

Essential (Inorganic) Chemistry, Chem 230

Spring Semester, Calvin College, 2022

'Set the Table'

Schedule: Lecture Room SB-302, MWF 9:00-9:50 AM
Lab (Chem 230L) Room DH-306, Th 8:30-11:20 AM
Lecture Instructor: Prof. David Benson
Office: DH-229 (x6-7699)
Email: dbenson@calvin.edu
Office Hours: 10:00-10:30 M, W, F or email for appointment

Texts: Weller, Overton, Rourke, Armstrong, *Inorganic Chemistry*, 7th edition
Tro, *Chemistry: A Molecular Approach*, 2nd edition

Additional Readings, if required, will be distributed on Moodle

(I will also draw on material from the following texts, but they are not required:

Rodgers, *Descriptive Inorganic, Coordination, and Solid-State Chemistry*, 3rd edition

Housecroft & Sharpe, *Inorganic Chemistry*, 4th edition

Course Description: This foundational course for 2nd-year students covers the properties and trends of molecules derived from across the periodic table. In addition to main-group elements, a deeper understanding of transition metal ions will be developed. Topics covered include periodicity, bonding, symmetry, and reactivity. Special attention will be given to visualization tools for molecular structures. Upon completion of the course, students will be prepared to critically compare and contrast molecular and biomolecular structures with chemical reactions presented in subsequent course work throughout the science division. *Prerequisite: CHEM 240 or CHEM 241 with a grade of C or better, or approval of the instructor (can also be taken concurrently).* *Corequisite: CHEM 230L.*

Course Design:

Chemistry is a feast, and with this course we set the table. Can this course be the **BEST** chemistry course you have ever taken? Yes! More than any other course in our department, this course can help you bring it all together so that thinking chemically becomes natural. All of us (freshman, upper classmen, and myself) have much to learn, but our efforts will pay off for ourselves and everyone else. There are always more things in inorganic chemistry to discover.

Student Learning Outcomes

Students will be able to:

- 1) Understand and predict chemical trends in periodicity/symmetry/bonding/reactivity.
- 2) Demonstrate visualization and spatial reasoning skills appropriate for inorganic chemistry.
- 3) Describe function of transition metal ions in a variety of chemical and biochemical systems.
- 4) Discuss the global limitations of elemental resources and stewardship of those resources.

Use of Personal Electronics:

To minimize distractions from electronics, I will be using an analog version of classroom response system. This is to maintain our focused classroom learning and exclude distractions from personal electronics. I ask that you put away all electronic devices.

Homework

All homework assignments will be graded by myself or grader. I've used an online homework response system in the past (Sapling/Achieve) but found it was not the greatest value for learning. Homework will be due by Thursday mornings in Chem 230L, so that answer keys can be posted for timely review. Answer Keys can then be used to study for the brief quiz that will be given at the start of the next class period. Therefore, delayed submissions substantially impact our learning community. Please make every effort for timely submission.

Quizzes

There will be a brief Moodle quiz due before class day after your homework is turned in to gauge your mastery of the content. The next day in class we will discuss the quiz and the answer key to the homework will be posted after class time. The combined score on quizzes (with some drops) will be scaled to 50 points total.

Laboratory

The lab for this course is a separate, co-requisite course; Chem 230L. It is wet laboratory that focuses on preparation and analysis of inorganic molecules and compounds.

Important Dates

Monday, January 10	First day of class
Thursday, Feb. 10 (In SB 302)	Test 1, Element Resources due
Feb. 28 – March 4	No Class, Spring Break
Friday, March 18	Test 2, Group's Ten Element Themes due
Tues/Weds, March 22,23	No Class, Academic Advising
Wednesday, April 13	Test 3
Friday, April 15, Monday, April 18	No Class recess for Easter Break
Thursday, April 21	Friday Schedule (last class meeting)
Monday, April 25	Final Exam at 1:30pm

Scoring for Grades

Tests	300 points
Final Exam (cumulative)	150 points
Quizzes	50 points (scaled)
Homework	50 points (scaled)
Collaborative Learning Project	50 points (scaled)
Total points	550 points

Final Exam April 25, Mon. **1:30 PM**

Course Themes (in discussion order):

Section 1: What is a covalent bond? (Ch. 1-3)

- Atomic Models & Electron Waves
- Localized Electron Model of Covalent Bonding
- Delocalized Electron Model of Covalent Bonding (and more)
 - Diatomic molecules
 - Classifying Shapes (mathematics sidebar) for larger molecules
 - Tri- and Tetra-atomic molecules
 - Fragment Analysis for larger molecules

Section 2: What happens in the solid state? (Ch 4, parts of Ch 24)

Structures in the Solid State

Ionic Bonding

Bonding in Metals and Semiconductors

Section 3: Structure and Bonding in transition metal ion species (Ch 7 & 20, parts of Ch 21 & 22)

Coordinate bonding: Ionic description

Coordinate bonding: Covalent description

How Strong are Ligands?

Organometallic bonding

Section 4: Developing Chemical Intuition based on bonding and periodic properties.
(Ch. 5, 6, & 9, parts from Ch. 10-19, 22, 24, & 26)

Putting principles to practice:

Oxidation-Reduction

Acid-Base

Periodic Reactivity Trends

Catalysis

Course Policies

Office Hours: Office hours are M, W, F 10:00-10:30 and you are welcome anytime I am in my office (DH 229). If you have to walk quite a distance or are on a tight schedule, you may want to call ahead to make sure that I will be in my office rather than somewhere else in the building. I am usually available outside of classes, labs, committee meetings, etc. If I am working with other students (Chem 102 or research students), especially when in the lab, please respect our class and either schedule an appointment or wait for the session to finish.

Email: I monitor email during normal office hours. Beyond these times, I try to access and provide quick responses between 7:30 PM and 9:30 PM. Obviously, some nights I have other responsibilities that keep me away from rapid responses, but I will attempt to provide responses the next morning before class. Questions that arise over weekends or when my duties at Calvin require travel during the semester (announced before I leave) will require you to be proactive. If you need to contact me before an exam, please email me so I have a record of any request for excused absences.

Electronic Points of Contact: My primary means of distributing information to the class will be through Moodle and your Calvin College assigned email. Therefore, please check your email daily and consult Moodle for missed lectures.

Tests: All tests will require the full period, which will include multiple choice questions, short answer questions, problems that may require some original thinking or analysis, and essay questions. I will allow you to continue taking the exam during chapel break. Extended time should provide enough time, but it is my expectation that you need at most 10 minutes of chapel break (60-minute test). For some tests, the amount of time to take a test is essential for me to assess your level of understanding. Therefore, I reserve the right to only give 60 minutes for a test. If additional time is needed, please consult me and/or Student Academic Services.

Final Exam: The final exam is cumulative and will include a combination of short-answer questions and an ACS Inorganic Chemistry exam. Since the final exam schedule is written in conjunction with all other classes at Calvin College, it is expected that there will be very few reasons that would warrant a make-up examination. Therefore, students should make every effort to take the final examination during the time set by Calvin College.

Energy Critical Elements Project: The chemicals that we use have a global impact. The energy critical elements project focuses on the societal impacts of a group of elements that we use every day. You will be working with your lab partner from Chem 230L to determine:

- Where are these elements derived from (geographically)?
- What chemicals, materials, and/or products are generated by these elements?
- How much energy consumed during their production?
- What side-products are formed during the production of these elements?
- Are there any geo-political implications threaded with these answers?
- How do we sustain God's creation while producing these elements?

Everyone will need to read one introductory article and take a Moodle quiz on the article before Test #1. When, I return Test 1, I'll assign you and your partner an Energy Critical Element. Between Tests 1 & 2 you will read a specific chapter on your element from US Geological Survey and search the primary literature using Google Scholar and Sci Finder Scholar. You must take written or electronic notes on your element (answering questions above and others you are interested in) by yourself. During Test #2 you will bring your notes (or email them to me) as an individual for me to evaluate while you are a taking Test #2. You and your partner will combine notes for a 5-10 minute presentation. You will present your findings to the class on April 7 (in Chem 230L).

Special Arrangements:

Calvin will make reasonable accommodations for persons with documented disabilities. Students should notify the Coordinator of Services to Students with Disabilities located in Student Academic Services, HH 446. Students should notify their instructors within the first two weeks of class."

Academic Dishonesty: It is anticipated that students will abide by the Calvin College Student Conduct Policy. All listed forms of cheating and plagiarism will not be tolerated and met with the appropriate paperwork and adjudication procedures. This is to maintain the faculty-student and student-student relationships that make lecture-laboratory learning effective. It is useful to remind each other about what constitutes plagiarism:

"The term "plagiarism" includes, but is not limited to, the use, by paraphrase or direct quotation, of the published or unpublished work of another person without full and clear acknowledgment. It also includes the unacknowledged use of materials prepared by another person or agency engaged in the selling or distribution of term papers or other academic materials." - Article I.14, Student Conduct Policy, Calvin College.