

CHEM 110L – Intermediate Organic Chemistry Lab**Instructor:** Caitlin Binder, Ph.D.**Email:** cambinde@ucsc.edu**Office hours:** Thursdays 1 – 2 pm in PSB 240 or email to set up an appointment TuW afternoons
No CB office hours on 4/25 or 5/18**Teaching Assistants** – office hours to be announced in lab and posted online

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Course Prerequisites: CHEM 8M and previous or concurrent enrollment in 110L.**Course Fees:** \$55 materials fee**Course Description:** CHEM 110L (2 units) is a course in synthetic organic chemistry and requires proficiency in the techniques learned in 8L/M. Experiments involve the preparation, purification, characterization, and identification of organic compounds, making use of modern as well as classical techniques. Technical, scientific writing skills are emphasized.**Required Materials**

- Access to the **course website:** <https://acrochem.sites.ucsc.edu/chem-110l/>
- Mohrig, J. R.; Hammond, C. N.; Schatz, P. F. *Laboratory Techniques in Organic Chemistry*, 4th Edition, Freeman: New York, **2015**. Older editions OK.
- McMurry, J. *Organic Chemistry*, 8th Edition, Brooks/Cole: Belmont, **2012**.
- Lab Notebook with duplicate pages & safety goggles (shared goggles provided in the lab)
- *Optional:* You may purchase your own lab coat and safety goggles.

Lecture webcasts at webcast.ucsc.edu. **User:** chem-110l (lowercase "l") **Password:** plane86sense**Enrollment and Make-up Policies** – see page 5 for more detail on make-ups

- Enrolled students must be present and properly dressed at the first lab meeting. If you are more than **15 minutes** late for the first lab or improperly dressed, **you will be dropped from the course**.
- Attendance to lab lecture is mandatory. **No make-up quizzes**. You are responsible for getting the notes from another student if you miss lecture. I do not give out lecture notes but webcasts are available several days after lecture. **Please do not email me to ask if I went over anything important in lecture; it's all important!!**
- There will be **no section switching** after the first lab meeting.
- Starting the second meeting of lab, if you are more than **two minutes late**, you cannot take the quiz. If you are more than **five minutes late**, you cannot participate in that lab (see *meeting half-way policy*).
- Attend every lab during your enrolled section. If you have a reasonable excuse to miss lab, you must contact the instructor (Dr. B) at least **two weeks prior** to that experiment. You are not guaranteed a make-up lab due to limited space but we'll try! *TA's do not arrange make-up labs*.
- If you are sick, it may not be safe for you to attend lab. Email Dr. B (cc your TA) as early as possible before your lab starts, otherwise your situation will be treated as an unexcused absence (see page 5).
- If you miss lab or come to lab late, unprepared, or are asked to leave for violating safety rules, you are **not eligible for a make-up and will take a zero for the results portion of the lab**, at minimum. You may still receive credit for pre-lab questions and notebook pages if you make arrangements before the end of the lab period. You are also responsible for turning in any lab report due that day.
- Consult the schedule for experiment due dates. Assume **no late lab reports** will be accepted unless **prior permission** is given by your TA in writing or e-mail *before the due date*.
- *Missing one full report means you drop one letter grade (ex. A to B)*.
- *If you do not turn in two reports or do not perform two labs for any reason, you cannot pass the course.*

Disability Accommodation: UC Santa Cruz is committed to creating an academic environment that supports its diverse student body. If you are a student with a disability who requires accommodations to achieve equal access in this course, please submit your Accommodation Authorization Letter from the Disability Resource Center (DRC) to me privately during my office hours or by appointment, preferably within the first two weeks of the quarter. At this time, we would also like us to discuss ways we can ensure your full participation in the course. *This may include scheduling make-up labs if there are time conflicts due to extended exam times for other courses*. We encourage all students who may benefit from learning more about DRC services to contact DRC by phone at [831-459-2089](tel:831-459-2089) or by email at drc@ucsc.edu.

Academic Integrity - https://www.ue.ucsc.edu/academic_integrity: Students work in pairs and are encouraged to discuss experiments with each other, but *each student turns in an individual lab report*. The work you turn in should be your own. Avoid copy/pasting from someone else's work. Instead, you may talk about thoughtful responses and put it in your own words. Your TA will on the look out for blatant copying – it is pretty obvious! *Zero points will be assigned to duplicate lab reports, or sections of lab reports that are obviously copied, at the TA's discretion*. The following are a few clarifications to avoid issues.

- Both students in a lab pair must perform roughly the same amount of hands-on lab work. If a TA finds only one student is performing the lab out of a pair, a warning will be issued. A second offense will result in dismissal from the lab and possibly from the course.
- Each student records his/her own raw data, not to be copied from a lab partner unless specifically instructed to do so.
- All calculations and analyses must be performed individually before comparing answers with another student.
- The technical writing assignments (abstracts & experimental methods) are to be completed individually using the provided guidelines. Lab partners are encouraged to proofread each other's work only after a draft has been completed. Consult the TA for help as well.

Lab Conduct

Safety first! With more advanced labs comes the responsibility of more potentially dangerous chemicals and procedures. Students are expected to act responsibly in lab. A comprehensive list of safety rules is on p. 6-7 of this syllabus. An abbreviated version is below. **Violations are taken very seriously – point penalties, dismissal from lab, or dismissal from the course (D).**

- No food or drink in the lab
- Wear proper attire and arrive to lab on time.
- No running, or otherwise 'horsing around' during lab; keep belongings out of the way
- Take care of chemical spills immediately; consult the instructor
- Keep your work station clean and follow instructions on washing glassware
- **Your assigned locker must be complete, clean, and organized before leaving lab each day.**
- Be sure you understand the full procedure before beginning an experiment.
- Pay attention to waste procedures and chemical hazards
- Label all glassware at every stage of an experiment
- Help your lab-mates clean up if you are done early
- **ABSOLUTELY NO GLASS IN THE TRASHCANS, INCLUDING PIPETS**

Classroom Conduct

Students should treat their instructor and fellow students respectfully!

Attendance to every lecture is mandatory and necessary for successful completion of this course. A lecture will be given on each experiment to aid in your preparation and understanding of the principles behind each lab. Quizzes will be given in lecture periodically.

* You are responsible for getting the notes from another student if you miss lecture. I do not give out lecture notes. Please do not email me to ask if I went over anything important in lecture; it's all important!!

* Friday's lectures cover lab material for the following week. Stick to the reading schedule to stay engaged in class. **It is recommended that students have as much of the notebook and pre-lab questions prepared as possible before lecture to aid in comprehension.**

* **Webcasts:** audio and anything projected in lecture will be posted online (username and password on page 1). This is not a substitute for attending lecture, as it may take four or more days to update lectures. Instead, use this to review material, supplement your notes, and/or help with reports.

* You are welcome to ask questions in lecture. It's more fun that way!

* Come to class on-time, stay for the duration. **Please wait to pack up until I have dismissed the class.**

* Please do not talk while the instructor is talking.

* **CELL PHONES OFF AND AWAY! Do not take pictures or video in class. I am not comfortable with this and you do not have my consent unless I say otherwise in class** (remember, the webcasts are available a few days after class). Please write notes by hand.

* **Electronic devices (tablets, laptops, etc.) are not permitted in the classroom** unless *prior permission* is obtained from the instructor and/or special accommodations are needed.

Description of Assignments:

Experiments, syllabi, and supplemental materials are online. Reading assignments are from Mohrig, *et al.* "Laboratory Techniques in Organic Chemistry, 4th Edition." The schedule of reading assignments is on the last page of the syllabus. Skim these sections before lecture and read the parts pertaining to the upcoming experiment more thoroughly before lab. Other editions and texts are suitable – use the lecture topics. Arrive to lab on time with a prepared lab notebook per the guidelines below. You cannot bring/use the text or handouts in lab unless otherwise instructed.

Notebook preparation: Your TA will check your lab notebook before you begin the lab. If your notebook is not properly prepared, you will be asked to leave and you will receive zero points for the results sections of the lab, including abstracts or experimental methods. You will not be eligible for a make-up. See *sample notebook page provided online and read specific instructions in lab handouts*. Write in pen (no pencil). Do not cut and paste anything into your notebook. If you make a mistake, use a single-line strike-through (no scribbles), NO WHITE-OUT!

- Experiment Number, Title, Your Name, Lab Partner Name, Date, Section Day/Time
- **Purpose** – one sentence plus scheme with structures & abbreviations
- **Reagent Table**
 - For each chemical used, make a table with its chemical name, molecular mass, moles used (mmol), mass or volume used (mg or mL), molar equivalents (for reactions only) bp/mp, density, and relevant hazards (flammable, corrosive, lachrymator, pyrophoric, hygroscopic, etc.) The hazards are listed in the safety tables at the end of each handout and chemical properties can be found at www.sigmaaldrich.com.
- **Full hand-written, step-by-step procedure with diagrams.** DO NOT copy directly from the handouts. This should be in your own words. You can number your procedure, use bullet points, or any other format that will be useful to you or a lab mate in easily following your own instructions in the lab. The included diagrams should be of glassware, especially if it's new to you, and/or some type of flow chart that complements your written procedure. This is not a substitute for the hand-written procedure.
- **Waste and Clean-up Notes.** Copy and pay attention to notes in the handout and announcements in lecture/lab.

Introduction (Pre-Lab Questions)

- Include a header at the top of the page with your name, section letter, day, time, and room number. A title should appear as well, such as "Exp 1 Introduction".
- **Responses to pre-lab questions** are to be numbered, written in complete sentences, neatly *typed*, printed, and handed in to your TA at the very beginning of the lab period (as you walk in the door). Your TA will return these to you the day the report is due.
- DO NOT re-type the question exactly but DO re-word the question as part of your answer.
- You may leave space to hand-write structures, mechanisms, calculations, etc. in PEN. Responses in pencil will not be graded.
- **Do not wait until the last minute to print this out.** *This is your only opportunity to get credit for the pre-lab questions, no exceptions for printer issues, etc.*
- The pre-lab questions will not be graded if the TA's initials are not present. Altering pre-lab questions after turning them in would qualify as academic dishonesty and you will receive zero points for that section of the lab report. A second infraction will not be tolerated (see section on Academic Integrity above).
- **Get help with your introduction before it is due!**

In-lab Quizzes – There will be a short quiz at the beginning of lab to assess your preparation. If you read the lab handout and put thought into the pre-lab questions, this should be easy! If you are late to lab (more than 2 minutes), you cannot take the quiz.

Assignments, cont'd.**Lab Reports (70% - semi-formal reports; 25% - formal report)**

Reports are due in the beginning of lab on the due date (see schedule) and are to be **typed** (with the exception of notebook pages, figures, structures, and calculations) in the format outlined below and according to technical writing guidelines provided on eCommons.

The components are as follows. *Only the formal report will contain all of these components.* Consult the specific grading rubric found at the end of each lab handout. The lab report must be in the order indicated in the grading rubric. Your TA may have specific instructions or expectations. Please pay attention to in-class announcements and **get help with your pre-lab questions and reports before they are due!**

- **Abstract** – refer to *Technical Writing Guidelines & specific notes in experiment handout*
 - Contains purpose, procedure overview, main result(s), and conclusions.
- **Introduction** - original pre-lab responses with TA initials, see description on previous page
 - Enumerate the questions and separate each question into its own paragraph.
 - Reword the question into your answer. Do not re-write the question itself.
- **Results** – Typed responses to in-lab questions in complete sentences
 - You may hand-write calculations, structures, and mechanisms.
 - Relevant tables should be given clear labels (**Table 1**, etc.) and a descriptive title.
- **Experimental Details and Characterization** – refer to *Technical Writing Guidelines*
 - One **General Methods** paragraph
 - One additional paragraph for each reaction performed
- **Lab Notebook Pages** – the only hand-written component
 - Tear out the carbon-copy pages from your notebook for that lab and attach to the lab report. DO NOT re-write or alter your experimental notebook pages once the lab is completed, except to complete calculations or analysis.
 - TA initials for leaving lab with all the proper data and analysis.
- **Pre-Lab Quiz, Neatness & Organization**, 10-15% of each report.
 - Refer to report guidelines in the syllabus, experiment handout, and technical writing guidelines when putting together every report.
 - Student workspace and locker will be checked for cleanliness at each lab.
- **Lab Technique**, 5-10% of each report
 - Students will be assessed on their ability to safely carry out experiments using proper techniques as described in the safety rules (p. 5-6), experiments posted on eCommons, and any other demonstrations or instructions given by TAs in lab.

Tentative Grade Distribution – any changes made will be to your benefit.

A+ 98 – 100%	A 93 - 97	A- 90 - 92
B+ 88 - 89%	B 83 - 87	B- 80 - 82
C+ 78 – 79%		C 70 - 76
D 55 - 69		F < 55

COURSE ASSESSMENT**Assignments Overview**

- * Do the assigned reading before lecture and lab.
- * Prepare your **lab notebook** and **pre-lab questions** before each lab (see guidelines).
- * Be prepared for a short **pre-lab quiz** at the beginning of every lab.
- * Five individual semi-formal **lab reports** (see due dates on schedule).
- * One **Formal Lab Report**

Grade Breakdown1000 Point Scale:(10 points, 1%) **Lecture Quizzes**(40 points, 4%) **Week 1 In-Lab Activities (Safety, Error, & Writing)**(700 points, 70%) **Semi-formal Lab Reports**(250 points, 25%) **Formal Lab Report (Exp 5)**

- * **Students must get a minimum of 60% on the formal lab report to pass the course**, even if lab report grades are in the passing range.

Course Policies

- * **Students are to keep a record of their own graded assignments.**
 - * Grading rubrics indicate total possible point values for each lab report.
- * **Students must perform all labs and turn in all lab reports.**
 - * Missing one *full* lab report will drop one letter grade.
 - * Missing two labs - grade is dropped to a D and student will have to re-take the course.
- * **The following conditions will keep students from performing the lab...**
 - * Arriving to lab unprepared, including missing notebook components and improper attire.
 - * Arriving to lab late (more than 5 minutes).
 - * Not abiding by safety rules, procedures, or TA instructions.

Make-up Policy

- All make-up labs must be completed within the same week and are scheduled by Dr. B only.
- Two weeks notice is required for make-up consideration under regular circumstances.
- Email Dr. B with your section information (day, time, room) and requested make-up time(s).
- Emergency or last-minute situations (illness or otherwise) will be handled on a case-by-case basis: If you cannot physically make it to lab, email Dr. B & your TA *before your section starts* with your section information and requested make-up time(s).
- ***This offer expires 5 minutes after your section starts!***
- We want to help but you must communicate with us in a timely manner.

“Meeting Half Way” Policy = you are 5+ min late, missed lab, or are not prepared AND do not contact us before your lab starts...

- *You are not eligible for a make-up lab.*
- Go to your regular section before it ends if possible to turn in your pre-lab and lab report.
- If you cannot physically come to lab, send us (Dr. B & your TA) an email to make arrangements to show your pre-lab questions (intro) and notebook pages to your TA.
- Leave your lab report in your TAs mailbox in PSB if one is due the week you missed.
- Turn in a lab report with grading rubric the following week. At minimum, you will get credit for the intro and notebook pages (roughly 50% of the report is better than 0%!). You are welcome to complete other parts of the report for feedback but will not get credit.
- ***This offer expires when your lab is over!***
- **Students who miss lab and follow the “meeting half way” policy are still eligible for an A in the course**, provided the rest of the reports have excellent scores. *You only get one of these!*

LABORATORY SAFETY RULES AND AGREEMENT*Safety First!*

Violation of any of the rules below may result in you being removed from the lab and/or you will receive ZERO for results portions of the lab (credit granted for preparation only – introduction & notebook). A second violation will result in you being dropped from the course.

No make-up labs for students who violate these rules.

1. **Safety goggles must be worn** at all times when anyone in the room is working with chemicals, especially yourself!
2. **NO food, drinks, or gum** are allowed anywhere in the labs or in your mouth while you're in the labs.
3. **Appropriate lab attire** must be worn at every lab. Students cannot go home to change.
 - **OK LAB ATTIRE:** Pants or long skirt, short or long-sleeve shirt, closed-toe shoes that cover the entire top of the foot. Long hair and loose clothing are confined or tied back.
 - **NOT OK:** Shorts or short skirts (no exposed ankles), *leggings/tights*, cropped pants that expose ankles, ripped pants that expose skin, tank tops, sandals, ballet flats, or any other shoes that expose the tops of the feet (Crocs and Tom's are NOT OK!). High heels, baggy clothing, and dangling jewelry are strongly discouraged.
4. **Lab coats** must be worn over appropriate lab attire (see above).
5. **NO running, fighting, or other acts of mischief.**
6. **NO visitors**, including pets and side-kicks.
7. Know the **locations of emergency equipment** including fire alarms, fire extinguishers, chemical fume hoods, safety showers, and emergency eye washes.
8. **Notify your instructor immediately of any injury, spill, fire, or explosion.** You may clean up small spills (less than a few milliliters) yourself, but let the TA know. You're not in trouble unless you do it on purpose!
9. Keep your lab space **clean and organized**. Backpacks, purses, jackets, phones, etc. are not allowed where chemicals are being used.
10. **Never leave an ongoing experiment unattended.** If you need to leave the room, be sure a neighbor is watching your experiment.
11. Unless otherwise specified, dispose of broken glassware in broken glassware boxes only, including ceramics and disposable glass pipets. NO paper or other items in the broken glass boxes. **NO PIPETS OR OTHER GLASSWARE IN THE TRASH!** Not cool and you'll lose points.
12. **DO NOT TASTE ANYTHING IN THE LAB. EVER.**
13. **Never remove chemicals or equipment** from the labs or stockroom without permission.
14. **NO unauthorized experiments.** Stick to the given procedure.
15. Follow appropriate procedures for inserting glass into a stopper and/or have the stockroom or your TA assist you. Seriously, students stab themselves when they're not paying attention.
16. **Wash your hands and arms with soap and water before you leave the lab**, even if you've been wearing gloves.

17. Always know the **hazards** as well as the physical and chemical properties of the materials used. Your lab notebook should include a brief note on the safety hazards for each chemical being used based on **Material Safety Data Sheets (MSDS)** available online.

18. **Read labels carefully.** Read labels twice. Know what you're working with!

19. **Label all containers** with chemical/mixture names, your name, and the date **before** anything goes into that container.

20. **Use plungeres and pipet bulbs with glass pipets.** NEVER pipet by mouth. It's gross.

21. Check all **glassware for cracks and cleanliness** before using...or you'll be sorry later that you didn't.

22. **Avoid contamination.** Take only what you need from reagent bottles and NEVER return unused chemicals to the original bottle that other students are sharing.

23. **Fume hoods** are often used to minimize chemical exposure. Handle chemicals six inches into the hood, **DO NOT PUT YOUR HEAD IN THE HOOD** and **DO NOT KNEEL IN FRONT OF THE** hood, or anywhere in the lab.

24. **Wash all glassware before leaving lab for the day.**

25. **Dispose of all waste as instructed in the lab handout or by the TA.** Read waste container labels carefully to be sure it's going to the right place. Waste containers are typically in the fume hoods. Let your TA know if a waste container is full. **DO NOT LET THE WASTE CONTAINERS OVERFLOW!** *Seriously, who does that?!*

26. **NO use of flame in the lab.** Nearly everything in the organic chemistry labs is flammable.

27. **Wear gloves** when appropriate in the lab and **change your gloves** if you get chemicals on them. They're cheap! Gloves are only a first line of protection. They do not make you invincible! Take off gloves before you leave the room. **DO NOT touch door handles or your face with gloved hands.**

28. **Minimize chemical exposure** and treat every chemical as if it were hazardous.

29. **No cell phones or electronic devices are allowed to be used in the labs.** If you'd like to take a picture or video of your experiment, ask your TA for permission, but take your gloves off first.

30. Abide by any instructions and additional rules announced by your TA.

GOLDEN RULE: Your drawer must be *pristine* at the end of each lab.

- All equipment must be clean and organized in the drawer. Check the equipment list and picture of the perfect drawer on the bulletin board in the lab.
- Obtain any missing items from the stockroom. Do not bring broken items to the stockroom!
- **Drawer penalties - points taken off for each missing, dirty, broken, or extra item. Additional points taken off for disorganization, at the TA's discretion.**
 - 1 point per item week 2
 - 2 points per item week 3
 - 3 points per item week 4, and so on...

Violation of any of the rules above may result in you being removed from the lab and you will receive ZERO POINTS for that lab. A second violation will result in you being dropped from the course. No make-up labs for students who violate these rules.

You will sign a contract on the first day of lab, stating that you agree to abide by these rules.

LAB AND LECTURE SCHEDULE

Week	Lab (Tu-Th)	Lecture Topic (Reading Assignments)
1	(4/4 – 4/6) Check-in & Lab Technique Refresher Activity Attendance is mandatory or you will be dropped from the entire course	4/7 – Introduction; Carbohydrates <i>Exp 1, McMurry Chapter 25</i>
2	(4/11 – 4/13) - pairs Exp 1 - Carbohydrates Lab <i>Due 4/18 – 4/20</i>	4/14 – Perkin Condensation <i>Exp 2</i> ¹H and ¹³C NMR Review <i>Mohrig 21-22 or McMurry Chapter 13</i>
3	(4/18 – 4/20) - solo Exp 2 – Perkin Condensation: Synthesis of <i>trans</i> -Cinnamic Acid <i>Due 4/25 – 4/27</i>	4/21 – Multi-Step Synthesis: Ionones <i>Exp 3</i>
4	(4/25 – 4/27) - pairs Exp 3 - Synthesis of Ionones, Week 1 <i>Due 5/9 – 5/11</i>	4/28 - Structural Elucidation: UV-vis <i>Exp 3, Mohrig 24 or McMurry 14.7-14.8</i>
5	(5/2 – 5/4) - pairs Exp 3 – Synthesis of Ionones, Week 2 <i>Due 5/9 – 5/11</i>	5/5 – Lipids <i>Exp 4, McMurry Chapter 27.1</i>
6	(5/9 – 5/11) - solo Exp 4 - Synthesis of Biodiesel <i>Due 5/16 – 5/18</i>	5/12 – Multi-Step Synthesis <i>Exp 5</i>
7	(5/16 – 5/18) - solo Exp 5A - Conversion of Acetaminophen into Phenacetin <i>Draft Due 5/30 – 6/1</i>	5/19 – NMR Structural Elucidation <i>Exp 5, Mohrig 21-22</i>
8	(5/23 – 5/25) - solo Exp 5B - Phenacetin Analysis <i>Draft Due 5/30 – 6/1</i>	5/26 – Substitution Puzzles <i>Exp 5</i>
9	(5/30 – 6/1) - solo Exp 5C - Substitution Puzzles, Bromination of Phenacetin <i>Report Due 6/6 – 6/8</i>	6/2 – Diels-Alder Reactions <i>Exp 6, Mohrig 24, McMurry 14.3-14.5</i>
10	(6/6 – 6/8) - pairs Exp 6 - Diels-Alder Reaction <i>Due Monday 6/12 by 5pm in TA's mailbox</i>	6/9 – Structural Analysis