

CH 4040/H4040/6040: Bioinorganic Chemistry

Spring 2021

Instructor: Professor Julia Brumaghim

Time/Location: 9:30 –10:45 am Tuesday/Thursday, in person at 229 Business Bldg. or online (see Zoom links in Canvas); please wait at least 15 minutes if I am not present at 9:30 am

Required text: Lippard and Berg, *Principles of Bioinorganic Chemistry*. University Science Books, 1994 (ISBN 978-0-935702-72-9). Available online from the Clemson University library.

Office hours: Online (see Zoom links in Canvas), Mondays 1–2 pm or by appointment

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COURSE OBJECTIVES AND LEARNING OUTCOMES

This course is intended to provide sufficient background knowledge of the topics and techniques used in bioinorganic chemistry so that students should be able to (1) describe the importance of metals in biological systems including the inorganic and biochemical relevance of the topics listed on p. 3 (e.g., how metal ions interact with biomolecules, what properties of metal ions make them suitable for specific biological functions, and why metal ions are both necessary and toxic) and (2) read and critically evaluate the current literature in this field. As a broader component, this course is also intended to develop general and subject-specific critical thinking skills as defined in the Course Specifics section. Specific skills (such as analysis and/or interpretation of data in figures or tables and analysis of experimental limitations) will be discussed during class as listed on p. 3.

COURSE SPECIFICS

Reading

Appropriate reading from the text is given in the course outline (p. 3); *it is highly recommended that the reading be completed prior to the lecture for which it is assigned.*

Problem sets

Problem sets are due *at the beginning of class* on the indicated days (p. 3) since answer keys will be handed out and/or posted on Canvas during class. Late homework will be not be accepted without a valid excuse.

Exams

The midterm and final exam dates are listed on p. 3. The final exam will focus *primarily* on material from the second half of the course. Make-up exams are given by appointment for excused absences only. Students with learning accommodations should present an appropriate letter from Student Accessibility Services as early as possible in the semester. If there are issues with providing this letter in a timely fashion, please let me know as soon as possible.

Review papers (4040H and 6040 students only)

A review paper in the format of an *Angewandte Chemie* research highlight is required. A recent paper from the inorganic chemistry literature should be selected as the focus of your paper and the paper outline must be approved by 12 March. Further details about this assignment will be given as the course progresses.

Critical thinking development

This is a critical thinking course developed as part of Clemson's CT2 initiative that aims to incorporate and develop critical thinking skills in addition to covering the topical course material. Thus, we will also focus on discussing the elements of critical thinking. Critical thinking is the ability to interpret and analyze a problem and to determine and evaluate possible solutions. It is a self-reflective process for learning and problem solving that must be cultivated and practiced because it can challenge current beliefs and thought processes. Critical thinking requires both cognition (thinking) and character skills (such as motivation, curiosity, perseverance, intellectual humility, and confidence). These skills are required for successful

scientists, and are widely sought after by graduate schools, pre-professional schools, and employers. Assignments in this course are designed to develop these broadly applicable critical thinking skills that will be assessed using an online assessment at the beginning of this course (specific details about this assessment will be provided in class).

Attendance and grading

Because of the fast-paced nature of this course, attendance at every class is highly recommended. Students are required to attend in person unless they have a COVID exemption or another documented reason for participating online. Grades will be based upon the midterm and final exams as well as the problem sets and the review paper. Completion of the critical thinking online assessment will result in four bonus points added to the midterm exam score. Final grades will be calculated using the percentages listed below and exams will be graded on a curve so that A: 100-90%, B: 89-80%, C: 79-70%, D: 69-60%, F: <60 %.

	CH 4040	CH 4040H/6040
Problem sets (8)	40 %	40 %
Midterm exam	30 %	20 %
Review papers	N/A	20 %
Final exam	30 %	20 %

Academic Integrity

Official Clemson statement: “As members of the Clemson University community, we have inherited Thomas Green Clemson’s vision of this institution as a ‘high seminary of learning.’ Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.”

Our class statement: Academic dishonesty is a very harmful habit both inside and outside of the university setting. It can (and has in some cases) lead to student expulsion or degree revocation and/or job loss for graduates and for faculty. It benefits everyone, including yourself, to avoid academic dishonesty, including but not limited to cheating and plagiarism. It will not be tolerated in this class and will receive no credit.

Student Accessibility Services

It is university policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. Students requesting course accommodations should make an appointment with Student Accessibility Services (656-6848; <https://www.clemson.edu/academics/studentaccess/student-resources.html>) in the first month of classes to discuss specific needs. Students should present a Faculty Accommodation Letter from Student Accessibility Services when they meet with instructors. New Faculty Accommodation Letters must be presented each semester, and accommodations are not retroactive.

Clemson University Title IX Statement

Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information, or protected activity (e.g., opposition to prohibited discrimination or participation in any complaint process, etc.) in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. The policy is located at <https://www.clemson.edu/campus-life/campus-services/access/title-ix/>. Alesia Smith serves as Clemson's Title IX Coordinator and may be reached at alesias@clemson.edu or 656-3181.

Class Cancellation, Moving to Online Instruction, or COVID-Related Absences

If class is canceled due to inclement weather or other unforeseen circumstances, you will be responsible for turning in work or being prepared for test or class assignments during the next class meeting period. Due to the unpredictability of the COVID-19 pandemic, instruction may switch to an entirely online format or syllabus modifications may be required. If you are ill with COVID-19 and/or required to quarantine, please

follow the medical guidance at <https://www.clemson.edu/covid-19/medical-guidance/positive-test.html> and complete the Notification of Absence form on this website to notify your instructors. Course accommodations for students in these situations will be made on a case-by-case basis.

COURSE OUTLINE

Date	Topic	Reading	Assignments Due
7 Jan. (Th)	Introduction and critical thinking overview Critical thinking pre-assessment (online)		
12 Jan. (T)	Inorganic chemistry review	Chapters 1 & 2	
14 Jan. (Th)	Inorganic chemistry review		
19 Jan. (T)	Biochemistry review	Chapter 3	Problem set 1
21 Jan. (Th)	Biochemistry review		
26 Jan. (T)	Physical methods and timescales	Chapter 4	Problem set 2
28 Jan. (Th)	Physical methods		
2 Feb. (T)	Critical thinking: Why and how?		Problem set 3
4 Feb. (Th)	Metal deficiency and excess	Chapter 5	
9 Feb. (T)	Metal uptake / transport / storage		
11 Feb. (Th)	Metal uptake / transport / storage	Chapter 6	
16 Feb. (T)	Metal uptake / transport / storage		Problem set 4
18 Feb. (Th)	Metal uptake / transport / storage	Chapter 7.1, 8.1, 8.2	
23 Feb. (T)	Review		
25 Feb. (Th)	MIDTERM EXAM		
2 Mar. (T)	Metals in proteins	Chapter 9	
4 Mar. (Th)	Metals in proteins	Chapter 10	
9 Mar. (T)	Metals in proteins		Problem set 5
11 Mar. (Th)	Metals in proteins	Chapter 11	Paper outline approved
15-19 Mar.	Spring break		
23 Mar. (T)	Metals in proteins	Chapter 12	
25 Mar. (Th)	Metals and nucleic acids	Chapter 7.2-7.4, Outside reading	Problem set 6
30 Mar. (T)	Metals and nucleic acids	Chapter 8.3-8.4	Paper due for review
1 Apr. (Th)	Metals in nucleic acids		
6 Apr. (T)	Metal toxicity	Outside reading	Problem set 7
8 Apr. (Th)	Metal toxicity		
13 Apr. (T)	Lanthanide enzymes		Peer review due
15 Apr. (Th)	Metals in medicine	Chapter 13	
20 Apr. (T)	Metals in medicine		Problem set 8
22 Apr. (Th)	Review		Revised paper due
28 Apr. (W)	FINAL EXAM 8:00 – 10:30 am (229 Business Bldg.)		