

CHEMISTRY 2315 COURSE SYLLABUS

COURSE

DESCRIPTION:

Chemistry 2315 will introduce all the fundamental organic chemistry laboratory techniques. Emphasis will be on performance and understanding of the theory behind the experimental techniques.

PREREQUISITES:

Chem 2310 is a co-requisite (or prerequisite) for Chem 2315 and Chem 2315 is a prerequisite for 2325. Chem 2315 and 2325 **cannot** be taken simultaneously.

INSTRUCTOR:

Bub Carlson

Office hours: I am normally on campus from 8 – 4 and you are welcome anytime after 9:30. My class schedule is on my door. You can sign up for an appointment on my door or just stop by. TA's also have weekly office hours; see bulletin board and course website for details of TA hours.

Room: 1340 HEB

Phone: please use e-mail

Email: mcarlson@chem.utah.edu

LECTURES:

Sect 001, H 10:45-11:35, HEB 2008
Sect 012, H 3:40-4:30, HEB 2004

(students can attend either lecture section regardless of lab section)

LAB:

Sect 002, F 1 - 5, HEB 4111
Sect 003, M 1 - 5, HEB 4103
Sect 004, H 1 - 5, HEB 4111
Sect 005, W 1 - 5, HEB 4103
Sect 006, H 1 - 5, HEB 4103
Sect 007, F 1 - 5, HEB 4103
Sect 008, M 5:30–9:30, HEB 4103
Sect 009, T 5 – 9, HEB 4103
Sect 010, W 5:30–9:30, HEB 4111
Sect 011, T 1 – 5, HEB 4111

Sect 013, T 5 – 9, HEB 4111
Sect 014, H 5 – 9, HEB 4103
Sect 015, M 1 – 5, HEB 4111
Sect 016, W 1 – 5, HEB 4111
Sect 017, T 1 – 5, HEB 4103
Sect 018, H 5 – 9, HEB 4111
Sect 019, M 5:30–9:30, HEB 4111
Sect 020, W 5:30-9:30, HEB 4103

TEXTS:

Organic Chemistry, Experiments and Techniques

Authors: W.W. Epstein; Jimmy Lee Seidel; Craig S. Young

Published by Hayden-McNeil, ISBN 0-7380-1697-7 (second edition)

Customized Lab Record, or similar bound notebook with carbon copies
Published by Hayden-McNeil, ISBN 1571829792

Lectures for Chemistry 2315 (copies of lecture transparencies),
Bub Carlson (optional, also on course website)

TEACHING ASSISTANTS:

The laboratory teaching assistants have full responsibility and authority in the laboratory. Please respect their authority by being responsible individuals when a request is made.

Get your TA's e-mail address so that you can communicate with him/her in case you miss a lab or an assignment. **The TA's mailboxes are located in HEB 1504.** Be sure to put your TA's name on anything you put in the mailbox because all TAs share mailboxes.

STOCKROOM ATTENDANTS:

The stockroom personnel have full responsibility and authority over laboratory and stockroom policies and procedures. Please respect their authority by being responsible individuals when a request is made.

RESPONSIBILITY: You are responsible for all information and announcements given in class. If you miss a lecture or are late for a lecture be sure to get the information from another student. Please do not call and ask questions about this information.

ATTENDANCE: Attendance is required. You learn by doing, not by the vicarious work of your friends. Because of limited availability of special equipment all students are encouraged to work in pairs on all experiments. It is recommended you switch lab partners frequently. Any student wishing to work alone may do so.

MAKE-UP LABS: Make-up labs are permitted in certain circumstances. If you cannot attend your regular laboratory section for a legitimate reason, it is your responsibility to inform your professor to discuss the situation and get a signed permission form to do the make-up lab. You must pick up the form in HEB 1340; do not send an e-mail to inform your professor you must miss a lab, just get the make-up permission form. Give the permission form to the TA of the lab where the make-up work is to be done, and that TA will certify the work has been done and notify your regular TA. The make-up experiment should preferably be done that same week, or at the very latest the following week. No make-up labs can be done later than one week after the normally scheduled time.

POINT BREAKDOWN:	1) Prelab	8 x 10	80
	2) Lab work/notebook	8 x 40	320
	3) Conclusions	8 x 50	400
	<u>4) Quizzes</u>	<u>8 x 20</u>	<u>160</u>
	TOTAL POINTS POSSIBLE		960

GRADING: You are expected to complete eight labs. If you do not complete at least six labs you will automatically fail the course. Nine labs are scheduled, so if you miss one of the labs without making it up during the semester you can do the final make-up lab to substitute for the missed experiment if you have not already made it up. If you have done the first eight labs you can still choose to do the make-up lab to replace the grade of an earlier experiment.

Everyone who conscientiously does all eight labs with complete write-ups, and eight quizzes (earning a minimum of 50% of total possible quiz points) will receive an A or a B. Missing two or more labs will result in a fail. A missing write-up will be considered equivalent to missing half a lab. Five missing quizzes will be considered equivalent to missing one lab. Persons who fail to do all required work, but complete more than seven labs will receive a C or a D. Persons who do not take all quizzes, do not have a minimum of 50% of total possible quiz points, do not write full and conscientious conclusions, and do not turn in conclusions on time will not be guaranteed a minimum grade of B-.

For those who complete all the required work, you will be graded on a curve of A's and B's. TA's may vary slightly in their grading on quizzes and write-ups, so you will be graded only in comparison to other students in your TA's sections, not in any other TA's section.

Your TA's will be told to show you your point total (and how you are doing relative to the rest of your section) about half way through the semester and at check-out time.

QUIZZES: Quizzes will be given at the end of each lecture covering the experiment done the previous week. Be sure to put your completed quiz in the correct folder for your section or your TA may not receive your quiz. One of the main purposes of the quizzes is to encourage you attend lectures. Under no circumstances may quizzes may be taken early or late! Do not even ask! There will be one make-up quiz given during the last class period over the make-up lab that can be used to replace a missing quiz or to replace the score of a lower quiz. You do not have to

do the make up lab to take the make up quiz.

For the best performance on quizzes it is recommended you always do your lab write-up (or at least a draft of your write-up) before the quiz. Quizzes will emphasize lecture material.

Your quizzes and your write-ups should be returned to you by your TA by the following week so that you can learn from your mistakes. Keys to quizzes will be posted on the bulletin board outside of the labs. If your work is not returned by your TA within two weeks, notify your professor.

CHECK-IN:

Check-in will occur in the first laboratory period. You are required to bring a combination (not key) lock, goggles, and paper towels. Your lock combination number will be left with the attendant for emergencies. Failing to bring a lock after the second lab will automatically prevent you from doing any further lab work.

Many students register for the course and later decide to drop. Lab space is in high demand. Students who do not attend the first day of lab for check-in, or who are not on time will be assumed to be dropping the course and their lab benches will be given to someone else. Students who must miss the first lab for a reasonable excuse can reserve their lab bench by notifying your professor in advance.

If you switch sections, do NOT change your registration with the registrar. Your instructor will change the section you are registered for. Changing sections with the registrar would require getting a permission code.

As part of the check-in you must be sure to sign the locker assignment sheet in the lab (with the correct number for the lab bench you have selected). If you do not sign the locker assignment sheet, then you are not registered for your lab bench and it may be given to other students registering late.

EQUIPMENT:

You are accountable for the equipment in your organic chemistry locker. On the first day of lab, your teaching assistant will assign a locker to you. Make sure to put a combination lock on the locker as you may be penalized for the replacement of missing items later during the quarter.

Located inside your equipment locker is a breakage card listing the entire contents of your locker. At check in, verify all items against the list. If anything is missing, the stockroom attendant will replace the item. During the semester, when you lose or break an item, the stockroom attendant will punch the card next to the item name to indicate that they have replaced the item. At the end of the semester, you may be assessed a grade point penalty based upon any breakage or loss in excess of that amount covered by your special course fee. Be careful with your equipment and do not lose the breakage card.

BREAKAGE:

Your laboratory fee is used primarily to cover the cost of chemicals and materials you use during the semester. It also includes a small component for small items in your drawer that are occasionally broken or lost. It does not cover breakage of special, major equipment that is not part of your equipment locker.

When doing the experiments part of your assignment is to work carefully without breaking equipment, particularly special equipment. If you do break a major piece of equipment during an experiment, you will lose all the points for that experiment (100 points). In most cases the loss of 100 points will cost you one or two grades (i.e., it would lower a grade of A to an A- or a B+). If you were to lose 100 points on three experiments, you would fail to complete the minimum number of required experiments (6) and you would fail the course.

As an alternative to losing 100 points, you may replace the equipment. You may obtain the equipment on your own, or the organic stockroom will replace it for you (at their wholesale cost). You can write a check, payable to the University of Utah Department of Chemistry, and make your payment at the organic stockroom. If you do not replace the equipment or write a check to replace the equipment by the end of the last week of the semester, you will automatically lose 100 points for the experiment in which the equipment was broken.

The costs for breakage of major equipment such as a 125 mL separatory funnel, a condenser, a 500 mL 3-neck rb flask, and a chromatography column are approximately \$65. Be careful when using this special equipment!

CHECK-OUT:

Check-out will occur at the end of the last lab and generally takes about 15 minutes. You are required to clean all your glassware and review the glassware with your TA. Failure to check out will result in your grade being lowered one level (e.g., an A- to a B+).

NOTEBOOK:

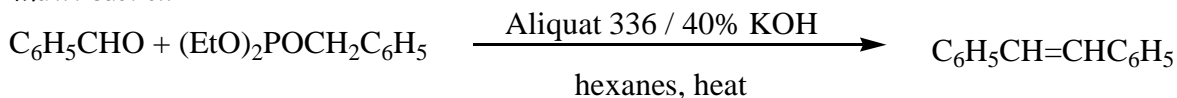
The purpose of a laboratory notebook is to record all pertinent information about a laboratory procedure while the procedure is being done; this promotes the accurate communication of the procedure to the scientific community and/or any other interested party.

You are required to purchase the "Customized Lab Record" from the bookstore. This is a carbonless, duplicate set laboratory notebook that will allow you to give one copy of your notebook entry to the teaching assistant. You are required to get the signature of your TA on the bottom of the last page before leaving the lab for the day. You must follow the format presented below for your notebook entry. It is recommended you use the left side of the page for outlining procedures and the right side for observations. Read section 1.2 in your Techniques manual (the second half of the lab manual) for more information, including guidance in common calculations. You will submit notebook entries together with the discussion written at home a week after performing the experiment.

SAMPLE NOTEBOOK ENTRY:

A. Experiment #6: The Synthesis of Stilbene Using a Phase-Transfer Wittig Reaction

B. Main Reaction:



C. Physical Data (from: CRC Handbook 52nd Edition; Aldrich Catalog, 1988-1989):

	<u>PhCHO</u>	<u>(EtO)₂-POCH₂Ph</u>	<u>Aliquat 336</u>	<u>PhCH=CHPh</u>
molecular wt.	106.12	196.1	501.5	180.25
density	1.044	1.095	0.884	
b.p. (°C)	178.1	106.108 ^{1 torr}		305 ^{720 torr}
m.p. (°C)				124.5-124.8
ml used	0.25	0.55	0.25	
wt. used (g)	0.26	0.60	0.22	
mmol used	2.45 (limiting)	3.05 (excess)	0.44 (catalyst)	

D. Brief Procedure Outline:

Assemble a reflux apparatus with a 10 mL rb flask.

Add 0.25 mL Aliquat 336, 0.25 mL benzaldehyde,

0.55 mL diethylbenzylphosphonate, 2 mL

hexanes, 2 mL 40% KOH.

Reflux 1.5 hr.

Cool 10 min, place in ice bath 10 min.

Remove the lower layer.

Collect crystals by suction filtration.

Wash crystals; cold water x 2, cold ethanol x 2.

Recrystallize from 3 mL ethanol and collect crystals.

Take mp and determine yield.

E. Actual Procedure & Observations: (Brief procedure does not need to be repeated, just write actual procedure and observations on right side of page.)

Assemble a reflux apparatus with a 10 mL rb flask.

Add 0.25 mL Aliquat 336, 0.25 mL benzaldehyde,

0.55 mL diethylbenzylphosphonate, 2 mL

hexanes, 2 mL 40% KOH.

Reflux 1.5 hr.

Cool 10 min, place in ice bath 10 min.

Remove the lower layer.

Collect crystals by suction filtration.

Wash crystals; cold water x 2, cold EtOH x 2.

Recrystallize from 3 mL ethanol and collect crystals.

Take mp and determine yield.

Empty thermowell of sand, start magnetic stirrer, refill thermowell with sand.

Add hexanes first—Aliquat 336 very viscous.

Clean pipet (acetone, air) after each reagent.

Wrap pipet with Parafilm so bulb fits.

During reflux colorless reaction mixture turned

A bright pink color.

Cooling stops reaction. Crystals form.

Use Pasteur pipet to remove lower (aq) layer.

Use Hirsch funnel.

Use 1 mL each cold water, cold EtOH.

Needed about 4 mL hot EtOH to completely dissolve solid. Cool in ice bath. Crystals were white platelets.

Dry in oven for 10 min at 100° C.

Mp was 124.4-126.6°C. Yield was 0.21 g.

Actual: $\frac{0.21 \text{ g}}{180.25 \text{ g mol}^{-1}}$

Theoretical: $0.25 \text{ mL} \times 1.095 \text{ g mL}^{-1} / 106.12 \text{ g mol}^{-1}$

$= \frac{1.17 \text{ mmol}}{2.58 \text{ mmol}} \times 100 = 45 \% \text{ yield}$

NOTEBOOK:

1. Leave the first two pages of your notebook blank and make a table of contents.
2. Items A – D constitute the prelab. The pre-lab should be done before you come to the lab and will be graded by the T.A. Item E is to be done during the lab and F is to be done at home following the lab.) See sample notebook entry after this section.
 - A. **Title.**
 - B. **Equations** (for labs 6 - 8) **or molecular structures.**
 - C. **Physical data for all reactants used and products produced and solvents** (with literature reference cited) with appropriate precautions (when using dangerous chemicals such as sulfuric acid). There are no physical constants for lab 1.
 - D. **Brief procedure outline.** Summarize the procedure, writing a sequence of well-defined steps that you are going to perform. Make sure that each step is described briefly so that you can easily read and follow it during the lab work. Avoid copying the text of the manual word for word. Write this outline on the left side of your notebook page.
 - E. **Actual procedure and observations (data sheets).** Include comments about what occurs during the experiment, like color changes, gas evolution, precipitates, etc. Make sure to write in such a manner that a person who would like to reproduce the experiment that you did can do so without getting verbal instructions from you and can then get identical results to yours. Be sure to write during the lab as you perform the experiment. Also include things that occurred that were not planned and which may or may not influence your results. Note that authentic description of the actual procedure sometimes demands recording the time. Write these observations on the right side of your notebook page.
 - F. **Discussion and Conclusion.** Explain your results and observations as well as any unexplained aspects of your experiment. Indicate if the goals were achieved. If they were not, do an error analysis.
3. At the end of lab, you will tear out the carbon copy of your completed, signed notebook entry and hand it in to your T.A. before leaving.

The notebook entry is not to be a regurgitation of printed material, but a brief account of what you really did. In your conclusion, tie together the purpose with the results and offer explanations for low yield, etc.

PRE-LAB:

It is important that you have read the laboratory experiment in advance and are prepared to begin work. It is your responsibility to read the experimental procedure and background information until you understand the details of the experiment. To assure your advance preparation you are required to submit a prelab sheet within the first 10 minutes of the lab or else no credit will be given for the prelab. This prelab will include sections A-D of the notebook record (see below). You may start work only after your TA has signed the prelab. No work is permitted without writing a prelab.

PHYSICAL
CONSTANTS:

Physical constants can be found in appendix 1 and 2 of your lab manual. They are also available at chemfinder.com on the web and in hard copies of the *Merck Index* and the Chemical Rubber Company *Handbook of Chemistry and Physics* in the Science Reserve desk on the fourth floor of the Marriott Library. To find the electronic edition of the *CRC* go to <http://www.lib.utah.edu> → research tools → article databases → C (or same route for the electronic edition of the Merck).

LAB WORK:

Record your observations on the right side of your notebook opposite the procedure you recorded for the pre-lab. Your lab work will be worth 40 points. Poor quality lab work and low yields cause a reduction of points awarded, especially for students who repeatedly achieve poor results.

CONCLUSIONS:

Your conclusions, including answers to any questions or topics your TA assigns will be collected at the beginning of the next scheduled lab period. Conclusions 1 - 7 days overdue will be lowered 7 points for each day they are late. **Conclusions more than 7 days overdue will not be accepted.** Conclusions for the make-up lab are due in your TA's mailbox (HEB 1504) one week after you complete the make-up lab.

Conclusions must be written individually, even if the experiment is done with a lab partner.

The conclusions/final write-ups for the experiments should be sufficiently concise so as to not exceed two pages, and it is doubtful you can do an adequate job in much less than two pages. They should be done on computer, double-spaced. A sample write-up is found on the web page.

The content of the conclusion will vary a lot depending on the type of experiment done. During the first part of the semester the primary emphasis will be on introduction of techniques and equipment, while during the last two weeks of the semester you will be conducting chemical reactions. In either case **your conclusion should not include procedure.** It should concentrate on "why" and not "what". Your conclusion should be scientific and objective, and should not include any personal pronouns. Be sure to organize your conclusion.

If the experiment introduces new techniques and equipment, such as TLC or fractional distillation, you should first discuss your experimental results and then the techniques. In TLC, for example, explain the logic behind how you decided the contents of your analgesics and determined your unknown, or explain how effective fractional distillation was in separating your two liquids. You need to provide or summarize important results (include TLC plates, distillation tables, etc). You also need to explain the important concepts behind the technique and equipment you were using; what is its purpose and what is the theory behind its operation. Explain **why** TLC or fractional distillation was able to separate compounds effectively.

If the experiment involves a chemical reaction, you should begin by restating the chemical reaction and give its mechanism. The mechanism should never exceed ½ page. Explain **why** you did certain important things in the reaction procedure (why was a catalyst or a reflux necessary, why was it necessary to have anhydrous conditions, why was an extraction or recrystallization or cooling necessary, etc). What did some of your observations indicate about the reactions that were occurring? How were impurities, by-products, and unreacted starting materials removed during the work-up?

Give your percent yield and show how you did your calculation (indicating limiting reagent). Compare your melting point range with the literature value (and include a reference). Discuss the quantity and purity of your product, and do an error analysis on your results if you had problems. Explain the possible sources of a low yield or impurities and what you would do differently if you were to repeat the experiment.

You should emphasize concepts in your write-up that were emphasized in the lab lecture. Your TA may also give you an indication of important concepts that you should include in your write-up.

If you use a reference for your conclusion, be sure to indicate it. Plagiarism in the conclusion is unethical and will result in a failure on the entire write-up.

For best results on quizzes it is recommended you always do your write-up (or at least a draft of your write-up) before the quiz. Flow sheets (experiments 7 on) will be particularly helpful in your write-ups.

If you have difficulty writing coherent conclusions, you can go to the University Writing Center for help. They are located on the third floor of the Marriott Library. Their phone number is 587-9122 and their website is www.writingcenter.utah.edu/. If your conclusions are poorly written your TA will not accept them.

DISABILITIES:

Any student needing special consideration because of a disability should contact the Center for Disability Services, 162 Union. It is recommended that any student who is pregnant delay taking organic laboratory courses until the pregnancy is complete.

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations.

All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

LAB SCHEDULE FOR CHEMISTRY 2315

Chem 2315 Online: webCT.utah.edu

Organic Chemistry Laboratory Fall, 2006

Week Beginning	Lecture Topics (H)	Laboratory (M-F)
August 8/23	Introduction	No Lab
8/28	No Lecture	Check-In
September 9/4 (Labor Day)	Lab #1	No Lab
9/11	Lab #2	Lab #1 – Thin Layer Chromatography
9/18	Lab #3 Quiz over Lab #1	Lab #2 – Fractional Distillation
9/25	Lab #4 Quiz over Lab #2	Lab #3 – Column Isolation of Plant Pigments
October 10/2 (Fall Break)	No lecture	No Lab
10/9	Lab #5 Quiz over Lab #3	Lab #4 – Steam Distillation (bring orange)
10/16	Lab #6 Quiz over Lab #4	Lab #5 – Preparation of an Ether by Nucleophilic Substitution
10/23	Lab #7 Quiz over Lab #5	Lab #6 – Dehydration of Cyclohexanol
10/30	Lab #8 Quiz over Lab #6	Lab #7 – Borohydride Reduction
November 11/6	Make-Up Lab Quiz over Lab #7	Lab #8 – Diels-Alder Reaction
11/13	Quiz over Lab #8 Quiz over make-up lab	Make-up Lab – Electrophilic Addition & Purification of Cholesterol (optional), Check-Out (required)
11/20 (Thanksgiving)	No lecture	No lab Make-up lab write up due
11/27	No lecture	No lab