CHEM 8M – Organic Chemistry II Lab

Instructor: Caitlin Binder, Ph.D. **Email:** cambinde@ucsc.edu
Office hours: Tu 11am – noon & Th 1 – 2 pm in PSB 257 or by appointment (Thimann 313)
No CB office hours on 1/30 or 2/20

Teaching Assistants – office hours and lab schedule posted online by week 2
John Saunders, jmsaunde@ucsc.edu
Longbo Li, lli69@ucsc.edu
Ahn McClean, amcclean@ucsc.edu
Evan Vickers, evickers@ucsc.edu
Patrick Skelly, pskelly@ucsc.edu
Kevin Schilling, kschilli@ucsc.edu
Chad Higa, cmhiga@ucsc.edu

Course Prerequisites: CHEM 8L and previous or concurrent enrollment in 8B; $55 materials fee
Course Description: CHEM 8M (2 units) builds on the isolation and purification techniques learned in 8L, including liquid-liquid extraction, chromatography, and distillation. Synthetic organic chemistry is a broad and exciting field that requires careful analysis of compounds, many of which are clear liquids and white solids (maybe not so exciting color-wise!). Students will become proficient in compound characterization *via* gas chromatography (GC), thin-layer chromatography (TLC), infrared (IR) spectroscopy, and nuclear magnetic resonance (NMR) spectroscopy. Proper technical writing is emphasized.

Required Materials
- Access to **Course Website**: https://acrochem.sites.ucsc.edu/chem-108m/
- Mohrig, JR; Hammond, CN; Schatz, PF "Laboratory Techniques in Organic Chemistry, 4th Edition" Freeman, 2015 (other editions acceptable, use lecture titles for reading assignments)
- Lab Notebook with duplicate pages and safety goggles (shared goggles provided in the lab)
- *Optional:* You may purchase your own lab coat and safety goggles, bring with you each day.

Lecture webcasts at webcast.ucsc.edu. **User:** chem-8m **Password:** @croCh3m

Course Policies – *see page 5 for more detail*
- 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 and/or watching the webcast if you miss lecture. I do not give out lecture notes. Webcasts are not intended as a regular lecture substitute – come to class!
- 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 pre-lab quiz. If you are more than **five minutes late**, you cannot participate in that lab (see page 5).
- Attend every lab during your enrolled section. If you have a reasonable excuse to miss lab, email the me and cc your TA **before your lab starts** (see page 5 for details to include). 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 miss or come to lab late, unprepared, or are asked to leave the lab for violating any safety rules (including dress code), you are ***not eligible for a make-up but may be eligible for partial credit.*** Communicate with the TA **before the end of lab** or this offer expires, no exceptions (see page 5).
- Consult the schedule for experiment due dates. Assume ***no late lab reports*** will be accepted unless ***permission is given by your TA before the due date***.
- *If you do not turn in 2 reports or are not present 2 lab days 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, submit your Accommodation Authorization Letter from the Disability Resource Center (DRC) to me by email, preferably within the first two weeks of the quarter. We can set up a time to meet and discuss how to ensure your full participation in the course, including **accommodations for the lab practical exam**. *This may also 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 or by email at drc@ucsc.edu.

Academic Integrity - https://www.ue.ucsc.edu/academic_integrity: Students work in pairs for most labs and are encouraged to discuss experiments with each other, but *each student turns in an individual report*. Avoid copy/pasting from someone else's work, including web sources and lab reports borrowed from a student from another term (**assignments change each quarter!**). Your TA will on the lookout 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.*

- 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.**
- Record raw data individually, rather than copying from a lab partner.
- Perform calculations and analysis *individually before comparing* answers with another student.
- Experimental methods sections 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. For best results, consult your TA for help well in advance of the due date (during lab!).

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 and abide by all of the safety rules posted online, including but not limited to the points 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
- **Goggles, gloves, and lab coats** are to be properly worn when anyone is using chemicals in the lab or instrument room – points deducted for not wearing personal protective equipment (PPE)
- Pay attention to **waste procedures and chemical hazards** – table given in each experiment
- Take care of chemical spills immediately; consult the instructor
- Notify your TA of all chemical exposures; **rinse minor exposure areas with water for 15 min**
- Label all glassware before adding chemicals to it, including water
- **Clean the balance and reagent areas after immediately** after obtaining chemicals every time
- Keep your work station clean; follow instructions on washing glassware - remove gloves
- **Check your drawer with your TA at the end of each lab – points deducted for every item missing, extra, or dirty**
- Foster a sense of community – ask your TA for a community cleanup task before you leave
- **ABSOLUTELY NO GLASS IN THE TRASHCANS**

Lecture Etiquette - *Students should treat all instructors 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. Attendance quizzes will be given in lecture periodically (no make-ups, no exceptions).
* 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. The webcasts are intended to allow students to review material, supplement lecture notes, and help with reports. *This should not be a regular substitute for lecture*, as you are far more likely to engage in the material in person and are able to ask questions. Also, it may take several days after lecture for the webcasts to be available online.
* You are responsible for the material if you miss lecture – get notes from a classmate and/or watch the webcast. I do not give out lecture notes. Please do not email to ask me if I went over anything important in lecture; it's all important!!
* You are welcome to ask questions in lecture. It's more fun that way! Otherwise, no talking during class.
* Come to class on-time, stay for the duration. **Please wait to pack up until I have dismissed the class.**
* 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.
* ***Tablets are great but laptops less useful for note-taking.*** Ask permission to use other electronic note-taking devices or I will ask you to put it away during class, as this can be distracting. Thank you!

Description of Assignments

Experiments, syllabi, lecture handouts, 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.

Arrive to every lab on time and properly dressed, even if no experiment is performed that day. On wet lab days, also have your prepared lab notebook and typed pre-lab questions per the guidelines below. You cannot refer to lab PDF's in lab unless otherwise instructed.

Lab Notebooks: *See sample notebook page provided online and read specific instructions in lab handouts.* Write in pen (no pencil). If you make a mistake, use a single-line strike-through (no scribbles), NO WHITE-OUT!

Be prepared, no surprises! Your TA will check your lab notebook before you enter the lab. You cannot stay to perform the lab and are not eligible for a make-up if your notebook is not properly prepared (see page 5 for partial credit potential).

- 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, or other type of TA notation for approval. 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!**

PRE-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 quick and easy! If you are 2+ minutes late to lab, you cannot take the quiz, no exceptions.

Description of Assignments, cont'd.

Lab Reports (70%)

Reports are due at the beginning of lab on the due date (see schedule). Reports should be ***typed*** with the exception of notebook pages, figures, structures, mechanisms, and calculations. The format outlined below should be used along with **writing guidelines** given on the first day of lab, also online.

Consult the specific grading rubric found at the end of each experiment PDF online to determine whether an Experimental section is required. Your TA may have specific instructions or expectations. Please pay attention to in-class announcements.

Get help with your assignments, ideally during lab or at least several days in advance!

- **Introduction** - original pre-lab responses with TA initials, see description on previous page
  - Your TA will either hand these back on the report due date or attach it themselves.

- **Results** – Typed, numbered responses to in-lab questions in complete sentences
  - You may hand-write calculations, structures, and mechanisms.
  - Tables should be given clear labels (**Table 1**, etc.) and a descriptive title.

- **Experimental Details and Characterization** - use Technical Writing Guidelines, specific notes in experiment handout, and sample experimental posted online
  - One **General Methods** paragraph
  - One additional paragraph for each reaction performed

- **Lab Notebook Page**
  - 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**, 10-20% of each report.
  - Refer to report guidelines in the syllabus, experiment handout, and technical writing guidelines when putting together every report. This includes spelling, grammar, format, and overall clarity.

- **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 online, and any other demonstrations or instructions given by TAs in lab.
  - **Students must check out with the TA for a notebook and cleanup check before leaving every lab, otherwise zero points are awarded for this section. Points are deducted for each item missing, extra, or dirty. Point penalties increase each week and this section of the report may go into negative points if many items are missing, extra, or dirty.**

Lab Practical Exam (25%)

- Prepare by thoroughly reading and understanding the detailed procedure provided online (Exp 6) and complete the pre-lab questions. An abbreviated procedure will be provided in the format of an experimental methods section. You are expected to understand and follow the instructions independently.
- Each student will perform this experiment individually using the provided procedure (no notebook) in 1 hr, 45 min without help from classmates or the TA (no talking).
- Your lab practical time will be assigned as either the *first or second half of your regular 4-hour lab time*. *If you come at the wrong time, you will get a zero for the exam.*
- DRC students must notify the TA of extra time accommodations, if applicable.

COURSE ASSESSMENT

Assignments Overview

* Read ***lab handouts and text assignments*** before lecture and to prepare for lab.
* Prepare your ***lab notebook*** and ***pre-lab questions*** before each lab.
* Be prepared for a short ***pre-lab quiz*** at the beginning of every lab.
* Five individual ***lab reports*** (see due dates on schedule).
* ***Final Lab Practical Exam*** assessing student's ability to complete an experiment & analysis.

Grade Breakdown

1000 Point Scale:
(*10 points, 1%)* **Lecture Quizzes** - unannounced
(*40 points, 4%*) **Safety Orientation, Writing, & Error Analysis Activities**
(*700 points, 70%*) **Lab Reports**
(250 points, 25%) **Final Lab Practical Exam** – Week 9
*** Students must get a minimum of 60% on the final lab practical exam to pass the course**, even if lab report grades are in the passing range.

Grading Policies

*** Students are to keep a record of their own graded assignments.** Incorporate feedback from graded reports into future assignments. Your TA is happy to *discuss* any grading concerns, however, we do not tolerate arguing or rude behavior. Thank you!
*** Students must perform all labs and turn in all lab reports.**
* One missed lab = 10% of overall course grade is lost, meeting half-way policy may apply (see below)
* Missing two lab periods = 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 - ***This offer expires 2 minutes after your lab section starts!***

- All make-up labs must be completed within the same week and are scheduled by Dr. B only.
- Two week's notice is recommended for make-up consideration if possible.
- 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).
- **Email Dr. B (cc your TA) with your section information (day, time, room) and all possible make-up lab time(s) that same week. Please check the section list online for lab times.**
- 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, no exceptions.*
- If possible, go to lab before it ends to **turn in your introduction, notebook pages, and report**.
- If you cannot physically come to lab, send us (Dr. B & your TA) an email to make arrangements to turn in the introduction and at least show completed notebook pages to your TA ASAP.
- **Leave your lab report in your TAs mailbox in PSB** if one is due the week you missed.
- Turn in the grading rubric the following week in lab at the very latest along with 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 the minute 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!*

LAB AND LECTURE SCHEDULE

Week	Labs (Tu-Th) *Experiments Online*	Lecture Topic, Fridays *Reading Assignment (Mohrig 4)* **See additional review topics in each lab handout*
Prior to the first experiment, read the sections of the text on safety and general lab technique (Mohrig Chapters 1-4). If using the Palleros text or another edition of Mohrig, use the table of contents to read the proper chapters based on lecture topics below.		
1	1/9 - 1/11 - **Check-in** **BYO Completed 8L Intro Packet** **Exp 1 Preparation** Mandatory attendance or student will be dropped from the entire course	1/12 - **Column (Liquid) Chromatography** *Exp 1; Chapter 19.1, 19.2, 19.5a, 19.7*
2	1/16 – 1/18 - pairs **Exp 1** Separation of Limonene & Carvone *Due 1/23 – 1/25*	1/19 - **Acid-Base Extraction** *Exp 2; Chapter 10.1-10.5*
3	1/23 – 1/25 - pairs **Exp 2** Acid-Base Extraction (Excedrin) *Due 2/6 – 2/8*	1/26 - **TLC; ^{1}H NMR Introduction** *Exp 2; Chapters 18, 22.1-22.7* **McMurry Chapter 13.1-3, 13.8-10*
4	1/30 – 2/1 - pairs **Exp 2** Excedrin Analysis *Due 2/6 – 2/8*	2/2 - **Oxidation Rxns; ^{1}H NMR Chemical Shifts** *Exp 3; Chapter 22.7-8* **McMurry Chapter 13.8-10, 17.7*
5	2/6 – 2/8 – solo **Exp 3** Oxidation of Benzhydrol *Due 2/13 – 2/15*	2/9 - **Dyes** *Exp 4; Chapters 4-5* **McMurry p. 971-972*
6	2/13 – 2/15 – pairs **Exp 4** Synthesis and Application of Organic Azo Dyes *Due 2/27 – 3/1*	2/16 - **Dyes; Esters; ^{1}H NMR Splitting** *Exp 4 & 5* *Chapters 5.1, 5.3, 6.1-2, 7.1, 22.9, 22.11* **McMurry Chapter 13.11, 21.10*
7	2/20 – 2/22 - pairs **Exp 4** Synthesis and Application of Indigo *Due 2/27 – 3/1*	2/23 - **Esters; ^{1}H NMR Splitting** *Exp 5; Chapters 22.9, 22.11* **McMurry Chapter 13.11, 21.3, 21.10*
8	2/27 – 3/1 - solo **Exp 5** Fruity Fragrances *Due 3/6 – 3/8*	3/2 - **Esters; ^{13}C NMR** *Exp 6; Chapter 23* **McMurry Chapter 13.4-5, 13.7*
9	3/6 – 3/8 - solo **LAB PRACTICAL EXAM** **Exp 6** Synthesis of Aspirin *Due at the end of lab*	3/9 *No Lecture*
10	3/13 – 3/15 *No Lab*	3/16 *No Lecture*

***McMurry's Organic Chemistry, 8th Edition (8A/B text)**

Strict Grade Distribution

A+ 98.00 – 100%	**A** 93.00 – 97.99%	**A-** 90.00 – 92.99%
B+ 88.00 – 89.99%	**B** 83.00 – 87.99%	**B-** 80.00 – 82.99%
C+ 78.00 – 79.99%		**C** 70.00 – 76.99%
C- 60.00 – 69.99%	**D** 55.00 – 59.99%	**F** < 55.00%