CHEM 346

Intermediate Organic Chemistry Laboratory

1- or 2-credits

Fall 2019

Chapter 1 Fall 2019 General Course Information and Policies

Course contacts and schedule

Instructors	Dr. Nicholas Hill	Kate Nicastri	Matthew Genzink
Role	Primary Instructor	Teaching Assistant	Teaching Assistant
Email	hill@chem.wisc.edu	knicastri@wisc.edu	genzink@wisc.edu
Office Hours	Mon 2:25 pm Wed 11:50 am	Thu 8:50 am	Tue 8:50 am
Office	B330a Chemistry	B317 Organic TA office	B317 Organic TA office

Course Designations and Attributes
Advanced level; physical science breadth; counts as L&S credit

Course Requisites
Completion of CHEM 344 and CHEM 345

Official Course Description
Multi-step synthetic processes. Advanced experimental techniques such as high-vacuum distillation. Independent research projects.

Additional Information
CHEM 346 introduces advanced chemical reactions and techniques for the synthesis, purification, and characterization of molecules, along with critical interpretation of experimental data. The course will provide students with opportunities to learn the practice and theory of contemporary organic chemistry via effective pedagogical and assessment techniques. Students will perform modern organic chemical reactions in a safe manner, collect data using modern instrumentation, analyze those data using current physical organic chemistry concepts, and explain their reasoning in written and visual format. The course includes material from CHEM 344 and CHEM 345.

Canvas Course URL
https://canvas.wisc.edu/courses/153307

Course Meeting Times and Locations
Tue & Thu: 1:00 – 5:25 pm, Room 8335 and Laboratory B331, Chemistry Building

Instructional Mode
Instruction is primarily face-to-face in the classroom and lab, with some online components.

Required Materials
CHEM 346 lab manual (files posted on Canvas, paper copy distributed)
Laboratory notebook
Laboratory coat, protective goggles
ChemDraw, MestReNova and Filezilla software (free downloads via Canvas)

Recommended Material
Organic Chemistry, Marc Loudon and David Parise 6th Ed. Roberts & Co.

Tentative Laboratory Schedule*	**Date**
Project 0: Suzuki-Miyaura coupling	Thu Sept 5
Project 1: Natural product synthesis	Tue Sept 10 – Tue Sept 24
Project 2: Synthesis of a bulky phosphine ligand	Tue Oct 1 – Thu Oct 10
Project 3: Pd-catalyzed amination	Tue Oct 15 – Thu Oct 17
Independent project (students enrolled for 2 credits)[†]	Tue Oct 29[‡] – Thu Dec 6

Tentative Group Activities Schedule*	
NMR spectrometer training	Thu Sept 5 & Tue Sept 10
Scientific communication session 1	Thu Sept 12
Scientific communication session 2	Tue Sept 24
Scientific ethics discussion	Thu Oct 3
[†]Oral presentations	Tue Nov 19 and Thu Nov 21
[†]Poster session	Tue Dec 10

Tentative Deadlines*	
Project 0 (Experimental, WebMO, and spectra)	Wed Sept 11
Writing assignment	Wed Sept 18
Project 1 Draft for instructor comments	Fri Sept 27
Project 1 Final submission	Wed Oct 2
Project 2 Draft for instructor and peer comments	Wed Oct 16
Project 2 Final submission	Wed Oct 23
Project 3 Draft for peer comments	Wed Oct 30
Project 3 Final report	Wed Nov 6
Poster abstract	Fri Dec 6
Poster (due 9:00 am)	Mon Dec 9

* Changes in the course schedule and associated deadlines for submission of work may occur for various reasons. All changes in the course schedule and/or deadlines will be announced verbally and via email/Piazza as soon as they become apparent.

[†] Students enrolled for 2 credits.

[‡] Project period may begin before this date – see calendar on next pages.

Fall 2019 Tentative Course Schedule*

September

Tuesday	*Thursday*
	5 **Classroom** Course introduction **Lab** Project 0 Practice reaction Suzuki NMR training groups 1-4
10 **Classroom** Project 1 overview **Lab** Start Project 1 Natural product NMR training groups 5-6	**12** **Classroom** Scientific communication 1 **Lab** Project 1 Natural product
17 **Classroom** Chemical database searching session **Lab** Project 1 Natural product	**19** **Classroom** Project 2 overview **Lab** Project 1 Natural product
24 **Classroom** Scientific communication 2 **Lab** Project 1 Natural product	**26** **Classroom** TBA **Lab** TBA

*Changes in the course schedule and associated deadlines for submission of graded work may occur for various reasons. All changes in the course schedule and/or deadlines will be announced verbally and via email/Piazza as soon as they become apparent.

Fall 2019 Tentative Course Schedule continued

October

Tuesday	*Thursday*
1 **Classroom** **Lab** Project 3 Ligand synthesis	**3** **Classroom** Scientific ethics discussion **Lab** Project 3 Ligand synthesis
8 **Classroom** **Lab** Project 3 Ligand synthesis	**10** **Classroom** **Lab** Project 3 Ligand synthesis
15 **Classroom** Project 4 Overview **Lab** Project 4 Pd-cat amination	**17** **Classroom** **Lab** Project 5 Day 2 Pd-cat amination
22 Possible extension of classroom/lab Possible start of project period	**24** Possible extension of classroom/lab Possible start of project period
29 **Project HARD START DATE**	**31** **Project**

November

Tuesday	*Thursday*
5 **Project**	**7** **Project**
12 **Project**	**14** **Project**
19 **Oral presentation groups 1-9**	**21** **Oral presentation groups 10-18**
26 **Project**	**28** **Thanksgiving**

December

Tuesday	*Thursday*
3 **Project**	**5** **Project**
10 **Poster Session**	**12**

Learning Outcomes

CHEM 346 is a laboratory-based course focusing upon contemporary topics and techniques in synthetic organic chemistry. A major goal of the course is to increase your competence and confidence in performing the basic procedures required to synthesize, separate, purify, and characterize organic compounds. In addition, you will learn non-laboratory transferable skills. For example, you will receive instruction in searching the chemical literature, using ChemDraw, and operating an NMR spectrometer. Essentially, it is a practical course in which we aim to assist you in making the transition from an introductory undergraduate laboratory course to an authentic laboratory research environment.

You will undertake a series of group-based, multi-session projects during the first half of the course. Even though you will be working in groups, you must be practically and intellectually engaged in all experimental procedures. Each member of the group will submit his/her own lab report for each project.

Upon completing CHEM 346:

Students will understand the role of spectroscopy and spectrometry in molecular structure elucidation, and be able to use spectral data to analyze pure samples and mixtures.

Students will understand and be able to use research-level apparatus, glassware, and techniques in a safe manner for the multi-step synthesis, isolation, and purification of organic molecules.

Students will be able to use computational chemistry to support analysis of experimental data, and to predict and rationalize experimental outcomes.

Students will be able to use the electronic and molecular structures of organic molecules, molecular orbitals, potential energy surfaces, and electron-pushing reaction mechanisms to predict, describe, and rationalize chemical reactivity.

Students will be able to use a research-level NMR spectrometer to obtain experimental data.

Students will be able to use experimental data to rationalize the outcomes of chemical reactions.

Students will be able to use electronic databases to search the chemical literature and to locate information regarding the safe handling, storage, and disposal of chemicals.

Students will be able to use various software packages to construct accurate visual representations of chemical reactions, to process NMR data, and to write laboratory reports.

Students enrolled for 2-credits will be able to plan and undertake a short-term independent research project, and communicate the results of the project via written, visual, and verbal presentations.

Communications B Learning Outcomes

In addition to the specific chemistry content, the course includes opportunities to improve your communication skills in the context of the UW-Madison Communication B ("Comm B") requirements. For example, the course includes discussion sessions on scientific communication, ethics, and peer review.

CHEM 346 is a "writing intensive" course. Students enrolled for 2 credits will fulfill the Comm B requirement. In Comm B courses, students learn information and skills appropriate to the course topic and discipline. Students also learn specific skills associated with effective communication. As the course progresses, you will develop skills enabling you to:

a) identify and make skillful use of relevant, reliable, and high quality research sources appropriate to modern chemical research;

b) make productive use of the writing process, including brainstorming, outlining, drafting, incorporating feedback, and revising, to develop a fledgling idea into a formal paper, presentation, and/or project;

c) produce formal written and oral presentations that are clear, persuasive, well-organized, and polished;

d) make proper use of expressive conventions and protocols (e.g. organization, content, presentation, formatting, and style) appropriate to the genres of communications relevant to synthetic chemistry.

A requirement of the Comm B designation for this course is that each student meets with a TA or instructor at some point during the semester to discuss their writing.

Credit Hour Accounting

Section 001/301 of CHEM 346 is for one credit and section 002/302 is for two credits. The University defines one credit as the learning that takes place in *at least* 45 hours of learning activities, which include time in lectures or class meetings, in person or online, labs, exams, presentations, tutorials, reading, writing, studying, preparation for any of these activities, and any other learning activities. Learning in this course is spread across multiple platforms, and thus the numbers provided below are supplied only as a good faith estimate of the time required.

Section 001/301 meets for 4.5 hours of discussion and lab twice per week for the first ~7.5 weeks of the semester. Students are expected to engage in ~45 to 60 hours of course learning activities, which includes class attendance, preparation, reading, and writing lab reports and other assignments.

Section 002/302 meets for 4.5 hours of discussion and lab twice per week for the entire semester. Students are expected to engage in 90-120 hours of course learning activities during the semester, which includes class attendance, preparation, reading, writing lab reports and other assignments, engaging in a research project, and designing and presenting a poster.

Preparation for lab

Your success in the laboratory is dependent upon your understanding of the experimental procedure and the chemical logic that governs it. The level of your understanding, in turn, depends on your commitment to effective preparation for each laboratory session. You are expected to read the assigned material, and understand the chemistry taking place and the purpose of each step in the procedure prior to each laboratory session. In addition, you must attend each laboratory session fully aware of the hazards, requirements, and goals associated with the procedure(s) to be performed that day.

Grading

The course is graded according to evaluation of various items of written work and, for students enrolled for 2-credits, an oral presentation and a research poster presentation. Grades are based entirely upon achievement in each assessment unit (shown below).

Assessment Unit	1-credit total	2-credit total
Project 0	45	45
Writing assignment	40	40
Project 1 (draft + final report)	100 (50 + 50)	100 (50 + 50)
Project 2 (draft + final report)	100 (50 + 50)	100 (50 + 50)
Project 3 (final report)	50	50
Peer review of draft reports 2 & 3	40 (20 + 20)	40 (20 + 20)
Oral presentation	-	50
Poster abstract	-	50
Poster presentation	-	100
Total points	**385**	**585**

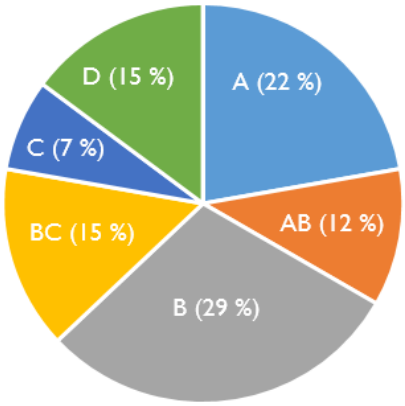
The following items will **not** be taken into consideration when determining grades.

- Effort and/or time spent on coursework or in the lab
- Attitude toward organic chemistry
- Participation in group discussion, office hours, or on Piazza
- Needing a certain letter grade for a scholarship, job, graduate school admission etc.

The final letter grade is not based upon total course points. Instead, the grade is based upon a normalized score (*z-score*) which can be compared to all students in the course. Your normalized score on any item of work can be calculated via the equation below:

$$Normalized\ Score = \frac{Your\ Score - Average\ Score}{Section\ Standard\ Deviation}$$

The average, high and low scores and the standard deviation will be reported for each item of graded work. The overall GPA of the course will be approx. 3.10. The final grade distribution will resemble the pie chart below, derived from GPAs during the last ~5 years of the course.



Submission of work for grading
All items for graded will be submitted in electronic format via email to the chem346@chem.wisc.edu account. Printed work will not be accepted. The email containing all electronic files must be received in the chem346@chem.wisc.edu email account no later than stared deadline. The tentative schedule and deadlines for submission of work are shown on pages 1-4 through 1-6. Material submitted after the deadline will be considered late and graded according to the policy outlined below.

Late work
Work submitted for grading up to 24 hours after the submission deadline will receive a maximum of 50% of the total points available (*i.e.* the assignment will be graded and the points you earn multiplied by 0.5). Work submitted for grading >24 hours late will not be graded for credit (*i.e.* you will receive 0 pts for the work). This policy applies to submission of all graded material in the course. Draft reports submitted after the deadline will not receive instructor and/or peer review. Late submission of peer review comments will result in no credit being awarded for the review. **It is your responsibility to be aware of all deadlines for submission of work.**

Absence Policy
You are expected to attend each course session for its entirety. You may, however, need to miss a session. All CHEM 346 students are granted a single excused absence (EA). The EA can be used if you need to miss a course session (but it cannot be used on the day of the poster session). Lab sessions cannot be rescheduled, and no make-up lab sessions are available. The EA submission form is posted on the course Canvas page.

Most of the lab work in this course is conducted in pairs or groups, and it is vital that you contribute to the group work dynamic. Accordingly, unauthorized absences from the discussion and/or lab sessions will result in a 20 point/day penalty for the lab report associated with the absences. **It is your responsibility to understand and follow the course absence policy.**

Research projects (2-credits only)
A small number of students will have the opportunity to perform a short-term research project in the laboratories of chemistry department faculty members. Students who are not placed in a faculty laboratory will select a project to be carried out in the CHEM 346 laboratory.

All students enrolled for 2 credits will prepare a two-page abstract describing their independent research project and present their research at a poster session to be held during the final week of the course. Further details of the project assignments, abstract, and the poster session will be provided as the semester proceeds.

Accommodations for Students with Disabilities
The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life.

Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform course instructors of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. The course instructors will work either directly with you and/or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.

http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php

Academic Integrity
All work submitted by a student for grading in CHEM 346 is required to be the product of that student alone. This will be assumed to be the case unless the work is clearly labeled otherwise. All laboratory reports are submitted individually; there are no group lab reports.

In the laboratory, this means that all work is performed by the student and the data obtained are recorded directly into the lab notebook during the lab session. All data recorded must pertain to actual measurements and observations made by the student on their own experiment (even when working in groups).

Calculations, interpretation of data, and assignment of NMR, GC-MS, IR, WebMO, or any other form of data, and all other items submitted for grading must be the original work of each individual student (even when working in groups).

Submission of work copied directly from any another student (including a lab partner), the lab report of a previous student, a textbook, web-site, journal article, or any other source without citation or reference is considered to be plagiarism and will be handled according to University guidelines for academic misconduct. Possession of another student's work (graded or ungraded) is considered academic misconduct. Enabling any of the above actions is also considered to be academic misconduct and will be dealt with according to University guidelines.

Information on academic misconduct is available from the Office of the Dean of Students.

http://students.wisc.edu/doso/acadintegrity.html

It is your responsibility to understand the definition, scope, and consequences of academic misconduct.

CHEM 346 Student Information

The disclosure of all requested information is voluntary

Name: Preferred name:

Declared major/minor:

I am enrolled in CHEM 346 for: 1 credit 2 credits (circle one)

I am currently a: Junior Senior Other (circle one)

I am currently enrolled in pchem lab: Yes No (circle one)

I have taken CHEM 311: Yes No (circle one)

Expected graduation year and semester:

What are your learning goals for this course?

Post-graduation plans (graduate school/professional school/job/etc.):

Are you currently in a science research lab at UW? If so, please name the group and department.