

Inorganic Chemistry Laboratory

Preparation and characterization of inorganic and organometallic compounds.

For students majoring in chemistry and biochemistry fields and closely related areas.

Cr. 1. Prereq: CHEM 4020/5020 (or concurrent enrollment for graduating seniors).

Instructor:	Dr. Javier Vela , University Professor	Email: vela@iastate.edu	Use "CHEM 4010L" in subject line
TA:	Ms. Woolin Lee, MS, PhD Candidate	woolinl@iastate.edu	Use "CHEM 4010L" in subject line
Office:	2101E Hach Hall	Office hours (Javier):	Please make an appointment by email
		Office hours (Woolin):	T 2:30 – 3:30 pm, 1225 or 2166 Hach

Course-Section	Time (1225 Hach Hall)	Other possible open lab hours:
CHEM 4010L-1	Tue 12:10 – 3:00 pm	Thu 12:10 – 6 pm; by appointment with a TA only
CHEM 4010L-2	Tue 3:10 – 6:00 pm	Thu 12:10 – 6 pm; by appointment with a TA only

Course Format: The lab meets for a 3-h lab-period once a week; additional time(s) may be available by appointment with a TA only to finish some work, and/or to record spectra.

Four-to-six (4–6) predetermined experiments will be completed according to the posted schedule. Experiments are performed individually. Some experiments take multiple sessions and will require students to schedule times to use the necessary equipment. During the semester, students may work on a *Challenge Assignment*, to be determined and preapproved in close consultation with the instructor.

Objectives and Outcomes: This course serves as an introduction to advanced techniques of synthesis and characterization of a variety of inorganic compounds and materials. Students will use techniques and concepts from many areas of chemistry. An elective Challenge Assignment may provide a capstone experience for the Bachelor of Science degree at Iowa State University. Upon completing this course, students will be able to:

- Work with compounds from diverse areas in inorganic chemistry.
- Retrieve information about hazards and safe handling of chemicals and equipment.
- Use several advanced techniques for the synthesis, purification, and characterization of inorganic materials.
- Evaluate and propose improvements to an experimental procedure based on their results.
- Design and carry out syntheses, purification, and characterization based on the chemical literature.
- Analyze data from measurements and characterization and assess the purity of products.
- Communicate results and compare them those published in the chemical literature.
- Connect the properties of products to fundamental aspects of chemical bonding and structures.

Textbooks and Supplies

Required items:

- Digital access of selected pages of "Synthesis and Technique in Inorganic Chemistry," (3rd Ed., 1999, by G.S. Girolami, T.B. Rauchfuss, and R.J. Angelici).
- PPE: Safety goggles and your own lab coat.
- A laboratory notebook with *bound and numbered pages and removable duplicate sheets* (you may continue a

used notebook from other labs if they meet these requirements).

- Pen, pencil, and ***your own*** permanent marker.

Other / optional suggested sources: (NOT required)

- "Synthesis and Technique in Inorganic Chemistry", 3rd Ed., 1999, by G.S. Girolami, T.B. Rauchfuss, and R.J. Angelici; this book is usually available and/or on reserve at Parks Library. The entire book has much useful information and chapters on other experiments. Only selected pages of this book are required and on Canvas.
- Any textbook of Inorganic Chemistry of your choice. We recommend the book used in Chem 3010 and/or 4020.
- Any source on laboratory techniques in a synthetic organic/inorganic lab.

Laboratory Notebooks: You will be using a laboratory notebook with bound and numbered pages and removable duplicate sheets for ***handwriting in ink*** and ***recording*** your data and observations ***during*** your experimental work.

How to Succeed, Learning Activities:

To successfully complete this course, students will do the following:

Work through the Unit Modules by

- Reading assigned materials.
- Watching any videos posted there.
- Accessing resources linked in the instructions. (Some of these may be available only while on campus!)
- Participating in discussion topics.
- Completing all quizzes.
- Submitting all assignments.

Work in the laboratory by

- Coming prepared to do the work.
- Adhering to all safety procedures.
- Taking careful notes of ***amounts*** of reagents and products.
- Taking careful notes on ***observations*** during the synthesis and purification steps.
- Recording all parameters of spectra taken.
- Cleaning equipment and workspace.
- Asking the TA when in doubt about anything.
- Communicating with the instructor and TA through the discussion boards, email, or Canvas.
- Visiting the instructor and/or TA during office hours, or connecting with the instructor or TA online.

Assignments and Grading Policies: Legibility, correct spelling, and grammar will be part of the grade of your assignments. Scores of individual assignments will be shown in percent. Different assignment categories are weighted (below) and are visible in Canvas. The standard letter-grading scheme will be used to assign final grades.

There are penalties for violating proper safety, waste disposal, and laboratory practices. Repeated non-compliance can result in dismissal from the laboratory. If details, such as due dates, differ, ***information on Canvas takes precedence.***

Attendance: Make-ups for missed lab periods* are hard to schedule and complete. Please plan any outside commitments away from class hours. You need to adhere to the chosen or assigned schedule to ensure that the required chemicals and shared equipment are available. When experiments require more than one lab period, you still need to leave your working area clean for students in other courses/sections using the same space.

****Please stay home if you are feeling unwell and/or have tested positive for highly communicable diseases.*** Contact your instructor and TA as soon as possible to discuss ways to make up the missed laboratory work.

Academic Honesty Expectations: Any resources used to create your submissions need to be cited as references. Feel encouraged to discuss questions with your classmates, TA, and the instructor. However, submit work in your own words.

Assignments in Units 1 - 6:

For each unit the following assignments need to be submitted for grading:

Assignment	Form	Due	Comments
Unit quiz	Online on Canvas	Mondays by (before) midnight	Review assigned reading(s) and experimental preparation
Lab report	Online: documents (*.docx or *.pdf)	One week after the experiment has been performed, on Mondays by (before) midnight	You may insert pictures and visuals, or clear scans of hand-drawn structural formulas or schemes
Structural models	Models	Three days after the experiment (by Fridays midnight)	Total of 2 assignments: Solids and Co(III) complexes

Use *Canvas* to stay informed on due dates. Several items may be due on the same day. Plan ahead and submit assignments according to our schedule and do not wait until the due dates. Late assignments will affect grades.

Missed and late assignments: It is important to keep up with the pace of this course, therefore try to submit your assignments *before the due date*. Each day the assignment is late, the Canvas grade book may deduct a certain percentage from your score. (Late assignments will show a zero grade *until* they have been graded.)

Weighting Scheme:

Category	Weight for Midterm Grade	Weight for Final Grade
Unit Quizzes	20%	20%
Final Reports	65%	65%
Structural Models	15%	15%
Final Teaching Evaluation (end of semester survey to help us further improve the course).	2%	2%
Challenge Assignment (optional)	0%	TBD (extra)

Approximate Schedule and Overview of Experiments:

Weeks	Dates	Scheduled Experiments:
1	Jan-20	Introductions, safety, and check-in.
2-4	Jan-27 – Feb-10	Unit 1: Solid State Chemistry: Synthesis of the 1-2-3 superconductor $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ and structures of solids.
3	Feb-3	Build models of related crystalline solids.
4	Feb-10	Meissner Test of the 1-2-3 superconductor $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$ (completes unit 1).
5-7	Feb-17 – Mar-3	Unit 2: Nanoscale Materials: Synthesis, characterization, and monolayer formation of gold nanoparticles.
8, 10	Mar-10 – Mar-24	Unit 3: Bioinorganic Chemistry*: Standard and microwave synthesis, isolation and characterization of <i>meso</i> -tetraphenylporphyrin and copper(II) tetraphenylporphyrinate.
9	-	Spring break no classes
11-12	Mar-31 – Apr-7	Unit 4: Coordination Chemistry: Synthesis, molar conductance, and UV/Vis spectra of Co(III) complexes.
11	Mar-31	Build models of related compounds.

13-14	Apr-14 – Apr-21	Unit 5: Glovebox operation and upkeep* : Setting up and atmosphere control, antechamber operation, purging of the atmosphere, catalyst regeneration, vacuum pump maintenance and oil change, charcoal filters and glove care.
15	Apr-28	Unit 6: Organometallic Chemistry : Preparation and use of a titanium metallocene: Methods of air-free transfer.
16	May-5	Checkout and cleanup.

Some experiments may need 1 day of more than 3 h in the lab and/or require you to work outside the regular lab period.

Possible Challenge Assignments:

Writing a Graduate Research Fellowship application to the National Science Foundation (or similar).
Writing a sample preliminary proposal for PhD Candidacy exam (5010L only).
Other (TBD - must be preapproved by instructor).