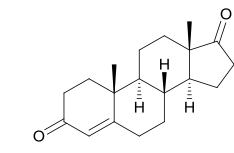
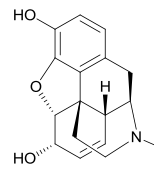


Strychnine  
(poison)

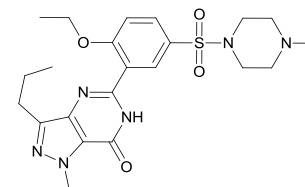


Androstenedione  
(estrogen and testosterone  
precursor)

## Organic Chemistry Chemistry 144 Spring 2013



Morphine  
(opiate analgesic  
drug)



Viagra  
(vasodilation by  
inhibition of PDE5)

Instructor: Matthias Brewer; Office: Cook A317; email: Matthias.Brewer@uvm.edu

BlackBoard Site: bb.uvm.edu

Lecture: 10:40am – 11:30am MWF, Votey 209

First Laboratory Meeting: Jan 22<sup>nd</sup>/24<sup>th</sup>

### Required Text and Course Materials:

*Organic Chemistry* 10th ed., T.W. Graham Solomons, Craig B. Fryhle; John Wiley and Sons Inc. (ISBN: 978-0-470-40141-5)

Bound lab notebook with numbered pages (can continue to use that purchased for 143).

Safety glasses (available in the UVM Bookstore)

### Recommended Text and Course Materials:

*Organic Chemistry, Student Study Guide and Student Solutions Manual* 10<sup>th</sup> ed., Graham Solomons and Craig Fryhle, John Wiley and Sons Inc. (ISBN: 978-0470478394)

Molecular Structure Models (e.g.: ISBN: 0471-362719)

*Organic Chemistry I as a Second Language: Translating the Basic Concepts* 2<sup>nd</sup> ed., D. Klein; ISBN: (978-0470-12929-6)

*Organic Chemistry II as a Second Language: Second Semester Topics* 2<sup>nd</sup> ed., D. Klein; ISBN: (978-0-471-73808-4)

### Books in library that you may find useful:

*The Art of Writing Reasonable Organic Reaction Mechanisms* R.B. Grossman; ISBN:0-387-95468-6

*Writing Reaction Mechanisms in Organic Chemistry* A. Miller; ISBN: 0-12-496711-6

**Course Prerequisite:** Chemistry 141 or 143.

### Office hours:

Mon. 3:00pm-4:00pm

Thur. 10:00am-11:00am

If you can't attend office hours, or you need to see the instructor or TA outside office hours, please make an appointment. Email is the best way to get a quick answer to a question.

## General Comments

In Chemistry 144 we continue to explore the basic principles of Organic Chemistry with a greater emphasis on the chemical reactivity of various functional groups (i.e. more similar to the last 1/3 of the first semester course). You will also learn about the analytical instrumentation used on a daily basis by chemists to determine the structure and composition of molecules.

By now you have probably noticed that Organic Chemistry involves many new concepts, a large number of rules and a very large number of reaction mechanisms. However, as the course progresses and your organic “repertoire” grows, you will also find that a relatively small subset of rules serves to tie together the vast amount of information contained in the text. A special effort made at the beginning of the course to review and master important concepts from the first semester will pay off as the course progresses. Topics that are especially important to review include:

Arrow Pushing: Arrow pushing is one of the most important “tools” of organic chemistry because it allows you to show a pictorial representation of a reaction mechanism. When done properly, arrow pushing will allow you to keep track of the bonds that are made and broken throughout the course of a reaction, as well as keep track of any formal charges that develop. Having a good grasp of arrow pushing will make learning the large number of reactions you will see in this course easier, because you will then understand the underlying mechanism of the reaction rather than trying to memorize it as a “fact”. ***I can't overemphasize the importance of having a good working knowledge of arrow pushing.*** Be forewarned that arrow pushing will be used on a daily basis in class and you will be expected to write mechanisms using correct arrow pushing on exams.

Resonance: This is a very important concept and you have already seen that resonance can help rationalize why carboxylic acids are more acidic than alcohols. You will see resonance used over and over again to rationalize why molecules react the way they do, and a good understanding of the rules for writing proper contributing “structures” to resonance hybrids will make the understanding of reaction mechanisms considerably easier. In order to have a good understanding of resonance you must also have a good grasp of electronegativity and arrow pushing.

Electronegativity: Knowledge of the relative electronegativities of atoms is essential to understanding why molecules react the way they do. For example, the concept of electronegativity allows you to rationalize why some atoms are good leaving groups and others are not.

Chemical Reactions: You will be expected to know all the chemical reactions you covered in Chem. 143.

Nomenclature: I will assume you know the names of all the functional groups as well as the standard IUPAC rules for naming simple organic compounds. If you don't know the functional groups, you will not be able to follow the discussion in class. In my view, it is more important that you be able to draw a structure from a given name than write a name for a given structure.

Stereochemistry: Determining R/S designations as well as E/Z. Understanding the difference between different types of stereoisomers (enantiomers/diastereomers) and

being able to correctly identify the stereochemical relationship between compounds (i.e. are they diastereomers, enantiomers, constitutional isomers, different molecules, etc.).

**Keys to success in Organic Chemistry:**

- Do not try to cram!
- **Work as many practice problems as possible.** Practice problems reinforce the new concepts and are the only way to test your understanding of the material. There are many organic chemistry textbooks in the library and they all cover similar material. Work problems in other books once you have finished the problems in our book.
- Do not look at a problem's answer until you have really tried the problem. After seeing the answer it often seems obvious and you may assume you understand.
- When you get a problem wrong, try to understand where your thinking was in error and attempt to identify what concept you missed.
- You will see many new concepts in this course. Try to write out an explanation of the concepts in your own words as if explaining them to someone else.
- Ask questions! Come to office hours or make an appointment with me or your T.A. to resolve any questions early!
- Review the material frequently... many people find that flash cards are a good way to learn this material.

For each chapter you should work as many of the suggested problems as possible. I strongly urge you to keep up with your reading and problem solving. Learning organic chemistry takes a combination of patience, practice, and repetition. Cramming does not work well in this subject!

**Academic Conduct:** Cheating will be considered grounds for failing the course. All graded assignments must be your own work. Cases of cheating or plagiarism *will* lead to further disciplinary action which may include dismissal from the University according to the rules set forth in The University of Vermont's *Code of Academic Integrity*.

**Policy of Electronic Device Usage on Exams:** In short, you can't use them! The use of any electronic device (calculator, cell phone, ipod, or anything else with batteries or a solar cell) is strictly forbidden on exams and will be considered cheating.

**Grading:** 3 mid-term exams = 60%; Final exam = 20%; Lab grade = 20% No makeup exams will be offered unless arranged in advance; if you miss an exam for any reason, you will receive a grade of zero for that exam. A request to take the exam at an alternative time including a legitimate reason for the request must be made in writing by the Friday before the normal exam time. No curves will be applied to mid-term exams. Although the exams provide 80% of your course grade and the lab component delivers the remaining 20%, **please note** that *you must earn a passing grade in the laboratory to receive a passing grade for the course. More than two laboratories missed for any reason will*

*result in a failing grade for the course (unless you are granted an incomplete by your Dean).*

**Standardized Exam:** To assess student learning over this year long course sequence a comprehensive standardized exam will be given during your normal laboratory time on April 23<sup>rd</sup> and 25<sup>th</sup>. If you choose to, you may use the grade you obtain on this exam as your final exam grade.

**Exam Re-grades:** If you have any questions concerning the grading of an exam, you must see me within one week after the day the exam is returned to the class. Exams must be taken in ink to insure that you can get points for a grading error.

**Midterm Dates:**

Thursday, February 21 <sup>st</sup>	6:00 P.M.-8:00 P.M.
Thursday, March 21 <sup>st</sup>	6:00 P.M.-8:00 P.M.
Thursday, April 18 <sup>th</sup>	6:00 P.M.-8:00 P.M.

**Exam Location:** Votey 209

**Standardized Final Exam:**

Take during your normal laboratory meeting time                      April 23<sup>rd</sup> / April 25<sup>th</sup>

**Final Exam Date:**

Monday, May 6<sup>th</sup>    7:30 A.M.-10:15 A.M.                      Place: TBA

**This course will address learning goals 1,2,3, and 5 below for chemistry majors:**

1. Students will demonstrate general knowledge in chemistry and will be able to apply chemical and physical principles in the solution of qualitative and quantitative chemical problems.
2. Students will understand the interplay of observational data, hypotheses, and hypothesis-driven experimentation through application of the scientific method.
3. Students will become proficient in chemical laboratory techniques and be able to apply these to practical and current problems in research.
4. Students will be able to read and critically evaluate the chemical and scientific literature.
5. The students will learn to present scientific data clearly and effectively through both written and verbal communication.

*Religious Holidays: Students have the right to practice the religion of their choice. Each semester students should submit in writing to their instructors by the end of the second full week of classes their documented religious holiday schedule for the semester. Faculty must permit students who miss work for the purpose of religious observance to make up this work.*

### Outline of Readings and Problems

#### Section 2.16: Infrared Spectroscopy

Problems: 2.47-2.50, 2.55

Chapter 9. Nuclear Magnetic Resonance and Mass Spectroscopy. All sections *except*: 9.8b, 9.9d, 9.11d, 9.11e, 9.12, 9.16, 9.17b, 9.18b, 9.19-9.20

All problems *except*: 9.10-9.12, 9.16-9.20, 9.22, 9.27-9.28, 9.32-9.35, 9.38, 9.49, 9.52

#### Chapter 13. Conjugated Unsaturated Systems

Sections 13.1, 13.2B, 13.3B, 13.4, 13.5, 13.7A, 13.7B, 13.9B-13.9C, 13.10, 13.11

Problems 13.1-13.5, 13.9-13.16, 13.19, 13.20, 13.22-13.24, 13.26, 13.29, 13.30, 13.33, 13.35-13.41, 13.47

#### Chapter 14. Aromatic Compounds

All sections *except* 14.7B, 14.10

Problems 14.7-14.10, 14.12, 14.14, 14.16-14.18, 14.21, 14.22, 14.27, 14.30, 14.33, 14.35, 14.37, 14.38

#### Chapter 15. Reactions of Aromatic Compounds

All sections

Problems 15.1-15.11, 15.13-15.15, 15.17, 15.19, 15.22-15.24, 15.25-15.31, 15.34-15.36, 15.41-15.43, 15.51, 15.53

#### Chapter 16. Aldehydes and Ketones

All sections *except* 16.3

All problems *except*: 16.2, 16.18, 16.37, 16.38, 16.43, 16.46, 16.49-16.51

#### Chapter 17. Carboxylic acids and their derivatives

All sections *except* 17.8E, 17.11, 17.12

All problems *except*: 17.1, 17.2, 17.12, 17.17, 17.19, 17.27, 17.39, 17.40, 17.42-17.44, 17.46, 17.48, 17.50-17.54

#### Chapter 18. Reactions at the $\alpha$ carbon of carbonyl compounds

All sections

All problems *except*: 18.25, 18.33, 18.34

#### Chapter 19. Condensations and conjugate addition reactions of carbonyl compounds

All sections

All problems *except*: 19.13, 19.29, 19.32, 19.40, 19.49, 19.50, 19.53, 19.54, 19.59, 19.60

#### Chapter 20. Amines

All sections *except* 20.3B, 20.3D, 20.3F, 20.5A, 20.7-20.13

Problems 20.1-20.9

#### Chapter 24. Amino Acids and Proteins

All sections *except* 24.3c, 24.13

**Chemistry 144 Laboratory  
Spring, 2013**

**Text:** Ault, "Techniques and Experiments for Organic Chemistry" 6th Ed., University Science Books, 1998.

**General Considerations:**

Read the entire chapter/handout before doing the experimental work. The experiments designated within each chapter describe the procedures that you will actually carry out in the laboratory.

Date	Experiment	Ault Experiment # or Handout	Ault Page
Jan 22/24	Check-in		
Jan 29/31	Generation and Reaction of an Organometallic Compound Part 1	Handout	
Feb 5/7	Generation and Reaction of an Organometallic Compound Part 2	Handout	
Feb 12/14	Diels-Alder Reaction	E66	508
Feb 19/21	Nitration of methyl benzoate	Handout	
Feb 26/28	Syn of 2,4- dinitrophenylpiperidine	E50	477
Mar 5/7	No Lab: Spring Break		
Mar 12/14	Prep trans,trans-1,4- diphenylbutane	E71	524
Mar 19/21	tetraphenylcyclopentadienone	E95	595
Mar 26/28	Prep of methyl salicylate: oil of wintergreen	E77	538
Apr 2/4	Biodiesel	Handout	
Apr 9/11	Vanillin oxime from vanillin	E58	490
Apr 16/18	Check-out		
Apr 23/25	ACS Standardized Exam		

## On-line resources that may be useful to you

<http://www.aceorganicchem.com/resources.html>

“Organic Chemistry Best of the Web 2012” – compilation of websites

<http://www.chemtube3d.com/Main%20Page.html>

High quality videos of organic reaction mechanisms.

<http://ochem.jsd.claremont.edu/intro.htm>

On-line flash cards

Video Tutorials

Practice Problems