

CHEMISTRY 241
ORGANIC CHEMISTRY I
FALL 2023

Welcome to the wonderful world of organic chemistry! This course will provide an introduction to the structure, bonding and reactivity of organic (carbon-containing) compounds. There are several novel concepts presented in this course, including 1) chemistry in three dimensions, i.e., stereochemistry, and 2) retrosynthetic analysis, i.e., thinking backwards in designing syntheses of organic compounds. I have been teaching this course at Penn since 1991, and I am more convinced than ever that every student can succeed in this course, but that it typically requires a significant commitment on your part.

Strategies for Success in this Course: A unique feature of this course is the focus on problem-solving. You will be expected to show what you know by solving problems—no essays! This is **not** a difficult subject, but it does *require regular* study habits. This material must be understood rather than memorized. Cramming does not work well with organic chemistry, as concepts must be understood as they are presented. You should read the chapters ahead of time, attend lectures, and note the points you do not understand. These must be clarified as soon as possible, as this is a cumulative type of subject. You should ask the teaching assistants or me to answer your questions as soon as possible, either at recitations or during office hours.

I recommend that, for every hour of class, you spend one hour working problems. There are assigned homework problems as well as recitation problems, and the latter are intended to be typical of the level of difficulty of the problems that you will encounter on my exams. When you have finished all of these problems, I suggest that you do the other problems at the end of each of the Wade chapters that we will cover. If you want more practice after that, there are several other organic chemistry textbooks, with solution manuals, on reserve in the Chemistry Library.

As important as these points are, the most important thing to me is that we operate in this class with a culture of mutual respect. The TAs, LAs and I will treat all of you with respect and we expect the same from you. If you experience or know of any exceptions to that, please let me know.

Pre-Requisites and Co-Requisites:

General Chemistry I and II (Chem 1011 & 1021, Chem 1012 & 1022, or Chem 1151 and 1161) are pre-requisites for this course. Organic Chemistry Laboratory (Chem 2412) is a co-requisite for this course, and can no longer be taken as a standalone class at Penn after you have taken the lecture part of this class. If you need to drop Chem 2411 (lecture), you must also drop Chem 2412 (lab).

Class: Monday-Wednesday 1200-130PM in Chem 102. There will be no in-class lecture on Monday September 4 (Labor Day) or September 25 (Yom Kippur), but a recorded lecture will be posted for 9/25.

Instructor: Professor Jeffrey Winkler, Room 449, Telephone 215-898-0052, email: winkler@upenn.edu.

Office Hours: I will be in my office to welcome you Monday, 230-430 PM (starting Sept 11), and Wednesday 930-1130 AM (starting August 30). If you have any questions or problems, it is important to see me as soon as possible so we can appropriately address the situation. I am also available via e-mail, but I do not respond during evenings (after 5 PM) or weekends. N. B. Many issues are much better dealt with in person and I encourage you to discuss with me directly.

Textbook: Wade, Organic Chemistry, Ninth Edition, and Study Guide and Solutions Manual (https://www.amazon.com/Organic-Chemistry-Leroy-G-Wade-ebook/dp/B01B7OIMLG/ref=tmm_kin_swatch_0?encoding=UTF8&qid=1692127319&sr=8-1). If you rent the e-text directly from the publisher (<https://www.pearson.com/store/en-us/pearsonplus/p/9780135213728.html>), you will be eligible for free access to the Mastering Organic Chemistry module, which you may find helpful as an additional resource, once you provide a proof of purchase to Lee Monroe (lee.monroe@pearson.com). For those of you interested in other supplemental materials, you may find

this free online text helpful
(<https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/intro1.htm>), and
an online video course can be found here
(<http://butane.chem.uiuc.edu/jsmoore/Cmap/CHEM232Fa12.html>).

It is also **highly** recommended that you purchase a set of molecular models. I recommend the Molecular Visions set (https://www.amazon.com/Molecular-Inorganic-Organometallic-accompany-Chemistry/dp/0964883716/ref=sr_1_4?crid=2GMBRRW52T6ZF&keywords=molecular+visions+kit+by+darling+models&qid=1692127215&srefix=molecular+visions%2Caps%2C77&sr=8-4) that should also be available at the Penn Bookstore but you are welcome to use any set of molecular models that you choose.

You will be encouraged to bring your molecular models to each of the exams. There are also copies of the text on reserve in the Chemistry Library. If you have any difficulties or concerns about access to any of these materials for financial reasons, please come and talk to me; I am confident that I can be helpful, and am happy to do so.

Syllabus: It is our intention to cover the material that roughly corresponds to the first eleven chapters of the Wade textbook in the order shown in the Lecture Schedule.

Homework: There will be an online graded homework assignment every week that will be due each Friday (no credit will be given for late assignments!). There will also be a recitation problem set that will be posted each Wednesday that will be discussed in the following weeks' recitation sections. In addition, a practice test will be distributed in class before each of the hour exams and the final examination.

Recitation Sections: Specific rooms and times have been assigned [Section 430 (T 330-430pm in Chem 109); Section 431 (M 515-615pm in Chem 119); Section 432 (Th 515-615pm in DRLB 2CB), Section 433 (F 145-245pm in Chem 109); Section 434 (T 515-615pm in Chem 514); Section 435 (F 1200-100pm in Chem 109); Section 436 (Th 515-615pm in Chem 109); Section 437 (M 515-615pm in DRLB 3W2); and 438 (T 330-430 in Chem B13). **The recitation sections WILL NOT meet this week (week of August 28th). They will begin on Tuesday September 5 (next week).**

The teaching assistants are prepared to discuss your classroom material as well as the homework problems. They will also each post an office hour outside of the recitation section times for any other questions. However, you must communicate with the teaching assistants only during these periods. Please do not hesitate to take advantage of the available help given in the recitations and office hours. Do not wait until it is too late to grasp the basic concepts of the subject. Safety regulations do not allow students in the research laboratories. Please **DO NOT** approach the teaching assistants in the research laboratories.

Exams and Grading: There will be four one-hour exams (100 points each; Wednesday Sept 27, Oct 18, Nov 8 and Nov 29) and an optional opportunity to retake each of these hour exams (100 points each; Wednesday Oct 4, Oct 25, Nov 15, and Dec 6), and all of these will be given during class time. Because I don't want to lose eight class sessions to exams, I will record lectures for each of the make-up exam dates. These will be posted on Canvas. Only your higher grade will be counted for each of these four sets of exams, although there will be no make-up exams offered for any of these dates.

In addition, there will be a final exam (200 points), at a time to be announced by the Registrar's Office. The Registrar's Office has instituted a new policy and final exams will not be scheduled until after the fall add/drop/swap period ends. The schedule and locations for in-person, synchronous final exams will be available later in the fall term and can be found in Path on the Section Details Panel. Students missing the final examination must obtain permission to retake the make-up exam the following semester (scheduled by the Registrar's Office) from an advisor in the SAS office.

There will be three other graded portions of the course. During each in-class lecture, starting Wednesday September 6, there will be an in-class quiz (one question) and these will be graded based on participation only. It is my hope that answers and the class results will be posted during class (but I haven't done this before!). These quizzes will be worth 2 points each, and students will be able to earn up to 30 points in this manner (there are a total of 18 in person classes (not including our first day, August 30, so that

students should be able to miss up to three classes and still get the total possible points).

There will also be graded homework in Canvas each week, which will be worth 5 points each week for 14 weeks (70 points). In addition, there will be an anonymous course evaluation at the middle of the semester, and you can earn 5 points by responding to the survey (this is very helpful for me to address any problems or shortcomings in the class).

Your final grade in the lecture portion of the class will be therefore determined as follows:

In class quizzes	30 points
Homework	70 points
Mid-Semester Course Evaluation	5 points
Hour Exams/Final*	500 points
Total Points	605 points

*You will have the opportunity to drop your lowest hour exam score (of your four hour exam scores) or half of your final exam score, so that each student should have a total of 500 hour exam/final exam points.

Your final grade in the course will be based on a combination of your final lecture grade (70%) and your grade in the organic laboratory (30%). All students with 90% or more of total points (including the lab) will earn A's (with plusses and minuses where appropriate), all students with 80% or more of total points will earn B's, and all students with 70% or more of the total points will earn C's. Using this rubric, it is possible for everyone to get an A by demonstrating mastery of the material, but the average grade is typically B/B+.

Regrades: If there has been an error in the grading of an exam or in the addition of the exam score, please submit it to me for regarding, although **exams written in pencil will not be eligible for regrading**. The exam must be submitted by the next class period after it has been returned to you, with a note attached describing the question regarding grading. **PLEASE DO NOT** write directly on the graded exam. Note that when exams are submitted for regrades, the entire examination will be regraded.

Violations of the Code of Academic Integrity: Academic integrity is the intellectual currency of our community. We expect honorable behavior from everyone. While study groups and strong interactions between classmates are encouraged (including working on homework together), your work on exams must be your own. Students are expected to be familiar with and comply with Penn's Code of Academic Integrity, which is available in the Pennbook or online at <https://catalog.upenn.edu/pennbook/code-of-academic-integrity/>. Any case of suspected cheating on any of the examinations or on a regrade of an examination will be directed to the Center for Community Standards & Accountability (CSA). Possible consequences are zero on the assignment or quiz, F in the course, note on your transcript, suspension, or expulsion. If you have any doubts or questions about what constitutes academic misconduct, please do not hesitate to contact me.

Policy of Drops, Withdrawals or Incompletes. The deadlines for **dropping** (Monday October 9) and **withdrawing** (Monday November 6) must be rigorously observed.

Ed Discussion: This semester we will use Ed Discussion as an online forum for your questions about course material. Ed Discussion is the fastest way to get a content-based question answered. You are encouraged to check and contribute to Ed Discussion daily. All users must maintain a positive, respectful tone. You are strongly encouraged to answer questions; explaining is the best way to ensure that you know something well. TAs/LAs will be the first and frequent curators of the discussions, and they will not answer immediately in order to give students opportunities to answer questions first. Due to the likely volume of questions, answers may be short—this is not a sign of disrespect or a lack of attention on the part of the instructor or TA/LAs. If you wish to have a lengthier discussion about a topic, please reach out to the instructor, TAs, or LAs during office hours and/or recitations. Ed Discussion is not the appropriate forum for grading, course policy, or course event questions. Please limit the questions only to organic chemistry content. Additionally, it is not appropriate for feedback on the instructors or the TA/LAs; there will be anonymous course surveys providing opportunities for that feedback. Ed Discussion will be started completely anonymously. If users violate the above terms, the anonymous

feature will be turned off for all users. Users who violate the terms more than once will have their access rescinded.

Weingarten Center The Weingarten Center offers a variety of resources to support all Penn students in reaching their academic goals. All services are free and confidential. To contact the Weingarten Center, call 215-573-9235. The office is located in Stouffer Commons, 3702 Spruce Street, Suite 300.

Academic Support. Learning consultations and learning strategies workshops support students in developing more efficient and effective study skills and learning strategies. Learning specialists work with undergraduate, graduate, and professional students to address time and project management, academic reading and writing, note-taking, problem-solving, exam preparation, test-taking, self-regulation, and flexibility.

Undergraduates can also take advantage of free on-campus tutoring for many Penn courses in both drop-in and weekly contract formats. Tutoring may be individual or in small groups. Tutors will assist with applying course information, understanding key concepts, and developing course-specific strategies. Tutoring support is available throughout the term but is best accessed early in the semester.

Disability Services. The University of Pennsylvania is committed to the accessibility of its programs and services. Students with a disability or medical condition can request reasonable accommodations through the Weingarten Center website. Disability Services determines accommodations on an individualized basis through an interactive process, including a meeting with the student and a review of their disability documentation. Students who have approved accommodations are encouraged to notify their faculty members and share their accommodation letters at the start of each semester. Students can contact Disability Services by calling 215-573-9235.

LECTURE/EXAM SCHEDULE FALL 2023

Week		Material	Chapter
Aug	28	Structure and Bonding General Introduction Atomic Structure and Molecular Orbitals Octet Rule Bonding, Covalent and Ionic Multiple Bonding Structural Formulas Normal Valence, Multiple Bonding Hybridization, Tetrahedral Carbon Restricted Rotation, Isomerism (Structural and Geometric) Generation of Isomers Geometric Isomerism	1
Sept	4	Structure and Bonding (cont.) NO CLASS MONDAY 9/4 (Labor Day)	1
	11	Acids and Bases; Functional Groups Nomenclature Acidity Resonance Inductive Effects Functional Groups	2
Sept	18	Structure and Stereochemistry of Alkenes Ethane-Butane Torsional Strain-Ring Strain Cyclohexane-Bicyclics Conformations of Cyclohexane (Boat-Chair)	3

Newman Projections
A Values
Disubstituted Cyclohexanes
Cis and Trans Decalin

25 **The Study of Chemical Reactions** 4
NO IN-CLASS LECTURE MONDAY 9/25 (Yom Kippur)

Intro to Halogenation
Halogenation of Propane
Reaction Kinetics
Energetics of Halogenation
Bromination
Hammond Postulate
Allylic Bromination
FIRST HOUR EXAM (9/27)

Oct 2 **The Study of Chemical Reactions (cont.)** 4
Stereochemistry 5
Optical Activity
R/S Configuration
Introduction to Diastereomers
Meso-Fisher
OPTIONAL FIRST HOUR EXAM REDO (10/4)

9 **Stereochemistry (cont.)** 5
Alkyl Halides: Nucleophilic Substitution 6
DROP PERIOD ENDS (10/9)
S_N2
Leaving Groups
Nucleophiles
Tosylates
Solvent Effects
S_N1

16 **Alkyl Halides: Nucleophilic Substitution (cont.)** 6
SECOND HOUR EXAMINATION (10/18)

23 **Structure and Synthesis of Alkenes/
Elimination** 7

Rearrangement Reactions

E1 vs. E2

Zaitsev's Rule

Alkene Stability

E1/E2/ S_N1/ S_N2

Bredt's Rule

OPTIONAL SECOND HOUR EXAM REDO (10/25)

30 **Reactions of Alkenes** 8

HBr Addition

Anti-Markovnikov Bromination

Hydration

Oxymercuration

Hydroboration

Bromination

Nov 6 **Reactions of Alkenes (cont.)** 8

**LAST DAY TO WITHDRAW FROM A COURSE
(MONDAY 11/6)**

THIRD HOUR EXAMINATION (11/8)

Hydrogenation

Epoxidation

Epoxide Opening

Dihydroxylation

Ozonolysis

Oxidative Cleavage

Oxidation Ladder

Polymerization-Metathesis

13 **Alkynes** 9

OPTIONAL THIRD HOUR EXAMINATION REDO (11/15)

Generation of Alkoxide
NO CLASS WEDNESDAY 11/22 (THANKSGIVING)

Grignard
Reduction (LiAlH_4 , NaBH_4)
Grignard on Epoxide, Acid Chloride
FOURTH HOUR EXAMINATION (11/29)

Oxidation
Fischer Esterification
Pinacol Rearrangement
Williamson Ether Synthesis
OPTIONAL FOURTH HOUR EXAMINATION REDO (12/6)

Review

FINAL EXAM (TBA)