

CHEM 344

**Introductory Organic
Chemistry Laboratory**

2-credits

Laboratory Manual

Spring 2018

University of Wisconsin-Madison

Course Instructors

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Office hours: Mon 2:00 pm, Tue 10:00 am
Other times available by appointment

Office hours: Tue 3:30 pm, Thu 2:30 pm

Teaching Assistants

Names, contact information, and office hours of course teaching assistants are not available prior to the printing deadline for this laboratory manual. Your section TA will provide this information during the first meeting of the course.

Course Website

<https://www.chem.wisc.edu/content/chemistry-344>

<https://canvas.wisc.edu/courses/76083>

Course Description and Mission Statement

Chemistry 344: Introductory Organic Chemistry Laboratory introduces the basic synthesis, purification, and characterization techniques of organic chemistry, along with critical interpretation of experimental and theoretical data. The course is primarily face-to-face in the classroom and laboratory, with some online components. The laboratory includes material from both Chemistry 343 and 345.

(Intermediate level; physical science breadth; counts as L&S credit)

Chemistry 344 will provide students with opportunities to learn organic chemistry theory and practice via effective pedagogical and assessment techniques. Students will perform organic chemical reactions in a safe manner, collect authentic data using state of the art instrumentation, analyze those data using modern physical organic chemistry, and explain their reasoning in written format.

Course Requisites

Completion of or concurrent enrollment in CHEM 345. May not repeat CHEM 344 if previously earned credit for CHEM 344. This is the official requisite that should be used in the syllabus. The C or better in CHEM 343 is implied, because students can't enroll in CHEM 345 without this. There is no requisite of a C or better in CHEM 345, since we permit concurrent enrollment.

Course Meeting times

Mon & Wed: 07:45-11:50 am, 1:20 – 5:25 pm, or 5:40 – 9:45 pm

Tue & Thu: 07:45-11:50 am, 1:20 – 5:25 pm, or 5:40 – 9:45 pm

The course meets in various classrooms and laboratories in the chemistry department. Consult your individual schedule for details on the location of your course section.

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Spring 2018 CHEM 344 Lab Schedule

Date	Monday	Tuesday	Wednesday	Thursday
Jan	22 No Class	No Class	Spectroscopy I	Spectroscopy I
	29 Spectroscopy II	Spectroscopy II	Spectroscopy III	Spectroscopy III
Feb	5 WebMO I	WebMO I	WebMO II	WebMO II
	12 Spec/WebMO Exam	Spec/WebMO Exam	Extraction I	Extraction I
	19 Extraction II	Extraction II	Bleach Oxidation	Bleach Oxidation
	26 Aerobic oxidation	Aerobic oxidation	Quiz 1 - Extract./ox.	Quiz 1 - extract./ox.
Mar	5 S _N 1	S _N 1	E1	E1
	12 E2	E2	Review	Review
	19 Midterm Exam	Midterm Exam	S _N Ar	S _N Ar
	26 No Class	No Class	No Class	No Class
Apr	2 EAS Nitration	EAS Nitration	Benzoin Reduction	Benzoin Reduction
	9 Quiz 2 - S_NAr/EAS	Quiz 2 - S_NAr/EAS	Benzoin Acetal	Benzoin Acetal
	16 Wittig	Wittig	Review	Review
	23 Grignard	Grignard	Review	Review
	30 Quiz 3 - carbonyl	Quiz 3 - carbonyl	Review	Review
May	7 No Class	No Class	Final Exam	No Class

Review – no laboratory work scheduled. Your TA will be available to answer questions, review the course, *etc.* Lab reports may be due and quizzes will be scheduled on review days (see lab report hand-in schedule).

Final exam: Wednesday May 9, 10:05 AM – 12:05 PM, Location(s) TBD

Alternate final exam: Monday May 7, 10:05 AM – 12:05 PM, Location TBD

The alternate final exam is available only to students who have 3 or more exams in a 24 h period. Details will be communicated after Spring break.

Chemistry 344 Learning Outcomes

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

Students will understand and be proficient in the safe use of basic apparatus, glassware, and techniques for the synthesis, isolation, and purification of organic molecules.

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

Students will be able to use the electronic and molecular structure of organic molecules to predict and rationalize chemical reactivity.

Students will be able to use molecular orbitals, potential energy surfaces, and electron-pushing reaction mechanisms to describe chemical reactivity with an emphasis on the reactions of alcohols, alkyl halides, aromatic compounds, and carbonyl-containing compounds.

Chemistry 344 (2 credits) Credit Hour Accounting

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 Chemistry 344 is spread across multiple platforms and the numbers provided below are a good-faith estimate of the time required. The exact hours will depend upon the individual student.

<u>Activity</u>	<u>Time in class (hr)</u>	<u>Time out of class (hr)</u>	
Spectroscopy 1 - 3	9	1	
WebMO 1 & 2	8	2	
Extraction 1 & 2	5.5	3	
Bleach Oxidation	3.5	3	
Aerobic Oxidation	2.5	3	
S _N 1	1.5	3	
E1/E2	5	5	
S _N Ar	2.5	3	
EAS	2.5	3	
Benzoin 1 - 2	6	3	
Wittig	2.5	3	
Grignard	3	3	
Review Days (4)	4		
Quizzes 1-3	1.5	3	
Exam 1	2	3	
Exam 2	2	3	
Final Exam	2	3	
Total	63	45	108

Course Communication

Email, office hours, and Piazza are the primary modes of communication in CHEM 344. This is a demanding course and you will require assistance from your instructors to have success and gain the most from the experience. For any and all logistical, registration, and excused absence-related issues it is acceptable to contact your instructors via email. Please always send a single email to Dr. Nick Hill (hill@chem.wisc.edu), Dr. Brian Esselman (brian.esselman@wisc.edu), and your TA. Please use “CHEM 344” in the subject line. For all other course content-related communications, students must use Piazza (see the course Canvas page for details).

Piazza Communication or Office Hours	Email Communication
Help with pre- or post-lab questions	Registration, scheduling, or enrollment
General organic chemistry background questions	Excused absence
Course schedule	Individual course-related issues
Quiz or exam content	McBurney VISA accommodations ^a
Issues involving retrieving/solving spectra	Health-related accommodations ^b
Issues accessing/using course software	
Questions regarding Academic Integrity issues	

McBurney VISA Accommodations

If you have a McBurney VISA, please email it to Dr. Nick Hill (hill@chem.wisc.edu), Dr. Brian Esselman (brian.esselman@wisc.edu), and your TA as an attached pdf. You are welcome to arrange a follow-up meeting if you so desire. This will allow us to more effectively and efficiently accommodate your needs. Please do this as close to the start of the semester as possible. Accommodations for exams and quizzes will be coordinated with the chemistry undergraduate office.

Health-related Accommodations

If you have health-related issues (such as severe allergies, pregnancy, respiratory illnesses, etc.) that may impact your participation in the lab course, please contact Dr. Nick Hill (hill@chem.wisc.edu) and Dr. Brian Esselman (brian.esselman@wisc.edu) to arrange a meeting. Please contact us as soon as possible prior to the start of lab work.

McBurney Disability Resource Center syllabus statement

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 the course instructors and their TA 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. Instructors and TAs will work either directly with you 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>

Institutional statement on diversity:

Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.

<https://diversity.wisc.edu/>

Spring 2018 CHEM 344 Lab Report Submission Schedule

Date	Monday	Tuesday	Wednesday	Thursday
Jan	22 No Class	No Class		
	29			
Feb	5			
	12 Spec/WebMO Exam	Spec/WebMO Exam	WebMO	WebMO
	19			
	26 Extraction	Extraction	Bleach Oxidation	Bleach Oxidation
Mar	5 Cu/TEMPO	Cu/TEMPO	Quiz 1 - extract./ox.	Quiz 1 - extract./ox.
	12 S _N 1	S _N 1		
	19 E1/E2 at Midterm	E1/E2 at Midterm		
	26 No Class	No Class	No Class	No Class
Apr	2		S _N Ar	S _N Ar
	9 EAS Nitration at Quiz 2 – S _N Ar/EAS	EAS Nitration at Quiz 2 – S _N Ar/EAS		
	16		Benzoin Red/Acetal	Benzoin Red/Acetal
	23 Wittig	Wittig		
	30 Grignard at Quiz 3 - carbonyl	Grignard at Quiz 3 - carbonyl		
May	7 No Class	No Class	Final Exam	No Class

Lab reports must be handed to your TA at the start of the discussion session.

Work submitted after the submission deadline will be considered late and graded according to the late work policy (see page xiv).

Spring 2018 CHEM 344 Lab Report Return Schedule

Date	Monday	Tuesday	Wednesday	Thursday
Jan	22 No Class	No Class		
	29			
Feb	5			
	12 Spec/WebMO Exam	Spec/WebMO Exam	WebMO	WebMO
	19			
	26 Extraction	Extraction		
Mar	5		Bleach Oxidation	Bleach Oxidation
	12 Cu/TEMPO & Quiz 1 - extract./ox	Cu/TEMPO & Quiz 1 - extract./ox.		
	19 S _N 1	S _N 1		
	26 No Class	No Class	No Class	No Class
Apr	2 E1/E2	E1/E2		
	9		S _N Ar & Quiz 2 – S _N Ar/EAS	S _N Ar & Quiz 2 – S _N Ar/EAS
	16 EAS Nitration	EAS Nitration		
	23		Benzoin Red/Acetal	Benzoin Red/Acetal
	30 Wittig	Wittig	Grignard	Grignard
May	7 Grignard & Quiz 3 – carbonyl via TA mailbox	Grignard & Quiz 3 – carbonyl via TA mailbox	Final Exam	No Class

Spring 2018 CHEM 344 Exam and Quiz Schedule

Spectroscopy and WebMO Exam

February 12th and 13th (Location(s) TBD, 7:45 am, 1:20 pm, and 5:45 pm, 120 min)

GC-MS/IR/¹H-NMR/¹³C-NMR & WebMO 75 pts

Quiz 1

February 28th and March 1st (Location(s) TBD, 7:45 am, 1:20 pm, and 5:45 pm, 30 min)

Extraction, Oxidation/TLC, Cu/TEMPO aerobic oxidation 25 pts

Midterm Exam

March 19th and 20th (Location(s) TBD, 7:45 am, 1:20 pm, and 5:45 pm, 120 min)

Cumulative up to and including E1/E2 100 pts

Quiz 2

April 9th and 10th (Location(s) TBD, 7:45 am, 1:20 pm, and 5:45 pm, 30 min)

Electrophilic and nucleophilic aromatic substitution 25 pts

Quiz 3

April 30th and May 1st (Location(s) TBD, 7:45 am, 1:20 pm, and 5:45 pm, 30 min)

Carbonyl chemistry 25 pts

Final exam

Wednesday, May 9th (10:05 am, Location(s) TBD, 120 min)

Cumulative for entire course 100 pts

Exams are written by Dr. Esselman and Dr. Hill with input from the course TAs.

Quizzes are written by the course TAs with input from Dr. Esselman and Dr. Hill. The quizzes focus upon the topics listed above, but may also include material covered earlier in the semester.

Grades and Grading Philosophy

Experiments

Experiment	Report Points	Results Points	Total Points
Chapter 3 Extraction	15	40	55
Chapter 4 WebMO	0	50	50
Chapter 5 S _N 1	15	25	40
Chapter 6 E1 & E2	15	40	55
Chapter 7 Oxidation & TLC	15	25	40
Chapter 9 Wittig	10	35	45
Chapter 10 Reduction of Benzoin	15	35	50
Chapter 11 EAS Nitration	10	45	55
Chapter 13 Grignard reaction	10	20	30
Chapter 15 Aerobic Oxidation	15	35	50
Chapter 22 S _N Ar reaction	20	25	45
Total points	140	375	515

Quizzes and Exams

The first exam of the semester covers the spectroscopy and WebMO material and is worth 50 pts.

There are up to 3 summary quizzes given during CHEM 344, each of which is written by your TA and graded out of 25 points. Each lab quiz will cover discussion and lab material specific to a particular set of experiments that you have covered earlier in the course.

In addition, 2 cumulative exams covering all techniques, reactions, and concepts in CHEM 344 are given (*i.e.* one mid-term exam and one final exam). Each cumulative exam is worth 100 points.

Assessment	Points
Quiz 1 (Extraction, Oxidation/TLC)	25
Quiz 2 (EAS and S _N Ar)	25
Quiz 3 (carbonyl chemistry)	25
Spectroscopy/WebMO Exam	75
Midterm Exam (experiments through E1/E2)	100
Final Exam (all experiments)	100
Total points	350

In total, there are $350 + 515 = 865$ points available in the course.

Grades must reflect achievement.

The instructors of this will do their utmost to ensure that your grade accurately reflects your achievement as measured by a variety of assessments. Your achievement will be assessed via quizzes, exams, pre-laboratory assignments, and post-laboratory data analysis.

All TAs use the same grading rubrics for lab reports in order to ensure grading consistency within the course. **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. Note that adjustments will be made to this method for particularly high achieving sections.

To determine your normalized score on any particular work, apply the following formula:

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

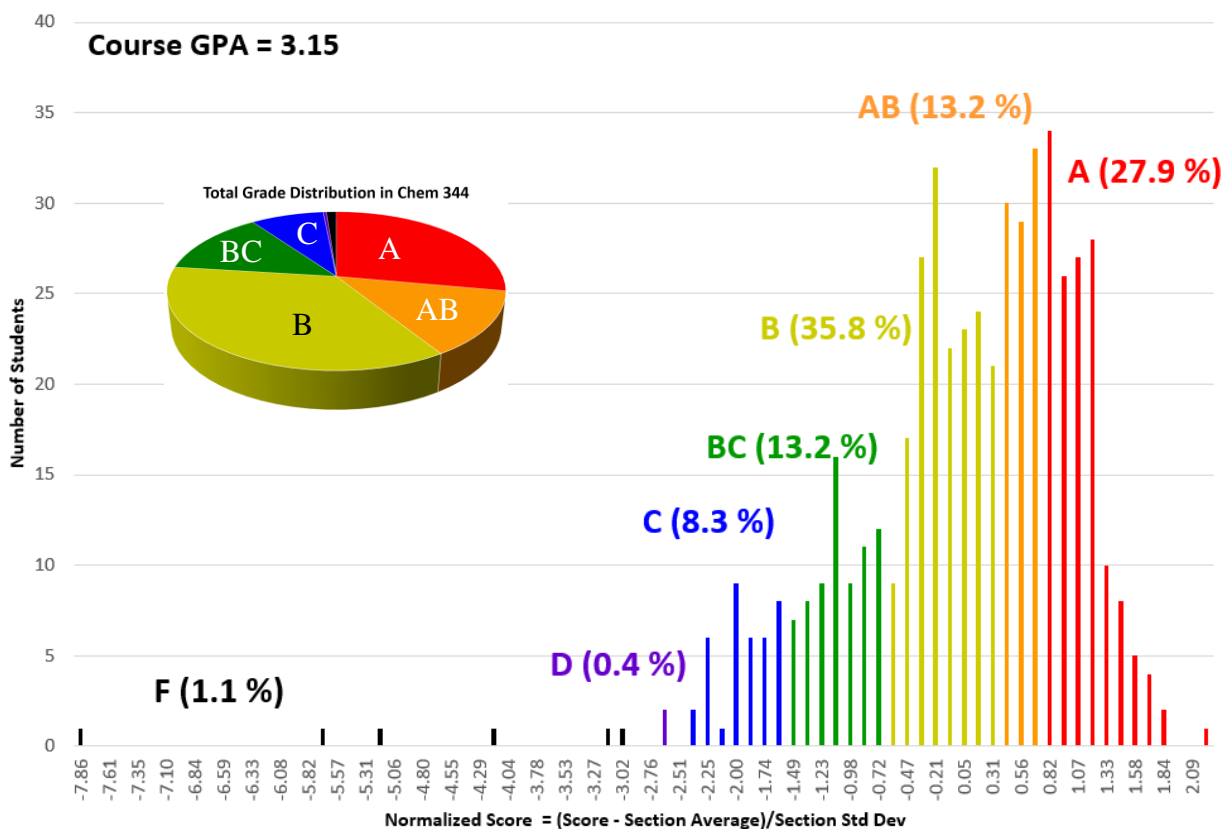
Your TA will provide you with the section average, the standard deviation, and the high and low scores for each item of graded work as it is returned to you. You can fit your normalized score on any piece of work to the ranges depicted on the x-axis of the following histogram. This will allow you to assign an approximate letter grade to each individual piece of work.

The overall GPA of the course will be approx. 3.15, though it will be slightly higher in some sections and slightly lower in others. The final grade distribution will resemble the pie chart below.

Common Chemistry 344 Grading Questions/Clarifications

Common Question/Myth	Clarification
There are only three A grades assigned per section.	There is no predetermined number of letter grades. In the recent past, there have been as many as 7 As and as few as 2 As in a section of 18 students.
I got 82% of the course points, what is my letter grade?	CHEM 344 does not use arbitrary grade cut-offs of 90% = A, 80% = B, etc. An entirely standardized grading scheme is not viable in a large laboratory course which has many units of assessment and up to 36 different TAs. Instead of arbitrary cut-offs, grades are determined by the normalized score for each student within the section.
Grading is solely based upon TA opinion/preference. Since my TA is a “hard grader” my grade has suffered.	All TAs follow detailed guidelines for grading lab reports and standard keys for exams (all of which are written by the course instructors), but there is always some variation in grading. This is why a normalized score is used for grade calculations.
Grades cannot be estimated until the end of the course.	The normalized score for each piece of work is calculated <i>via</i> the formula shown below. $\text{Normalized Score} = \frac{\text{Your Score} - \text{Your Section Average Score}}{\text{Your Section Standard Deviation}}$
My friend in another section has a higher score on the quiz than I and my classmates do, does that mean we all failed?	The raw point scores themselves do not matter. The normalized score in your section matters for all quizzes and lab reports.

Chem 344 Spring 2017 Grade Distribution



To reiterate the first premise of the Chemistry 344 grading philosophy, **grades will be based solely upon achievement.** The following will not be taken into consideration when determining your final grade.

- Effort/hard work
- Time spent on coursework
- Number of posts/replies/etc. on Piazza
- Attitude toward organic chemistry
- Participation in discussion or office hours
- Attendance at office hours
- How much you perceive your instructor(s) like/dislike you
- Needing a specific letter grade for graduate or professional school admissions
- Wanting a specific letter grade to improve your GPA
- Wanting to take a course for which Chem 344 is a prerequisite
-

CHEM 344 Laboratory Safety Policies

You are required to follow the rules and guidelines discussed in the lab safety video presentation and Chapter 1 of this manual. In summary:

Place book bags, coats etc. in the hanger area at the front of the lab. Do not block the pathway, exit, or fire extinguisher with your belongings.

A lab coat must be worn at all times in the laboratory

No sandals, flip-flops, open-toed/heeled shoes! Your entire foot must be covered by shoes or a combination of shoes and socks.

Trousers or jeans covering the entire leg must be worn – no shorts.

Gloves and goggles must be worn at all times in the lab.

Gloves must be removed and discarded before leaving the lab.

Do not eat/drink/chew in the lab.

Do not inhale chemicals.

No smoking or open flames.

Cell phones, laptops, and music devices are not allowed in the lab.

Follow all safety instructions given by your TA!

Access to the lab

The only times that you are allowed access to the organic teaching labs are during the scheduled meeting times for the lab session in which you enrolled. You may not work in the lab at any other time. Unless you are enrolled in the scheduled lab session you are not allowed in the lab. There are no visitors allowed.

Lab equipment

You have been assigned a lab bench space and a drawer containing lab equipment. During check-in, make sure that every item that is listed on the yellow check-in sheet is in the drawer and is in good condition. If a piece of glassware is chipped or cracked, replace it! If it is dirty, wash it! You are responsible for keeping all equipment clean and in good condition and accounting for it at the end of the semester.

CHEM 344 Exam Conflict Policy

Instructors of daytime courses often schedule exams that conflict with a scheduled CHEM 344 class meeting time. If you miss a CHEM 344 lab session due to an exam given in another course, you will be required to use your excused absence to cover the missed lab session. You will not be allotted any extra excused absences.

According to the timetable and Faculty Document 1585a:

"Instructors who schedule evening exams should make every possible effort to accommodate students with unavoidable conflicts. It is the instructor's responsibility to assure that all students with conflicts between daytime courses with evening exams and evening courses are treated fairly and without penalty.

If a scheduling conflict exists between the evening exam of a daytime course and a regularly scheduled evening course, then the evening course takes precedence over the exam."

It is the responsibility of the instructor who schedules the conflicting exam to offer you an alternate exam time that does not conflict with your CHEM 344 or other class time. **Thus, it is your responsibility to check for any exams that conflict with your CHEM 344 class time and contact the instructor of the conflicting course as soon as possible so an accommodation can be made.** No make-up lab sessions are available to students who miss a CHEM 344 lab session due to a conflicting exam.

CHEM 344 Late Work Policy

Complete lab reports submitted up to 24 hours after the submission deadline shown on page vi will receive a maximum of 50% of the total points available (*i.e.* your lab report will be graded and the points you obtain multiplied by 0.5). Complete reports submitted >24 hours late will not be graded for credit (*i.e.* you will receive 0 pts for the work).

Pre-lab work submitted after the start of the discussion session will not be graded for credit.

It is your responsibility to be aware of all deadlines for submission of work to your TA.

CHEM 344 Lab Absence Policy

You are expected to attend every lab session during the course (and to arrive on time). You may, however, need to miss a lab session due to circumstances beyond your control. The course policies and procedures that you need to follow are detailed below. It is your responsibility to understand and follow these policies.

What if I need to miss a lab session?

All CHEM 344 students are granted one (1) Excused Absence (EA). The EA can be used if you need to miss a laboratory session. *The EA cannot be used on the day of a quiz or exam. Students who miss a quiz or exam will receive a score of zero for that assessment.*

Who should I inform, and when?

By email, you should inform your laboratory TA, Dr. Hill, and Dr. Esselman as soon as you know that you will use the EA. You must submit the EA form to your TA **no later** than the returning lab session. The EA form is printed on page xv of this lab manual.

Will using the EA affect my grade?

You will neither gain an advantage nor be penalized by using the EA. You are required to complete the lab report for the day you missed and submit it at the regularly scheduled time using stock data downloaded from the course website. Any lab reports due on the day you are absent must be submitted to your TA at the start of the next discussion session. The points associated with the observations during the laboratory session will be prorated from the score of your pre-lab assignment (whether it is a one day or multiple day lab). The EA cannot be used retroactively to negate a lower-than-desired lab report score.

What happens if I am late to the pre-laboratory discussion?

You will not be allowed into the laboratory for the day's experimental work without permission from Dr. Hill or Dr. Esselman if you are more than 15 minutes late. This is critical for your success in the laboratory as well as for the safety of all students and TAs. You may be required to use your excused absence if you are late for the session.

What happens if I have not completed or submitted the pre-lab material?

You will not be allowed into the laboratory for the day's experimental work without permission from Dr. Hill or Dr. Esselman. Appropriate preparation is critical for your success in the laboratory as well as for the safety of all. You may be required to use your excused absence if you are late for the session.

Excused Absence Form for CHEM 344 Spring 2018

Student name:

TA name:

Experiment and date missed:

Student signature:

TA signature:

Date:

Hand this form to your TA no later than the day you return from your absence.

Maximizing your learning in an ethical manner

As the instructors of CHEM 344, Dr. Hill and Dr. Esselman continually aim to improve student learning and update the curriculum. Integral to this mission is the development of new experiments and assessments. For existing experiments, this goal is partly achieved by the introduction of new pre- and post-lab questions each semester. We also regularly introduce new experiments to the CHEM 344 repertoire. The majority of you will not take another organic chemistry course, but the thought processes, ability to learn and communicate new concepts, and data analysis skills you acquire from CHEM 344 will be invaluable in your future studies and careers. With this in mind, we strongly encourage you to approach the data analysis and pre-/post-lab assessments in this course using all of the resources provided and endorsed by the teaching staff. These include instructor office hours/drop-ins, TA office hours, Piazza, talking to your TA and classmates in lab, and organized study groups.

It is an unfortunate fact that students often attempt to take shortcuts in the course by submitting work copied from their classmates or previous students of the course. We are aware that CHEM 344 computational/spectral data and answers to lab report questions from previous semesters are available to many of you, and that there is a temptation to use these resources. Not only does this behavior hinder your learning of the material and the growth you should experience in the course, it is unethical, fraudulent, and constitutes academic misconduct.

In this course, as in all scientific endeavors, claiming credit for the work of another is academic misconduct. Despite unambiguous communication of our expectations, multiple students have ignored the academic misconduct policies of this course in recent semesters. All of them were assessed a significant point penalty for the plagiarized work, and several were awarded a grade of F in the course and had a letter detailing their misconduct placed on file with the Dean of Students office. Clearly, we treat academic misconduct with the seriousness it deserves, and are obliged to deal with all cases that are brought to our attention (see pages xv and xvi in lab manual and <https://www.students.wisc.edu/doso/academic-integrity/>). At this point in your academic career, you are expected to be fully aware of the requirements for academic integrity, and the definitions, scope, and consequences of academic misconduct at UW-Madison. We urge you to make sure that all experimental, computational, and spectral data submitted for grading in CHEM 344 have been obtained and generated by you from your material, or have been obtained in accordance with our stock data policy.

We approach every semester with optimism that we have designed a challenging course that is rich with opportunities for deep learning. All of the teaching staff strive to make CHEM 344 a rewarding experience for each student. The main determinant of your experience and learning outcome in this course, however, is you. We encourage you to engage with the course material and all available resources in a manner that is both ethical and which maximizes your learning.

The course and university academic misconduct policies are outlined on the subsequent pages.

You are required to sign and submit an academic integrity declaration form (page 1-7) prior to beginning laboratory work.

CHEM 344 Academic Integrity Policies

All work submitted by a student for grading in CHEM 344 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 partner or group laboratory reports.

All laboratory 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 pairs).

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

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, etc., without citation or reference, or possession of another student's work (graded or ungraded) are all considered to be plagiarism and will be dealt with according to University guidelines for academic misconduct. Enabling any of the above actions is also considered to be academic misconduct and will be dealt with according to University guidelines. At a minimum, such behavior will result in a significant point deduction for each lab report in question.

Information on academic misconduct is available from the website of 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.

Generation and use of WebMO data

You are required to understand and adhere to the following policies pertaining to the generation and use of WebMO data:

- As with all material submitted for grading in CHEM 344, all WebMO data and images submitted for grading by you must be entirely your own work. Specifically, this means that all WebMO-related images, job numbers, and data that appear in your lab report must have been generated by you in your own WebMO account.
- Each WebMO calculation you run will have a unique 6-digit job number. The unique job number for each relevant calculation must be written on the lab report cover sheet, and must correspond to the data presented in your lab report.
- Sharing of a WebMO account between 2 or more students is not permitted under any circumstances. Should evidence suggest that a single account has been used by multiple students, all students involved will be under suspicion of academic misconduct. Information on academic misconduct is available from the website of the Office of the Dean of Students (<https://www.students.wisc.edu/doso/academic-integrity/>).
- The WebMO activity of all students enrolled in CHEM 344 is checked regularly during the semester. Should evidence suggest that data have been plagiarized, all students involved will be under suspicion of academic misconduct.
- Keep your web browser up to date - "I couldn't see the molecule/my computer would not start/etc." is not a valid reason for sharing data or not doing the calculations. Links to browsers such as Firefox and Chrome are provided on the CHEM 344 website.

Summary: you are required to perform every WebMO calculation yourself in your own WebMO account. Sharing of WebMO data between you and your lab partner or anyone else will be considered as academic misconduct. All data you present must be traceable to specific 6-digit job numbers. **You must not delete any data submitted for grading from your account.**

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

CHEM 344 NMR Stock Data Policy

Most of the experiments in CHEM 344 involve the post-lab analysis of ^1H -NMR spectroscopic data obtained from the compound(s) that you synthesized in the lab. The data will be posted on the appropriate experiment page of the CHEM 344 course website.

You are required to use MestReNova to process and analyze your own experimental NMR data. MestReNova is available for download from the University of Wisconsin chemistry department website via the CHEM 344 website.

In cases where your experimental NMR data are unusable, you are required to use MestReNova to process and analyze the stock FID data file for the specific experiment. The stock data file contains authentic student data (i.e. usable, but not necessarily perfect data) and will be posted on the course website next to the experimental data.

Points to note:

- A spectrum generated from stock FID data **must** be accompanied by an explanation of why the stock data were necessary, along with a hardcopy of your own experimental NMR spectrum.
- You will not receive credit for the NMR portion of the lab report if you submit only the prepared stock spectrum (watermarked "Stock Spectrum").
- You are required to process and work-up the spectrum yourself in MestReNova.
- Do not use another student's NMR data or spectrum (see preceding pages for background).

Valid reasons for using stock data	Invalid reasons for using stock data
fid file missing (sample not run)	Impurities are present in my experimental data
NaN error (no data in fid file)	I can't be bothered to find my data.
Only baseline noise/no signals present	I don't know how to find my data/install MNova

Post on Piazza or bring your data to office hours if you have any questions on these policies.

CHEM 344 Suggested Reading

There is no required textbook for CHEM 344, but it is assumed that you have access to a copy of “Organic Chemistry” by Loudon, 6th Ed. and CHEM 343/345 lecture notes.

The content of a discussion section will be based upon the material found in the corresponding chapter of the textbook and the current CHEM 344 lab manual. However, your TA may introduce concepts that are not covered in the textbook or the lab manual. It is your responsibility to be familiar with all concepts covered in the discussion. It is strongly recommended that you read the textbook content prior to attending the pre-lab discussion.

Experiment	Location in Loudon 6th Ed.
Mass spec/IR and NMR	Chapters: 12, 13, 14.3B, 14.3C, 15.2, 16.3, 19.3, 20.3, 21.4, 23.4, AII, AIII, & AIV
3 Separation of a Mixture by Extraction	Chapters: 3, 8.6, 18.7 20.4, & 23.5
4 Computational Molecular Modeling	Chapters: 1, 12, 13, 15.1, 16.1-16.3, 19.7, 26.2
5/20 Nucleophilic Substitution Reactions (S _N 1/S _N 2)	Chapters: 9, 10.3, 18.7, & 23.6
6 Elimination Reactions (E1/E2)	Chapters: 9 & 10.2
7 Oxidation of 4- <i>tert</i> -Butylcyclohexanol	Chapters: 6.6, 10.5, & 10.6
8 Reactions of Nitrogen Functional Groups	Chapters: 19.11 & 23.7
9 Wittig Synthesis of Ethyl Cinnamate	Chapters: 19.13
10 Stereochemistry of a Carbonyl Reduction	Chapters: 10.9, 13.3, & 19.8
11 Electrophilic Aromatic Substitution – Nitration	Chapters: 16, 18.9, 23.9, 23.10, 26.3, & 26.4
12 Electrophilic Aromatic Substitution – Acylation	Chapters: 16, 18.9, 23.9, 23.10, 26.3, & 26.4
13/21 Grignard Reaction	Chapters: 9.8, 19.9, & 21.10
14 Formation of a Biaryl by Suzuki-Miyaura Coupling	Chapters: 18.5 & 18.6
15 Cu/TEMPO Catalyzed Aerobic Oxidation of a Primary Alcohol	Chapters: 10.5, 10.6, & 17.5
16 Biginelli Multicomponent Reaction	Chapters: 19.7 & 19.11
17 Aldol Condensation	Chapters: 22.4
19 Radical Bromination of Bibenzyl	Chapters: 5.6 & 17.2
22 Nucleophilic Aromatic Substitution (S _N Ar)	Chapters: 18.1 - 18.4

How do I locate property data for the prelab?

In CHEM 344 you will regularly need to locate property data about chemicals (e.g. melting point, boiling point, density, solubility, etc.). Below is a list of reference sources to consult in the Chemistry Library (Rm. 2361) or online. If you cannot find the data you need, please contact a Chemistry Library staff member – they are very happy to help!

Data compilations

CRC Handbook of Chemistry and Physics
Dictionary of Inorganic Compounds
Dictionary of Organic Compounds
Dictionary of Organometallic Compounds
Lange's Handbook of Chemistry
Merck Index
Aldrich Catalog

Library Reference call numbers

QD65 H32
QD148 D53 1992, QD148 D532 v.1-4
QD251 H45
QD411 D53 1995
QD65 L362 1999, QD65 L36 1985
Ready Reference Shelf RS356 M52
Ready Reference Shelf or outside labs

Spectral information

Aldrich Library of FT-IR Spectra
Aldrich Library of ¹H-NMR Spectra
Sadtler Spectra

Library Reference call numbers

QD96 I5 P66 1985
QC462.85 A44 1993, QD96 I5 P66 1985
Green Binders in Reference Area

Online Resources and Databases

Sigma-Aldrich
Wikipedia
Chemfinder
CRC Handbook of Chemistry & Physics
Spectral Database for Organic Compounds,
SDBS

URLs

www.sigmaaldrich.com
www.wikipedia.com
www.chemfinder.com
<http://www.hbcnetbase.com>
http://sdbs.db.aist.go.jp/sdbs/cgi-bin/cre_index.cgi