

LECTURE SYLLABUS

Course Organic Chemistry I, 31: Lecture and Laboratory
Time and Location Monday through Friday– 1:00-4:00 p.m., Daly Science 206

Lecture Text

The text for the lecture component of this course is optional. The following texts/resources may be useful for you in this course:

1. Virtual Text in Organic Chemistry: <http://www.cem.msu.edu/~reusch/VirtualText/intro1.htm>
2. Any reasonable organic chemistry text, electronic or print form, for lecture preparation by reading about topics to be covered in the subsequent lecture. McMurry (any edition) or texts by Loudon, Ege, Solomons and Wade are also good.

Course Materials

All course materials are posted on our class webpage: <https://sites.google.com/a/scu.edu/chemistry-31---organic-chemistry-i/> and a Google folder I will share with you. You will need to obtain a copy of the two large packets, the Class Packet and the Problems Packet. Both are large documents, which can be printed from our Chem 31 page or purchased from Copy Craft for about \$15 each (<http://copycraft-ca.com>, 341 Lafayette St, Santa Clara). We will refer to the Class Packet in lecture regularly, so you are expected to bring the Class and Problems Packets to every lecture. I will email additional materials as needed, including problem assignments after every lecture.

Laboratory Text and Materials

Required Text: *Laboratory Techniques in Organic Chemistry* by Mohrig, Alberg, Hofmeister, Schatz and Hammond, 4th Edition. You will use this text in Chem 31-33. Other materials for laboratory can be found on Chem 31 Laboratory webpage (<https://sites.google.com/a/scu.edu/organic-chemistry-laboratory/>). You also must bring your safety splash goggles (meaning they form fit to your face, safety glasses can not be used) lab coat and lab notebook to laboratory every day, including the first day your lab section meets. You can purchase a lab coat and goggles from the SCU Bookstore. Picture of the goggles we sell: <http://www.safetyglassesusa.com/s3960d.html>

Laboratory Notebook: You are required to use a notebook that we ordered especially for Chem 31-33, which can be purchased from the Campus Bookstore. The laboratory notebook is black with numbered, quad ruled pages, embossed with "Santa Clara University" from the Scientific Notebook Company Do not purchase other notebooks that could be on sale in the bookstore.

Supplements

Molecular model set. This is optional; very helpful for visualizing molecules in 3D throughout the sequence. You can purchase a kit from the bookstore, we sell the Darling Model Kits (<http://www.darlingmodels.com/>) but any model kit will suffice.

Problem notebook to record all of your solutions to the problems packet and other assigned problems.

Instructors

Lecture: Dr. Brian J. McNelis; Email: bmcnelis@scu.edu; Phone: 554-4797
Laboratory: Drs. Ruhland and Tichy

Office Hours Alumni Science 160 M-Th 4-5 pm; Other times by appointment

Course Learning Objectives

This course is your first focused on molecules and their properties and through this course you will develop your understanding of the fundamental principles that govern reactions and properties of organic compounds. With that understanding, students will be able to interpret and solve chemical problems in this course but also understand and interpret molecular function in other systems as well. Additionally, you will apply learned

concepts from lecture in the laboratory setting in addition to learning the fundamental organic laboratory skills not discussed in lecture. This course will meet the following specific objectives:

1. You will learn and master the fundamental principles of organic reactivity. To achieve this goal, we will develop a series of evaluative tools and learn to apply them to organic compounds: polarity, acidity ranking (pKa) and rules for determining and comparing the relative stability of molecules.
2. You will learn to use the curved arrow formalism to describe bond forming and bond breaking in chemical reactions and in drawing different resonance forms for compounds.
3. You will develop your ability to evaluate and predict organic reactions and the interactions between molecules. Using these tools and skills, you will develop your ability to solve advanced, application problems in the field.
4. Applying chemical principles in the laboratory. You will learn to execute independent experiments that supplement and complement the topics covered in lecture. You will become proficient in essential techniques for the reaction, isolation, and purification of organic compounds, and the proper disposal of waste produced in generating them. You will also learn the proper use and maintenance of a laboratory notebook as a record of your experimental work.

One of the most lasting values of this course is learning to apply your understanding of molecular structure and reactivity to solve advanced, problems in the field. This will demonstrate the value and power of the method and is an exemplar of how you will master new areas of study and fields in your career to become an expert in those fields. I believe this is the most important outcome of this course and why it so valuable to your science training at this stage in your career, even if you will not pursue work or an advanced degree in science.

Course Content and Approach

This course will develop a number of basic concepts that will serve as the foundation for understanding organic chemistry. Learning these fundamentals will enable you to evaluate and comprehend all of the new material encountered during the organic chemistry sequence. The approach to achieve this objective is to reinforce these basic principles throughout the course demonstrating their application to problem solving.

An important goal of this introductory course is to teach the principles of organic reactivity through the careful study of each step in the reaction processes we encounter. A stepwise description of the reaction process is commonly referred to as the reaction mechanism. An understanding of mechanism is the foundation for further learning and problem solving in organic chemistry and eases the burden of memorization in the course by demonstrating the relationships between reactions. The use of mechanism in problem solving develops cognitive skills as the basic knowledge and understanding of chemical reactions must be applied to answer challenging questions on exams and problem sets. Developing the ability to critically analyze a reaction using the rules of chemical reactivity is one of the primary learning objectives for this course.

We will begin reviewing some topics covered in general chemistry such as Lewis structures, molecular geometry, and atomic orbital hybridization. This leads into the topics of covalent bonding, molecular orbitals and the drawing conventions for organic compounds. From this background we will study three classes of organic compounds and their reactions: alkanes, alkyl halides, alkenes and alkynes. Using our understanding of atomic and molecular structure, we will study the relationship between structure and reactivity. To demonstrate the principles of organic reactivity, we will develop our understanding of each step of the reaction mechanisms so that reaction outcomes make “chemical” sense. This fundamental understanding of reaction mechanism will allow you to predict reaction results and interpret the new reaction processes encountered in this course. Other important concepts include: bond formation and cleavage, the strength of acids and bases, resonance and stereochemistry, and synthesis.

How to be Successful in Organic Chemistry

Educational studies have shown that learning/mastering material early in an organic chemistry course and having a proactive approach to seeking help leads to significantly improved performance. (Szu *et.al. Journal of Chemical Education*, 88, 2011, 1238 and Horowitz *et. al. Journal of the Scholarship of Teaching and Learning*, 13, 2013, 120). My own experience over 25+ years of teaching has shown that students who master fundamental concepts early in the course as the topics are covered perform much better in this class. I have a developed a

large number of support materials to promote your learning in this class. Development of strong problem-solving skills is a goal of this course and essential to your future success in science and related careers. My goal is for you to succeed to the best of your ability and effort, so I have detailed below the specific behaviors that will help you perform your best in this class.

1. *Lecture and Notes*

a. Come to lecture prepared and attend every lecture.

b. Before the lecture, review your notes from the previous class and after class, take 15-20 minutes to review your lecture notes and highlight any topics or concepts you do not understand fully. Reviewing your notes after lecture has been shown to dramatically increase concept retention with a nominal time investment.

c. Students' notes often contain errors or there are critical omissions in recording important content. Look for gaps and mistakes and compare your notes with other students in the class; often I find students are confused with what we covered in-class because their notes are incorrect. Consult my notes and lecture videos on topics that you find challenging or confusing based on your notes.

2. *Homework*

a. Do **all** the assigned problems. I send out a customized problem assignment via email after every lecture so that you are able to do all the assigned problems based on what we have covered. The Class and Problems Packets contain exam-level questions that my colleagues and I wrote and most are previous exam questions. If you can do all the assigned problems independently, you will be successful on the weekly quizzes and the exams. Expect to spend several hours each week working on problems.

b. **Don't look at the answer key to check your answers!!** The biggest challenge students have in this class is consulting the key too soon, which truncates the learning process. Ideally, you would never look at the answer key yourself; use a friend or Benson tutors to check your answers or use your notes to make sure your answer is consistent with what we learned in class. If you can't get started on a problem, ask for a hint from the Benson tutors or another student in the class. I often give hints in the problem assignment for this purpose. If you have to look at the key, do so only after you have tried a difficult problem a number of times (try to rework the problem after doing other problems; I found waiting a day would often lead to success on a problem) with the help of your notes.

c. Score yourself on every problem assignment and keep track of the number of correct and incorrect answers. Try to correct wrong answers with the help of your notes. Studying the answers on the key is very counterproductive since it gives you the impression of understanding the solution but without any real learning that would lead you to be able to do a similar problem in the future. An important part of the learning process is to identify errors in your thinking process as you solve problems—ask yourself “why did I get this wrong? What did I forget to consider?” Thinking about problems that challenge you this way will help you improve your problem-solving skills.

3. *Seek Assistance*

a. I am available for posted office hours every week and by appointment if you have schedule conflicts. Bring your solved problems and specific questions about course content. Work with other students, but be sure to not give each other too much information to answer the problem.

b. Email. I will answer quick questions by email, but you have to send me a picture of the problem and your solution. I will reply with just enough info so you can try to correct your answers (this allows for a quick response that helps you but does not give you the answer) and sometimes I reply with a picture or a video and I often share those videos with the class.

Grades

Grades will be based on your performance two exams (100 points each) and the final exam (200 points). Your grade in laboratory will have a small but possibly significant impact on your overall final grade, possibly to increase or decrease your overall course grade. Unsuccessful completion of the laboratory work is grounds for failure in the course. Final grades will be based on a curve, which reflects your performance relative to the average for the class.

Policy on Electronic Devices

Students are encouraged to decide for themselves how to best utilize our lecture time and since I post all my lectures as videos, lectures can be missed without significant content consequences for the student. Given this, there is no reason to come to class and do other work on your laptop or other devices. The use of laptops and other digital devices in class is left to students' discretion, until such use is deemed by me to be distracting (to anyone) or otherwise problematic. However, **it is highly recommended that students take proactive steps to ensure that they do not attempt to multitask during class** and that they strengthen their capacity to monotask when engaging in their college coursework. Studies on the efficacy of multitasking are not ambiguous and it does adversely affect your performance. Research strongly indicates that even "minor" **multitasking (checking messages, email, the web, etc.) is highly correlated with learning less and lower performance in college-level coursework**. Students are advised to read the papers below to decide on how to best utilize in-class time and individual study time:

1. "Media multitaskers pay mental price" Golrick (<https://news.stanford.edu/2009/08/24/multitask-research-study-082409/>)
2. "Multitasking Increases Study Time, Lowers Grades" Poitras (<https://today.uconn.edu/2015/07/multitasking-increases-study-time-lowers-grades/>)
3. "Make it our time: In class multitaskers have lower academic performance" Bellur *et. al.* (<https://www.sciencedirect.com/science/article/pii/S0747563215004677>)
4. "Laptop multitasking hinders classroom learning for both users and nearby peers" by Sana, Weston, & Cepeda (<https://www.sciencedirect.com/science/article/pii/S0360131512002254?via%3Dihub>)
5. "The Pen Is Mightier Than the Keyboard: Advantages of Longhand Over Laptop Note Taking" by Mueller and Oppenheimer (<https://journals.sagepub.com/doi/abs/10.1177/0956797614524581>)

Academic Integrity

You are expected to maintain the highest standards of academic integrity in both the lecture and laboratory components of this course. Giving or receiving unauthorized aid in any form will result in course failure. Please see me if you need clarification on what constitutes unauthorized aid in your lecture or laboratory work. In the lecture, you will be asked to sign an academic integrity pledge on all quizzes and exams. The pledge reads: "I am committed to being a person of integrity. I pledge, as a member of the Santa Clara University community, to abide by and uphold the standards of academic integrity contained in the Student Conduct Code." ANY use of cell phones or other electronics during exams will be considered a breach of academic integrity and will result in sanctions including course failure.

Exam Policies

Prior to exams or quizzes, it is **your** responsibility to ensure that any course materials, such as class notes or study sheets, are stowed completely out of view. The instructor will supply all of the allowed materials for each exam or quiz (except for a calculator or an optional model kit). Using your own scratch paper is not permitted. If the instructor sees any resources that are not allowed you will be subject to academic integrity sanctions, which can include course failure. Phones must be turned off, put away and not accessed during the exam.

Standards

This course is a prerequisite for Chemistry 32, Organic Chemistry II. A grade of C- or higher in Chem 31 is strongly recommended before taking Chem 32. Students who receive grades lower than C- are urged to meet with their instructor before considering continuing on to Chemistry 32.

Disability Accommodation Policy

If you have a documented disability for which accommodations may be required in this class, please contact Disabilities Resources, Benson 216, www.scu.edu/disabilities, as soon as possible to discuss your needs and register for accommodations with the University. If you have already arranged accommodations through Disabilities Resources, please initiate a conversation with me about your accommodations during my office hours within the first two weeks of class. Accommodations will only be provided after I have verification of your accommodations as approved by Disabilities Resources, and with sufficient lead time for me to arrange testing or other accommodations. For more information you may contact Disabilities Resources at 408-554-4109.

Accommodations for Pregnancy and Parenting

In alignment with Title IX of the Education Amendments of 1972, and with the California Education Code, Section 66281.7, Santa Clara University provides reasonable accommodations to students who are pregnant, have recently experienced childbirth, and/or have medical needs related to childbirth. Pregnant and parenting students can often arrange accommodations by working directly with their instructors, supervisors, or departments. Alternatively, a pregnant or parenting student experiencing related medical conditions may request accommodations through Disability Resources, as detailed in the section above.

Discrimination and Sexual Misconduct (Title IX)

Santa Clara University upholds a zero-tolerance policy for discrimination, harassment and sexual misconduct. If you (or someone you know) have experienced discrimination or harassment, including sexual assault, domestic/dating violence, or stalking, I encourage you to tell someone promptly. For more information, please consult the University's Gender-Based Discrimination and Sexual Misconduct Policy at <http://bit.ly/2ce1hBb> or contact the University's EEO and Title IX Coordinator, Belinda Guthrie, at [408-554-3043](tel:408-554-3043), bguthrie@scu.edu. Reports may be submitted online through <https://www.scu.edu/osl/report/> or anonymously through Ethicspoint <https://www.scu.edu/hr/quick-links/ethicspoint/>

In-Class Recordings

The Student Conduct Code (p. 13) prohibits students from "(m)aking a video recording, audio recording, or streaming audio/video of private, non-public conversations and/or meetings, inclusive of the classroom setting, without the knowledge and consent of all recorded parties," except in cases of approved disability accommodations. The Student Conduct Code also prohibits the "falsification or misuse, including non-authentic, altered, or fraudulent misuse, of University records, permits, documents, communication equipment, or identification cards and government-issued documents." Dissemination or sharing of any classroom recording without the permission of the instructor would be considered "misuse" and, therefore, prohibited. Violations of these policies may result in disciplinary action by the University. At the instructor's discretion, violations may also have an adverse effect on the student's grade.

Wellness Statement

Santa Clara University is a Jesuit Institution wherein the value of cura personalis, translated to care for the whole person, holds a place of incredibly high importance. Caring for oneself in both a physical and mental sense is paramount to a student's ability to live an enjoyable life at Santa Clara University, excel in academia, and reach their full potential in all aspects of their personhood.

- Students should always strive to get an appropriate amount of sleep each night; the recommended amount of sleep for adults ages 18-25 is 7-9 hours.
- Visit the Wellness Center's (currently located at 852 Market Street) website to see what resources are available on campus to aid and promote student well-being at <https://www.scu.edu/wellness/>.
- Students are given six free counseling sessions with Counseling and Psychological Services — it is highly encouraged you utilize these sessions should you find yourself in need of someone to talk to about anything at all. The number to make an appointment with CAPS is (408) 554-4501. Visit the Counseling and Psychological Services website to learn more about these sessions and more at <https://www.scu.edu/cowell/caps/>.
- If you are sick, please check in with your professor regarding your ability to attend class or lack thereof. By continuing to attend class while feeling sick, you are not only harming your own health, but likely the health of those around you as well. If you are feeling ill, we advise you visit Cowell Health Center during the operating hours of 8:30 am to 5:00pm, Monday through Friday. Visit the Cowell's center website to learn more about the various services this health center provides at <https://www.scu.edu/cowell/>.

CLASS SCHEDULE

<u>DAY</u>	<u>DATE</u>	<u>TOPIC</u>
M	June 17	Introduction and Course Approach

Structure and Covalent Bonds: Hybridization, Geometry and Bonding Rules
Bond Polarity, Dipole Moment and Charge

T	June 18	Bond Length, Strength and Chemical Reactivity Drawing Organic Molecules Functional Groups Functional Groups and Introduction to Infrared Spectroscopy
W	June 19	Structural Variations in Hydrocarbon Chains - Isomerism Nomenclature Isomerism and Physical Properties ¹³ C NMR Spectroscopy Alkanes and Cycloalkanes: Conformational Analysis
Th	June 20	Stereochemistry and Chirality Formal Charge Organic Compounds as Acids and Bases Principles of Organic Reactivity and Stability
F	June 21	EXAM 1 Principles of Organic Reactivity and Stability
M	June 24	Reaction Mechanisms and Energetics Example Reactions, Mechanisms and Reaction Coordinates
T	June 25	Nucleophilic Substitution and Elimination Reactions
W	June 26	Nucleophilic Substitution and Elimination Reactions
Th	June 27	Nucleophilic Substitution and Elimination Reactions-Review and Problems
F	June 28	EXAM 2 Alkenes: Structure and Reactivity, Alkenes: Reactions and Synthesis
M	July 1	Alkenes: Reactions and Synthesis
T	July 2	Reactions of Alkynes
W	July 3	Reactions of Alkynes, Alkynes in Synthesis
Th	July 4	Alkynes in Organic Synthesis Review and Problems
F	July 5	FINAL EXAM