Advanced Inorganic Chemistry
Bioinorganic Chemistry
Fall 2014
M,W,F 8-8:50 am, Chem 155

Instructor: Steven M. Berry
Email: smberry@d.umn.edu
Office: SSB 152C
Phone: 726-7087
Office Hours: M,W 9-10 AM

Suggested Text:

Biological Inorganic Chemistry, Structure and Reactivity, Ivano Bertini, Harry B. Gray, Edward I. Stiefel, Joan S. Valentine, 2007 University Science Books, Sausalito, CA.

Optional Texts:

a) Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life: An Introduction and Guide, Wolfgang Kaim, Brigitte Schwederski, 1994.
b) Inorganic Biochemistry : An Introduction, J. A. Cowan, 1996.
c) The Biological Chemistry of the Elements: The Inorganic Chemistry of Life, J. J. R. Frausto Da Silva, R. J. P. Williams, Frausto Da Silva, 2001.
d) Bioinorganic Chemistry : A Short Course, Rosette M. Roat-Malone, 2002.
e) Principles of Bioinorganic Chemistry, Stephen J. Lippard, Jeremy M. Berg, 1994.
f) Bioinorganic Chemistry, Ei-Ichiro Ochiai, 2008.

Description: This is a graduate level, special topics in inorganic chemistry course. Bioinorganic chemistry and organometallic chemistry topics are typically discussed. This section of the course covers Bioinorganic chemistry. We will begin this section with a brief review of the fundamentals in biochemistry, inorganic chemistry, and spectroscopic methods as they relate to the course. We will then proceed to study metalloproteins classified based on the type of metal ion they utilize. We will begin with heme containing proteins, followed by copper, non-heme iron, zinc, tungsten and molybdenum containing enzymes. Common themes in each class of metal protein will be reviewed, such as common structural motifs, typical reactivity, and spectroscopic signatures. It is the goal of the course to familiarize the student with common classes of metalloproteins, their biological roles, and the methods used to study them.

Tentative Outline of Topics:	*Relevant Readings in Bertini Text*
I. Introduction	I p.1-3; VII p.95-135
II. Introduction to Biochemistry	Tutorial 1 p.657-694; III p.31-41
III. Introduction to Inorganic Chem	Tutorial 2 p.695-712; IV p.43-56; V p.57-77; VIII.3 p.151-156
IV. Common spectroscopic techniques	
V. Metalloproteins by ion type	
Calcium, Magnesium, Sodium, & Potassium	XIV.3 p.635-646; IX.2 p. 192-194 (Ca^{2+}); IX.1 p.175-179; IX.2 p.185-192 (Mg^{2+})
Oxygen Reactivity	XI.1 p. 319-331
Heme iron	X.1.4 p.245-250; XI.3 p.343-353; XI.4.1 p.354-366,370-388; XI.5 p.388-394
Copper	VIII.5 p.163-165; VIII.6 p. 166-173; X.1.5 p.250-254; XI.2 p.331-338; XI.4.4.2 p.366-368; XI.5.1.2 p.394-397; XI.5.2.2 p.402-403; XI.7 p.427-442; XII.4.2.2 p.496-502; XII.4.2.4 p.503-505; XIII.5 p.595-601; XIII.6 p. 601-607
Nonheme iron	XI.4.4.3 p.368-370; XI.5.1.2 p.397-400; XI.4.2 p.400-401; XI.5.2.3 p.403-413; XIII.3 p.575-581
FeS clusters	IX.4 p.209-215; X.1.3 p.239-245; XIII.4 p.582-595
Zinc	IX.1.3 p.179-183; IX.2.4 p. 194-97; XIV.1 p.613-618; XIV.2 p.628-634
Other Metals: Co, Cr, Mo, W, Mn, Ni, V	
VI. Related areas	
DNAzymes	IX.5 p.215-228
Electron Transfer	X.2 p.261-277
VII. Case Studies	
C*c*O	XI.6 p.413-426
Photosystem II	X.4 p. 302-318
VIII. Class Presentations	
IX. Final Exam	***Tuesday 12/16/14 , 8-10 AM***

Grading: Grades for this section of the course will be based on one 150 pt Final Exam, the 100 pt Assignment and quizzes worth 25 points each.

Assignment: (100 pts) Choose one metalloprotein and get it approved by the instructor. Use primary literature (Scifinder Scholar is best) and research your metalloprotein. Prepare a 15 minute power point presentation on your metalloprotein. The presentation will be turned into the instructor and presented to the class at a date to be determined. Please include all of the following information as a minimum:

1) Include the protein name and all metal ions utilized.
2) List the names and the institutions of main researchers working on the metalloprotein.
3) Name the common biological sources of the metalloprotein.
4) What are other related proteins? Is the protein a member of a larger family?
5) List the ligands and active site geometry.
6) Is there a crystal structure available? What is its PDB ID? (www.rcsb.org) Use RASMOL and make pictures of the overall protein, as well as the active site.
7) Describe the metalloproteinôs function and show its reaction mechanism. If multiple mechanisms are debated, please discuss.
8) Name the key spectroscopies used to characterize the metal site and present the conclusions drawn from the data. Show pictures of the spectra from the paper.
9) Find examples of synthetic model compounds of the metalloprotein site. Show their structure. Is it a structural model, functional model, or both? What insights into the native protein were learned from the model?
10) Provide at least one separate literature reference for each piece of information above. Use primary literature sources only. Internet citations, such as wikipedia, google, etc., or citation of class textbooks will not be accepted.

Directions on using the Protein Data Bank, Rasmol, Scifinder Scholar, literature PDFs and power point will be discussed in class.

Access for Students with Disabilities: It is the policy and practice of UMD to create inclusive learning environments for all students, including students with disabilities. If there are aspects of this course that result in barriers to your inclusion or your ability to meet course requirements, please notify the instructor as soon as possible. You are also encouraged to contact the Office of Disability Resources to discuss and arrange reasonable accommodations. Please call 218-726-6130 or visit the DR website at www.d.umn.edu/access for more information.