

CHEMISTRY 25

Organic Chemistry Laboratory, Fall 2023

Lead Instructors:	<u>Dr. Cynthia Kellen-Yuen</u> TSC 2013 ckyuen@csus.edu phone: 916-278-5348	<u>Dr. Claudia Lucero</u> TSC 2017 cglucero@csus.edu phone: 916-278-6006
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Dr. Kellen-Yuen's Faculty website: <http://www.csus.edu/indiv/k/kellen-yuen>
Canvas site: <https://csus.instructure.com/courses/110729>

Office Hours for all instructors:

Dr. Kellen-Yuen: M, T, and W 12:15 -1:15 pm; or by appointment (TSC 2013)
Dr. Claudia Lucero: M, W, and R 11am -12 pm; or by appointment (TSC 2017)
Dr. Homer Poorjahanshah: (SQU 520C)
Dr. John Spence: W 12-1:30 pm, F 9-10:30 (SQU 528)
Mr. Alex Berrier: R 1-2 pm (SQU 457)

Text-Required: Chemistry 25 Laboratory Manual (*sold in bookstore*)

Texts-Recommended: *Organic Laboratory Techniques*, 3rd ed., Fessenden, Fessenden and Feist (ISBN 0 534-37981-8); and any standard Organic Textbook

Required Materials: Bound, lined, laboratory-grade notebook (preferably with page numbers), calculator, gloves, lab coat and chemistry-grade laboratory goggles (not glasses).

Prerequisites: Successful completion of Chem 1A, 1B, and 24 (with appropriate passing grades) and completion of or concurrent enrollment in Chem 124—**NO EXCEPTIONS.**

Course Description: This class is designed to give students hands-on experience with basic techniques used for the preparation, separation, purification and identification of organic compounds.

Learning Objectives: Students will learn basic organic laboratory techniques, which will be utilized to prepare, separate, purify and identify organic compounds. Students will also learn some instrumental techniques (e.g. gas chromatography, infrared spectroscopy, and nuclear magnetic resonance spectrometry). Students will also be required to keep a laboratory-grade notebook, to write discussions summarizing their laboratory findings, and to familiarize themselves with safety information sources.

This course will be part of a research project which is trying to evaluate the effect of different teaching environments on student learning and retention. You will perform all the usual tasks undertaken in the standard course. You will not need to commit any extra time to the research project other than the time needed to attend class in the usual manner. Student data, such as performance/grades on course assignments (e.g. quizzes, lab papers, exams, etc.) will be used for evaluation purposes in this research study. You will not be identified in the results. These results may be used to tailor topics and/or teaching strategies to better serve students in future classes. Any risk associated with participating in this study will be no different from what you may experience in taking this course in any other semester. Your participation or lack of participation will not affect your grade in this class, either positively or negatively. If you don't want your assignments to be used in this qualitative analysis, please send an email to your instructor (Dr. Cynthia Kellen-Yuen: ckyuen@csus.edu).

Student Responsibilities:

- 1) Before starting any lab work, a student must familiarize him/herself with lab procedures, chemicals, equipment, hazards, safety procedures, and disposal procedures associated with the work being performed. If the instructor feels that a student is unprepared the student will be asked to leave.
- 2) The student must complete the pre-lab assignment or he/she will not be allowed to work in lab.
- 3) Students must be properly attired to enter the lab, or the student will not be allowed to work in lab. There are no make-up labs, so you will not be given any extra time if asked to leave.
- 4) Students are required to properly clean their work area before leaving lab or their grade will be lowered. Students must get the instructor to sign their lab book before leaving the lab each day—they will only sign if the student’s personal lab space as well as the shared space for the class is clean. Failure to get a signature will result in a 5 point penalty on the corresponding lab score.

Attire: Students will **ALWAYS** come to the lab in clothing appropriate to a chemistry lab. This means long pants (long skirt) and shoes that cover the entire foot **AT EVERY LAB CLASS**. No skin should be showing around your legs or feet, including when you are seated. This is the best way to protect yourself in the case of a chemical spill. A lab coat will be required at all times since it also protects your skin and clothing. **STUDENTS WILL WEAR CHEMICAL-GRADE LABORATORY GOGGLES AT ALL TIMES IN THE CLASSROOM WHILE LABORATORY CHEMICALS ARE PRESENT. THERE ARE NO EXCEPTIONS.** Any student who must be repeatedly warned to put on his/her/their goggles will be told to leave the class without being allowed extra time to make up the work. **Contact lenses are not recommended in a chemistry laboratory.** Gloves will be worn whenever touching chemicals, glassware, or equipment—we recommend nitrile gloves. Face masks will be worn at the discretion of the student in accordance with any University regulations.

Experiments: The experiments to be performed this semester are listed below in the approximate order in which they will be carried out, along with the point values for each experiment.

Points	<u>Experiment and Reading Assignment</u>
25	<u>Melting Points</u> , with Unknown Lab Manual: Experiment #1 and Appendix IV; and Text: pp. 1-22, 213-221, 39-48
50	<u>Recrystallization of Unknown</u> Read: Lab Manual: Experiment #2 and Text: pp. 23-38
50	<u>Spectroscopy</u> Read: Lab Manual: Experiment #3 and Appendix III; and Text: p. 163-194
50	<u>Distillation</u> (simple and fractional) and Gas Chromatography (GC) Read: Lab Manual: Experiment #4 and Appendix I; and Text: pp. 71-75, 77-92, 93-97, 107-110, 141-152
50	<u>Dehydration</u> Read: Lab Manual: Experiment #9 and Appendix I; and Text: pp. 141-152
50	<u>Column Chromatography</u> Read: Lab Manual: Experiment #5 and Text: pp. 119-131, 133-140, 153-162
50	<u>Extraction</u> Read: Lab Manual: Experiment #6, Appendix II and III; and Text: pp. 49-76, 163-178, 206-7
50	<u>Grignard Synthesis of Benzoic Acids</u> Read: Lab Manual: Experiment #10, Appendix II and III
50	<u>Polymerization</u> Read: Lab Manual: Experiment #16

Experiment Points:

Your points for each experiment will be based on (1) a completed pre-lab written into your lab notebook – see lab notebook section below; (2) lab report sheets which include results, calculations, spectral data, graphs, and purity/yield of chemicals synthesized in the lab; and (3) in-class post-lab quizzes taken when reports are turned-in.

The pre-lab must be completed **BEFORE** the beginning of each experiment (at the time the lab begins, not 5 minutes later). No student will be allowed to work in the lab without first completing the pre-lab.

The lab report sheets are due one week after the posted end date for that lab experiment. All lab reports are due at the **beginning** of the laboratory period in which they are due—IF YOU COME LATE TO LAB, YOUR LAB REPORT IS LATE AS WELL. Late materials will be accepted for grading only within one week of the due date or until graded material is returned to students (whichever comes first) unless prior permission of the instructor is obtained. Late material will lose 10% of its assigned value with each day it is late. Synthesized compounds must be turned-in in a properly labeled vial (student name, date, compound name, weight, mp range).

Post-lab quizzes will be given on the day the lab report forms are collected and at the beginning of the lab period. If you come to lab late you will lose that time for answering the post-lab questions. Arriving after the post-lab is finished means you will lose all of the post-lab points.

Attendance:

Students are expected to attend all laboratory lectures in person (attendance will be taken). Students missing a lecture will lose 10% of the corresponding experiment grade for the lecture missed; students missing three lectures will fail the course. (Arriving more than 10 mins late counts as absent)

Students who miss 2 lab sessions without a valid excuse will fail the class. A valid excuse would include hospitalization, NOT catching a cold, oversleeping, or being unprepared for lab. If official documentation is provided for an excused absence, students may not miss more than 4 labs or they will be dropped from the course. You must clear the excused absence with your lecture instructor. You will still be expected to make up missed work, and it must be done in a timely manner, since lab set-ups are changed every week and cannot be replaced.

STUDENTS WILL WORK ONLY DURING THEIR ASSIGNED LAB TIME, AND MAY NOT WORK DURING ANOTHER LAB TIME without prior written permission of all instructors affected by the scheduling change. Lab sections are full and cannot take overloads, therefore make-ups will be allowed only under extreme circumstances and will not be given for students who are simply slow in finishing their work. Students who are late to lab pose a safety hazard to their lab mates, since safety instructions are given in the first few minutes of the lab. Students who are late can be asked to leave the lab and may not be allowed to make up the time. Four or more late arrivals can cause a student to be dismissed from the course for safety reasons. No materials, chemicals, or supplies may be removed from the lab without permission of the instructor.

Exams: There will be two exams given. The first will be given about half way through the course during the discussion/lecture hour. There will also be an exam given during finals week (see schedule below).

Grading: Your grade for the course will be based on your experiment points, exams, your laboratory notebook (including a hazard table), and your laboratory technique throughout the semester (see below for instructions on keeping a laboratory notebook). When multiple instructors lead the various laboratory sections, each section may be given slightly different grading scales to account for the differences in grading schemes.

Assignment	Points
Lab book and technique	50
Hazard Table	50
Review Problems	25
Experimental points	425
Exams (2)	300
Total	850 pts.

Letter grades are assigned based on a range of: A to A- = 90.0% and above, B+ to B- = 89.9-80.0%, C+ to C- = 79.9-70.0%, D = 69.9-60.0%, F = below 60.0%

Cheating:

Cheating in any form is not tolerated in this class. A student caught cheating will receive a zero on that experiment/exam. If a student is caught a second time, the student will fail this course. Cheating includes: copying from another student's report (**yes, even lab partners must have their own unique answers**), **copying material or data from a previous report (your own or someone else's)**, turning in lab work done during a previous semester, reporting data for an experiment you did not perform, using extra materials during testing, programming data into a calculator, having other people take tests for you, altering exams after they have been graded, etc. Cheating will be reported to the Student Conduct Office.

Cleanliness in Lab:

Due to problems encountered in previous classes, students are warned that they are directly held responsible for the cleanliness of the lab, since messy labs pose hazards to the students and add costs to the department in terms of clean-up time and wasted chemicals. Therefore, instructors and stockroom staff may periodically walk through ANY lab sections and can fine a single student or every student in the section up to 5 points per day if their work area or the laboratory room is found to be messy or unsafe. Students are further required to have the instructor check that they have cleaned up their space at the end of lab—which will be acknowledged by initialing the student's lab book. Not getting this ok from the instructor will result in a 5-point deduction for the lab being performed.

Please note: if your instructor allows you to be messy, you are not off the hook. If the instructor from the next lab section finds that the lab has been left unclean, they can request that the students from the previous lab lose the 5 points for not cleaning, so do not rely on sneaking out of the lab quickly to avoid your cleaning duties!! Students are encouraged to remind each other to clean up their areas to avoid losing points. If any student notices that one of their lab mates is not following the rules, they should report this to the lab instructor so that the problem can be easily addressed without any points being taken away.

Laboratory Notebook: (See Fessenden pp. 8-22, 197-202 or any lab text for reference)

The correct notebook for the lab is a hardcover, bound notebook containing lined pages. A loose-leaf or spiral notebook is not satisfactory because pages are easily removed and lost. A separate notebook should be used for each laboratory course. If the pages are not numbered, number them before using the book. Pages should never be stapled in or otherwise added to the laboratory book.

Make sure you write your name and contact information on the inside cover, in case it is lost. Record your locker number and combination of your locker in your lab book or in some convenient place (like a picture on your phone). Leave two pages at the front of the lab book for a table of contents, then enter your experiments consecutively. All entries will be recorded in permanent ink, and data is to be entered as it is collected—never transferred from a “temporary paper”. NEVER ERASE OR USE WHITE-OUT IN A NOTEBOOK. If an error is made, ONE line is drawn through the mistake. DO NOT SCRATCH OUT ERRORS AND DO NOT RIP OUT PAGES FROM THE LAB BOOK. Violations of these rules will result in a loss of lab book points. Points will be deducted for illegible notebooks; however, we do understand that the only “perfect” lab book is one that has been copied. Make sure your work is reasonably neat and easily followed.

The format for writing experiments in your laboratory notebook is as follows:

Date-date experimental work performed. NEVER FORGET TO DATE YOUR WORK—in the real world this can mean the difference between getting a patent and losing it to someone else.

Title – name of experiment

Reaction Equations – you should write a complete and balanced equation for any reaction taking place in the experiment performed. **Under each of the starting materials you should list the molecular weight of each compound, the amount you intend to use in the experiment, and space to write in the actual amount used and the number of moles this represents.**

Procedure Outline – the outline should include sufficient detail to carry out the experiment without referring to the original experiment in the lab manual. DON’T COPY WORD FOR WORD, (a waste of time!!) and long paragraphs make it hard to quickly determine your next step.

****Your lab instructor will check your lab book for these four sections (this is your completed pre-lab assignment), before you are allowed to begin any experiment.**

Observations and Experimental Data – Observations include words describing the experiment: color changes, phase changes, nature of the products, sudden volcanic eruptions or lack thereof, observed temperatures, etc; what you did a little differently than the original procedure. Also give any factors that might have influenced the outcome of the experiment, or reasons why you chose one method over another (why one solvent and not another, particularly important in recrystallization and purification experiments). Observations are what most students fail to include in their lab books. Include as data values you collected during the experiment in a form that makes it easy for you to follow, for example, in Experiment #1 a table with six columns would work well: (1) the name and (2) the structure of the compounds, (3) reagent bottle melting points, (4 & 5) experimental data (two trials), and (6) the average melting point. Data also includes things like dates, exact weights, product yields/calculations, and mp data.

****Your lab instructor will check your work area for cleanliness before you leave at the end of each day, and initial if they approve. Leaving without getting this approval will result in a 5 point penalty on the lab being performed.**

Conclusions – a Brief analysis of the outcome of the experiment, for example: name and structure of the identified unknown, reasons for deciding on the identification of an unknown, calculation for yield of a product (**always show calculations**), physical constants measured in an experiment, purity found by analysis, a comparison of observed versus literature values for physical properties written as a 2-3 sentence summary.

Laboratory Safety: (See Fessenden pp. 1-8, 213-221 or any lab text for reference)

In addition to cleanliness, chemicals pose a large hazard in the laboratory. Since most organic compounds are potentially volatile, flammable and toxic either alone or in combination, a student must become familiar with the chemical and physical properties of all the substances with which they work. These properties can be found in the SDS (Safety Data Sheets), which are available on the Internet web sites of many companies (Fisher, Acros, Baker, Sigma-Aldrich) and Universities (Cornell, Vermont SIRI, Oklahoma State University). Cambridge Scientific sponsors a ChemFinder web site. In the CSUS Library web page under the Chemistry databases you will find a link to many of these on-line SDS sites. You can also search for SDS sheets in Google.

You will devote the last 10-15 pages of your lab book (starting from the last page then working backwards) to listing the following types of information about chemicals used in the lab. (You only need to list a chemical once, even if it is used in many different experiments; when using a chemical a second time still list it in the hazard table for the experiment, then instead of filling in the table you can reference “See Experiment #2” - plan for 10 different experiments and about 80 chemical citations). Keep the SDSs for each experiment on a separately labeled page for easy reference when checked by your instructor. Turn your book sideways and make a table with the following columns:

1. Chemical name
2. Structure (this is NOT a formula)
3. Melting point for solids / Boiling points for liquids
4. Density for liquids
5. An oral LD₅₀ (lethal dose with 50% kill rate)
6. Exposure Dangers – is it a carcinogen? or potential carcinogen? etc
7. Incompatibilities—does it explode when it touches water?
8. Other Notes (for other things you want to remember about the compound)
 - for example, NFPA (National Fire Protection Association) fire diamond listing health hazard, fire hazard, and instability (available for most but not all compounds used this semester)



Special Needs: Students requiring special accommodations should see the instructor ASAP. Students should bring documentation from the [Disability Access Center](#) office here on campus (Lassen Hall 1008, 278-6955). Students who are pregnant or planning to become pregnant during this semester should consult with the instructor and their physician before undertaking any lab work.

Tentative Laboratory Work Schedule

Week of:	Lecture	Monday/Tuesday Lab	Wednesday/Thursday Lab
8/28	Introduction	No Lab	No Lab
9/04	No lecture due to Monday holiday	No lab-Labor Day	Orientation/Safety/Review
9/11	Melting Point	Check in	Melting Point
9/18	Recrystallization	Melting Point	Recrystallization
9/25	Spectroscopy	Recrystallization	Spectroscopy
10/2	Distillation	Spectroscopy	Distillation and GC
10/9	Dehydration	Distillation and GC	Dehydration
10/16	Chromatography	Dehydration	Column Chromatography
10/23	Extraction	Column Chromatography	Column Chromatography
10/30	EXAM	No Lab--Exam	Extraction
11/6	Grignard	Extraction	Grignard
11/13	Advanced NMR	Grignard	Grignard
11/20	Polymerization	Catch-up lab for Grignard (if needed)	No Lab - Thanksgiving
11/27	Review	Polymerization	Polymerization
12/4		Final lab due, Clean-up and Check-out	No Lab

Final Exam:

Mon. / Wed. Lab: Monday, December 11th 12:45 pm – 2:45 pm
 Tues./Thurs. Lab: Thursday, December 14th 12:45 pm – 2:45 pm

CHEM 25 Student Laboratory Cleanliness Policy

At the beginning of each laboratory period

1. Visibly inspect your work area (hood and counter next to hood) and let your instructor know if your work area was left dirty from the previous section.

At the end of each laboratory period

1. Wipe down the inside of your hood with acetone/paper towels to clean-up any small chemical residues. Be sure to dispose of paper towels in solid waste container.
2. Wipe down the inside of your hood and the counter next to your hood with paper towels soaked in water. Dispose of paper towels in the solid waste if chemical residue was present or in the trash if no chemical residue was present.
3. As you are finishing work for the day, help clean any common areas of the lab as directed by your laboratory instructor.
4. Before you pack-up, have your lab instructor inspect your work area and give you approval that your work area is properly cleaned. A deduction of 5 points can be assigned for failure to get this approval.

Lab cleanliness point deduction policy:

When laboratories are left dirty they pose significant safety hazards to the students in subsequent lab sections. If your work area is found dirty by the next laboratory section, you will be docked 5 points on your laboratory report. If the common areas of the lab are found dirty by the next laboratory section (balance areas, instruments, reagent hoods, waste hood, refrigerator, etc.) the entire lab section will be docked 5 points on the laboratory report.

Special notices in the time of COVID:

If you are sick, stay home (I know, you already know that). Notify your instructor. If you are experiencing any COVID-like symptoms (fever, cough, sore throat, muscle aches, loss of smell or taste, nausea, diarrhea, or headache) or have had exposure to someone who has tested positive for COVID contact **Student Health & Counseling Services (SHCS)** at **916-278-6461** to receive guidance and/or medical care. You are asked to report any possible COVID related illnesses/exposures to SHCS via this link [COVID-19 Illness/Exposure Report Form](#). Expect a call from SHCS within 24 hours.

If you become ill or are placed under quarantine during the COVID-19 pandemic, please contact the instructor to discuss how course assignments could be adjusted if necessary.

We at Sac State want you to know that help is available:

"If you are experiencing challenges with food, housing, financial or other unique circumstances that are impacting your education, help is just a phone call or email away! The CARES office provides case management support for any enrolled student. Email the CARES office at cares@csus.edu to speak with a case manager about the resources available to you. Check out the [CARES website](#)."

Campus Resources:

1. Links to campus policies related to student academics (e.g. [Grading policies](#), [Sacramento State Academic calendar](#), [Hornet Honor Code](#), [Student Rights Responsibilities](#)),
2. Links to campus resources (e.g. [Martin Luther King Center](#), [Multicultural Center](#), [Dreamer Resource Center](#), [Student Success Center](#), [Academic Advising](#), [PARC](#), [Reading & Writing Center](#)).