam, a student will not knowingly obtain access to the exam questions.

Departures from the above standards are contrary to fundamental principles of GSU. Such departures are considered serious offenses for which disciplinary penalties, including suspension and expulsion, can be imposed.

**Evaluation to the instructor:** Your constructive assessment of this course plays an indispensable role in shaping education at Georgia State. Upon completing the course, please take time to fill out the online course evaluation."

**Disability Service:**

Students who wish to request accommodation for a disability may do so by registering with the Office of Disability Services. Students may only be accommodated upon issuance by the Office of Disability Services of a signed Accommodation Plan and are responsible for providing a copy of that plan to instructors of all classes in which an accommodation is sought.