

Fall 2009

Chemistry 255

Organic Chemistry I Lecture

Room: Kirkbride 149 (MWF) & 211 (T)

Class Time: MWF 11:00 am – 11:50 am

Workshop: Sect. A: T 8:00 am – 9:15 am

Sect. B: T 9:30 am – 10:45 am

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“All of these activities of living organisms are chemical in nature. To understand them we must understand the substances, how they are made up of molecules, how the molecules are made up of atoms.” (Linus Pauling)

“UNLESS someone like you cares a whole awful lot, nothing is going to get better. It's NOT.” (The Lorax)

Required Textbooks and Materials*Organic Chemistry*, 2nd edition by Joseph M. Hornback*Student Solutions Manual and Study Guide for Hornback's Organic Chemistry*, 2nd edition by Joseph M. Hornback and Balasingam Murugaverl*Pushing Electrons: A Guide for Students of Organic Chemistry*, 3rd edition by Daniel P. Weeks.*Molecular Visions Molecular Model Kit* by Darling Models are **highly** recommended but you may use other model kits if you prefer, and you are welcome to share a set with a classmate.**Office Hours**

Monday 2:30 – 3:50 pm

Thursday 9:00 – 9:50 am

Wednesday 1:00 – 1:50 pm

Friday 2:00 – 3:30 pm

If you would rather setup a time to meet when no one else can interrupt, I would be happy to find a time that we can both meet and discuss your questions and/or concerns. Also, if my office door is open, please feel free to stop by and ask for help.

Course Description

In this course we begin are journey into the world of organic chemistry. Organic chemistry was traditionally defined as the study of substances isolated from living systems, but organic chemistry has expanded due to the ability of synthetic chemist to synthesize most any molecule and is now defined as the study of compounds containing carbon. While organic chemistry opens the door to the understanding of living systems including but not limited to protein chemistry and pharmaceuticals, organic chemistry is also the basis of materials chemistry which has given us such commercial materials as fiberglass, plastic, lasers, and computers to name a few. We will learn to control the formation and breaking of covalent bonds in order to produce chemicals with desired structures and properties. In this first semester course, we will form the foundation of our organic chemistry knowledge by looking at the past as well as the present states of organic chemistry. We will explore the importance of molecular orbital theory, three-dimensional structure and chirality, constitution, and conformation to chemical reactivity. Once we have these concepts mastered, we will begin to control the formation and destruction of covalent bonds in addition to common characterization techniques for organic molecules. Prerequisite: Chem 146 and 148

Course Goals

We have five major goals in this course: 1) to promote effective written and oral communication of chemical nomenclature and structures of organic molecules (the language of organic chemistry); 2) to promote a basic knowledge of the concepts of organic molecules and their relationship to mathematics and other sciences in order a) to compare theoretical calculations and experimental results, b) to obtain and interpret spectra, c) synthesize and characterize compounds, and d) to recognize how chemistry relates to other disciplines and society; 3) to develop problem solving and analytical analysis skills. This knowledge will be judged based on start-ups, exams, and class participation.

Readings

The purpose of the readings is to prepare you for and supplement the lectures. You **MUST** read the assigned readings **before** the appropriate class (as outlined later), because I do not cover every detail of the readings and my lectures will be prepared based upon the assumption that you have prepared for class. My lectures incorporate several different teaching styles. First, I do ask questions during lecture and I expect thoughtful answers. Answering these questions requires that you have thoughtfully read the assigned material. Second, there will be days where you are asked to solve and present questions during class. If you have not prepared for class, you will find difficulty solving these problems and you will gain little knowledge from this extremely useful experience. Third, I do not cover every detail of the readings and you are responsible for all of the material unless otherwise noted by myself in class.

Supplemental Readings on special topics relating to the current material can be found on my Chem 255 website. These readings will serve as the topic of our discussions during lectures labeled with an asterisk on the class schedule. Please be sure to read them **prior** to the appropriate lecture as they will serve as discussion material and will not always be the subject of my lecture.

Class Activities

Class activities will include the presentation of new material and discussion of new and old material including sample problems, group problems, lecture, and questions. Although Hornback will provide the basic knowledge of each topic, we will discuss aspects of the topics that are not covered by this tertiary textbook. We will delve into the history of many of the founding discoveries in organic chemistry in order to gain a greater perspective of our subject. These historical accounts will be taken from the primary chemical literature at the time of the discoveries in addition to some historical accounts of the discoveries. We will also move beyond the coverage in the text for some topics and also discuss how organic chemistry affects your life everyday. Again, much of this material will be provided in supplemental handouts and other information will be provided through lecture. These additional topics are meant to spawn an excitement for organic chemistry and to catalyze in-class discussions.

Grading

Startups (14 at 10 pts each)	140 pts
Midterms (4 at 100 pts each)	400 pts
Final Exam	200 pts
<u>Class Attendance/Participation</u>	<u>60 pts</u>
Total	800 pts

Class Attendance/ Participation

Since organic chemistry is a difficult subject and requires your consistent dedication, you are expected to attend and participate in all class meetings and activities. A significant portion of your grade will be based upon your class participation, frequency and quality of questions, and preparedness and attendance of class based upon my subjective evaluation. Also, you will receive a failing grade in the course if you miss 9 or more class meetings.

Worksheets/ Workshops

Worksheets are sets of problems that are designed as pre-class meeting assignments to prepare you for the workshop (Tuesday class meeting) exercises. These worksheets are designed to be completed after your reading of the appropriate sections of the textbook and to elaborate upon certain topics. The worksheets are submitted for grading **prior to the beginning** of the appropriate workshop. They will **not** be accepted once class has begun. The worksheets can be found on my Chem 255 website 1 week before the class in which they are due. The solutions will also be posted on the Chem 255 website within 1-2 days after the appropriate workshop. These worksheets are designed to prepare you for the class exercises, so if you have any problems with the questions, you are more than welcome to ask questions during office hours. The workshop exercises are group problem-solving activities that are designed to further your understanding of the material and to clarify questions that arose during your readings and completion of the start-ups. We may also discuss the problems during class meetings in order to

clarify some key points and answer any questions that your group(s) has generated. If your group does not complete the allotted assignment during class time, your group is expected to have the assignment completed BEFORE the start of the next class.

Exams

You will have 4 mid-term exams and a final exam. These 5 exams provide a way for you to demonstrate your knowledge of the course through problem solving questions in addition to questions that test your conceptual understanding and general knowledge of the material. The only way to do well on the exams is to **practice, practice**, and then **practice** more. I suggest you review the worksheet assignments, the workshop exercises, attempt *all* of the questions at the end of each chapter, and work through the practice exams. The practice exams may be found on my Chem 255 website 1 week before each exam. You will find this very rewarding when the exams roll around. Also, I have an abundance of organic chemistry textbooks in my office that I would be delighted to loan you if you want/need additional problems.

The final exam is *cumulative*. If your percentage score on the final exam is higher than any one of the midterm exams, I will replace your lowest exam score with your percentage score of the final exam.

IF YOU ARE ABSENT FROM AN EXAM IT WILL COUNT AS A ZERO. There are no make-up exams given except under extenuating circumstances (ones beyond your control). I will be the sole judge as to whether or not sufficient extenuating circumstances exist. If you miss an exam and feel extenuating circumstances exist, you must contact me within 24 hours of the missed exam. If you do not, there will be no reconsideration under any circumstances. In addition, once an exam has been graded and returned to the class, no make-ups will be possible.

Discussions

Optional discussion sections will be scheduled throughout the semester, especially before exams, and will usually meet in the evening at a mutually convenient time.

Grading Scheme

Grading will not be on a curve. The following grading scale will be used:

A	85%
B	75%
C	65%
D	54%

So, if you collect 75% of the points, you are guaranteed a "B". If you score very near (~1-2%) one of the borders, you will likely receive the higher grade with a minus sign affixed or the lower grade with a plus sign, but that is not guaranteed.

These cutoffs are not arbitrary. They are derived from experience with this course over several years. However, the cutoffs are absolute. If everyone is above 85%, then everyone gets an A and vice-versa.

I am providing an absolute scale for several reasons. First, I want to encourage collaboration between everyone. Working in groups can be extremely useful, so I don't want you competing with one another. Second, I want you to be informed throughout as to the score you need in order to achieve your goal for the course. I do reserve the right to lower the cutoffs but that is not very likely.

Academic Fraud

The Science Division and the Chemistry Department strictly enforce the University's policy on cheating and other forms of academic fraud. Cheating on an exam will result in automatic failure of the course. See the student handbook for details.

Grievance Procedure

Please refer to the student handbook, the science office, or myself if you have a problem.

Syllabus Modification

I reserve the right to change/modify the syllabus throughout the semester if needed. All changes will be announced in class and you are responsible for those changes whether you are present or absent during those class times.

Learning and Studying Organic Chemistry

Organic Chemistry and your sophomore year represents a significant jump in your intellectual growth path. This year you will make significant strides up “Bloom’s Taxonomy of Learning” and begin to realize your intellectual abilities. Much of your education to this point as focused on the acquisition of knowledge and comprehension of that knowledge with a little emphasis on application and analysis in your freshman courses. These lowest levels of Bloom’s taxonomy can be reached by memorization and last minute studying; however, that will not be the case this year and particularly in Organic Chemistry. Organic Chemistry focuses on the application, analysis, and synthesis of information. These intermediate levels of Bloom’s Taxonomy can not be reached by memorization and last minute studying, they require slow digestion of material over the course of time and a true understanding of the material in order to apply, analyze, and synthesize the material that you have learned. Please refer to the handout, “How to Study for Organic Chemistry” for more information.

Bloom’s Taxonomy of Learning (from Benjamin S. Bloom *Taxonomy of educational objectives*)

Competence	Skills Demonstrated	Question Cues
Knowledge	<ul style="list-style-type: none">▪ Observation and recall of information▪ Knowledge of dates, events, places▪ Knowledge of major ideas▪ Mastery of subject matter	List, define, tell, describe, identify, show, label, collect, examine, tabulate, quote, name, who, when, where, etc.
Comprehension	<ul style="list-style-type: none">▪ Understanding information▪ Grasp meaning▪ Translate knowledge into new context▪ Interpret facts, compare, contrast▪ Order, group, infer causes▪ Predict consequences	Summarize, describe, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend
Application	<ul style="list-style-type: none">▪ Use information▪ Use methods, concepts, theories in new situations▪ Solve problems using required skills or knowledge	Apply, demonstrate, calculate, complete, illustrate, show, solve, examine, modify, relate, change, classify, experiment, discover
Analysis	<ul style="list-style-type: none">▪ Seeing patterns▪ Organization of parts▪ Recognition of hidden meanings▪ Identification of components	Analyze, separate, order, explain, connect, classify, arrange, divide, compare, select, explain, infer
Synthesis	<ul style="list-style-type: none">▪ Use old ideas to create new ones▪ Generalize from given facts▪ Relate knowledge from several areas▪ Predict, draw conclusions	Combine, integrate, modify, rearrange, substitute, plan, create, design, invent, what if?, compose, formulate, prepare, generalize, rewrite
Evaluation	<ul style="list-style-type: none">▪ Compare and discriminate between ideas▪ Assess value of theories, presentations▪ Make choices based on reasoned argument▪ Verify value of evidence▪ Recognize subjectivity	Assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, conclude, compare, summarize

Tentative Lecture Schedule

<u>Date</u>	<u>Topic</u>	<u>Reading/Assignment</u>
Fri, 9/4	Introduction and Syllabus	Hornback: 1.1
Mon, 9/7	What is Organic Chemistry?	Enjoy!
Tue, 9/8	NO CLASS – Labor Day	Startup #1 Due
Wed, 9/9	Workshop: Lewis Structures	Prozac
Fri, 9/11	How cool is Organic Chemistry?	Hornback: 1.2-1.11
	Covalent Bonds	Weeks: Ch. 1
	Resonance	Weeks: Ch. 2
Mon, 9/14	Organic Compounds: A First Look	Hornback: 2.1-2.7
Tue, 9/15	Workshop: Resonance and Organic Compounds	Startup #2 Due
Wed, 9/16	Organic Compounds: A First Look (cont)	Hornback: 3.1
	A Little Quantum Mechanics: Atomic Orbitals (AOs)	Hornback: 3.2, 3.9
Fri, 9/18	More Quantum Mechanics: Molecular Orbitals (MOs)	Kohn and Popel
	What can we do with Molecular Orbitals?	
Mon, 9/21	More MOs	Startup #3 Due
Tue, 9/22	Workshop: AOs and MOs	Hornback: 3.3-3.5
Wed, 9/23	Structure of Methane and hybridization	
Fri., 9/25	sp ² and sp ³ hybridization	
Mon, 9/28	Carbon and sp, sp ² hybridization	
	Resonance and MO Theory	Hornback: 3.6-3.8
Tue, 9/29	Workshop: MOs and hybridization	Startup #4 Due
Wed, 9/30	Review of Acids/Bases	Hornback: 4.1-4.2
Thurs, 10/1	Midterm Exam #1 (5:30 – 7pm, Room: 233)	Chapters 1 – 3
Fri, 10/2	Energetics	Hornback: 4.3
Mon, 10/5	Effects on Acidity	Hornback: 4.4-4.10
Tue, 10/6	Workshop: Acids/Bases and Energetics	Startup #5 Due
Wed, 10/7	Continue Effects on Acidity	
Fri, 10/9	NO CLASS – Fall Break	Enjoy!
Mon, 10/12	NO CLASS – Fall Break	Enjoy!
Tue, 10/13	Workshop: Nomenclature	Startup #6 Due
Wed, 10/14	Nomenclature/Functional Groups	Hornback: 5.1-5.10
Fri, 10/16	Cis-Trans Isomers	Hornback: 6.1-6.2
Mon, 10/19	Conformations of Alkanes	Hornback: 6.3
Tue, 10/20	Workshop: Conformations	Startup #7 Due
Wed, 10/21	Conformations of Rings	Hornback: 6.4-6.6
Fri, 10/23	Conformational Analysis	Hornback: 6.7-6.8
Mon, 10/26	What is Chirality and why is it important?	Hornback: 7.1-7.3
		Thalidomide
Tue, 10/27	Workshop: Conformational Analysis and Symmetry	Startup #8 Due
Wed, 10/28	Symmetry Operations	
Thurs, 10/29	Midterm Exam #2 (5:30 – 7pm, Room: 233)	Chapters 4 – 6
Fri, 10/30	Optical Activity	Hornback: 7.4
	Stereochemistry	Hornback: 7.5-7.6
Mon, 11/2	Stereochemistry	Van't Hoff
		Hornback: 7.7-7.10
		Louis Pasteur
Tue, 11/3	Workshop: Symmetry and Chirality	Startup #9 Due
Wed, 11/4	Finish Stereochemistry	
Fri, 11/6	Substitution Reactions. Sn2	Hornback: 8.1-8.5
Mon, 11/9	Substitution Reactions. Sn2 (cont)	
Tue, 11/10	Workshop: Sn2 Reactions	Startup #10 Due
Wed, 11/11	Substitution Reactions. Sn1	Hornback: 8.6-8.11
Fri, 11/13	Finishing up Substitution Reactions	Hornback: 8.12-8.14

Mon, 11/16	Elimination Reactions. E2	Hornback: 9.1-9.4
Tue, 11/17	Workshop: Substitution and Elimination Reactions	Startup #11 Due
Wed, 11/18	Elimination Reactions. E1	Hornback: 9.5-9.6
Thurs, 11/19	Midterm Exam #3 (5:30 – 7pm, Room: 233)	Chapters 7 – 9
Fri, 11/20	Choosing a Mechanism	Hornback: 9.7
	Synthetic Uses of Substitution and Elimination Reactions I	Weeks: Ch. 3 & 4
Mon, 11/23	Synthetic Uses of Substitution and Elimination Reactions II	Hornback: 10.1-10.5
Tue, 11/24	Workshop: Synthesis	Hornback: 10.6-10.15
Wed, 11/25	Markovnikov Addition of H-X to Double Bonds	Startup #12 Due
	Oxymercuration	Hornback: 11.1-11.3
Fri, 11/27	<i>NO CLASS – Thanksgiving Break</i>	Hornback: 11.6
Mon, 11/30	Anti-Markovnikov Addition of H-X to Double Bonds	<i>Enjoy!!</i>
		Hornback: 21.1-21.3
Tue, 12/1	Workshop: Addition Reactions	Hornback: 21.9
Wed, 12/2	Hydroboration	Startup #13 Due
		Hornback: 11.7
	X ₂ Addition	Herbert & Hydroboration
	Epoxidation	Hornback: 11.4-11.5, 11.12
		Hornback: 11.9
Fri, 12/4	Addition of Carbenes	Sharpless and 2001 Nobel
	Ozonolysis	Hornback: 11.8
	Oxidation	Hornback: 11.11
Mon, 12/7	Addition Reactions to Alkynes	Hornback: 11.10
Tue, 12/8	Workshop: Synthesis	Startup #14 Due
Wed, 12/9	Synthesis	Hornback: 11.13-11.14
Thurs, 12/10	Midterm Exam #4 (5:30 – 7pm, Room: 233)	Chapters 10 – 11
Fri, 12/11	Synthesis	
TBA	Final Exam	Cumulative