Chemistry 112A: Introduction to Organic Chemistry (Fall 2013)

Lectures:
Tuesdays and Thursdays, 8:10-9:30 am, 120 Latimer
Tuesdays, 5:10 – 6:00 pm, 100 Lewis (laboratory lecture)

Lecture and Laboratory Instructor:
Prof. Anne Baranger (abaranger@berkeley.edu)
Office Hours: time announced on BSpace, 213 Lewis

Graduate Student Instructors:

Eduardo Mercado (eduardomercado@berkeley.edu)	Section 201 (Tu, 12-5, 320 Latimer)
Bernard Parker (bfp@berkeley.edu)	Section 202 (Tu, 12-5, 321 Latimer)
Rocio Mercado (rocio@berkeley.edu)	Section 301 (W, 1-6, 320 Latimer)
Dimitri Khrakovsky (dimitrik@berkeley.edu)	Section 302 (W, 1-6, 321 Latimer)
Rong Ye (rye@lbl.org)	Section 401 (Th, 1-6, 320 Latimer)
Rebecca Durr (rebeccadurr@berkeley.edu)	Section 402 (Th, 1-6, 321 Latimer)
Samantha Keyser (skeyser@berkeley.edu)	Section 422 (Th, 5-10, 322 Latimer)
Mark Levin (mark.levin@berkeley.edu)	Section 501 (F, 1-6, 321 Latimer)

GSI Office Hours are held in Bixby Commons. All GSI office hours are open to all enrolled students – you are not limited to the GSI who teaches your lab section. A schedule is posted on the class website.

Review Sessions by GSIs: T 6-8pm 100 Lewis. Start 9/10

Administration: The administrative coordinator for the course is Mark Jenkinson (213 Lewis Hall, 642-8163, mjenkinson@berkeley.edu), and questions about prerequisites, add/drops, enrollment, etc. should be directed to him.

Class Web Site:
https://bspace.berkeley.edu

Materials:
1. *Organic Chemistry* by G. Marc Loudon, 5th Edition; Roberts & Company, 2009 (the study guide is a recommended supplement)
2. *Understanding the Principles of Organic Chemistry: A Laboratory Experience* by Pedersen and Myers
3. A laboratory notebook with carbon-copy pages (ISBN: 9780738035871, stocked by the bookstore for Chem 3AL/3BL - check with your GSI for approval if you would like to use a different one)
4. Recommended: HGS Molecular Structure Kits, W. H. Freeman and Co.
5. Sapling Learning System. Purchase at http://saplinglearning.com

Grading:

250	Midterm Exams (125 points each)
300	Lecture Final Exam
50	Lecture Problem Sets (top 5 scores will contribute to this score)
50	Sapling Learning Problems (top 20 scores will contribute to this score)
100	Laboratory Final Exam
180	Laboratory Notebook Reports
20	Grignard Reaction Lab Report
50	Lab Lecture Quizzes
50	Worksheets
1050	Total

Assigned Problems:

Assigned problems come in three forms.

1) Regular assigned problems from Sapling Learning System. These will be due at 7:00am before each lecture. These problems will be at an easy to moderate level for you to gain a basic mastery of the material. Your top 20 scores will be used to calculate your total Sapling score.

2) Bi-weekly problem sets. These problems will be at a higher level than the Sapling problems. Some of the problems will be written by the instructor, and others will be assigned from the book. Additional practice problems from the book and other sources will be recommended. There will be a total of six lecture problem sets. The lowest score will be dropped from grade calculations.

3) Worksheets completed at home or in laboratory. These will focus primarily on laboratory techniques, especially NMR.

Exams:

Exam 1: Thursday, October 10, 8:10 – 9:30 am
Exam 2: Thursday, November 14, 8:10 – 9:30 am
Laboratory Exam: Tuesday, December 3, 5:10-6:00pm
Final Exam: Group 9: Wednesday, December 18, 2013 3:00-6:00 pm

For an excused absence at an Exam, as evidenced by a note from a medical professional or another acceptable source, the missed exam will be handled in one of two ways, at my complete discretion, as follows: (1) Your score on the missed Exam will be assigned as the average of your scores on the other two Exams, scaled appropriately to the class averages on those other exams; or (2) You will be required to take a make-up Exam.

Laboratory Reports and Quizzes:

1. **Lab Lecture Quizzes**: *(50 points; 10 quizzes, 5 points each*): Most lab lectures will begin with a 8-min quiz. This quiz will include questions related to recent lab lectures and/or questions related to recent lab experiments. The quiz will begin promptly at 5:10 pm, and students who arrive late will not receive extra time. There will be no makeup quizzes, however one extra (eleventh) quiz will be given, and the lowest score will be dropped from grade calculations.
2. **Lab Notebook Reports** (*180 points; 10 reports, 18 points each*): These will be completed in lab each week, including prelab preparation, data/observations, analysis, and conclusions. There are 11 weeks of experiments, the lowest score will be dropped from grade calculations.
3. **Grignard Reaction Lab Report** (20 points): There will be a take-home assignment related to the Grignard lab experiment, in addition to the normal lab notebook report. Details will be provided at a later date.

Course Grade

The table below shows the correlation between your final grade and the total number of points you earn. The point ranges may be lowered slightly when final grades are assigned. Bonus points will be offered from time to time for completing surveys.

Grade	Range	Percent
A+, A, A-	892-1050	85–100%
B+, B, B-	735–891	70–84%
C+, C, C-	577–734	55–69%
D+, D, D-, F	0–576	45–54%

General Course Policies:

Cheating and Plagiarism: Any cheating in examinations and any other unethical conduct will result in an automatic grade of F, a report to the committee on student conduct, and procedures designed to alert past and future professors about any such incidence. **Don't do it!** *If you have a problem of any sort that impinges on your performance,* see Professor Baranger, rather than resorting to ill-informed and poorly conceived measures.

Lecture Component of 112A

This course provides a comprehensive introduction to the fundamentals of organic chemistry – the chemistry of carbon and its compounds. We will first review electronic structure and bonding. We will then focus on four general topics:

1. Conformation and structure
2. Reaction mechanisms
3. Reactions involving alkenes and alkynes
4. Substitution and elimination reactions

All of these topics are interrelated. An important objective of the course is to provide you with an understanding of organic chemistry to apply to problems you encounter in the future involving organic chemistry.

By the end of the class you should be able to:

1. Predict the 3D dynamic structures of organic molecules.
2. Represent mechanisms of organic reactions with arrows, reaction energy diagrams, and orbitals
3. Identify nucleophiles, electrophiles, and leaving groups in reactions.
4. Predict products, including regio and stereoselectivity, based on a knowledge of the mechanisms of reactions.
5. Propose multistep syntheses of organic molecules.
6. Use an understanding of the kinetics and thermodynamics of a reaction, predict how the rates and product compositions are affected by changing the substrate, adding a catalyst, changing the temperature or solvent, etc.

Course Outline: The following topics will be discussed in the order shown below (subject to change). The number of lectures per topic will vary. Topics not found in the text will be inserted when appropriate.

Topic 1	Orbitals and bonding
Topic 2	Alkanes and conformational analysis
Topic 3	Acid/Base
Topic 4	Alkene – structure and properties
Topic 5	Addition Reactions of Alkenes
Topic 6	Stereochemistry
Topic 7	Conformation of cyclic compounds
Topic 8	Properties and reactivity of alkyl halides
Topic 9	Substitutions and eliminations w/ alkyl halides
Topic 10	Properties and reactivity of alcohols and ethers
Topic 11	Alkynes – Structure, properties and reactions

Sapling Instructions:

To get started:

1. Go to http://saplinglearning.com
2. a. If you already have a Sapling Learning account, log in and skip to step 3.
   b. If you have a Facebook account, you can use it to quickly create a SaplingLearning account. Click "create account" located under the username box, then click "Login with Facebook". The form will auto-fill with information from your Facebook account (you may need to log into Facebook in the popup window first). Choose a password and timezone, accept the site policy agreement, and click "Create my new account". You can then skip to step 3.
   c. Otherwise, click "register here" located under the username box. Supply the requested information and click "Create my new account". Check your email (and spam filter) for a message from Sapling Learning and click on the link provided in that email.
3. Find your course in the list (listed by subject, term, and instructor) and click the link.
4. Select your payment options and follow the remaining instructions. You can enter your access code or pay with a credit card. You will be access the homework site for 2 weeks before you are required to pay for it.

- Once you have registered and enrolled, you can log in at any time to complete or review your homework assignments.

- During sign up - and throughout the term - if you have any technical problems or grading issues, send an email to support@saplinglearning.com explaining the issue. The Sapling support team is almost always more able (and faster) to resolve issues than your instructor and TAs.

- To optimize your Sapling Learning experience, please keep your internet browser and Flash player up to date and minimize the use of RAM-intensive programs/websites while using Sapling Learning.

Laboratory Component of 112A

Laboratory Lecture:

These discussions (Tuesdays 5-6 pm) will focus on the theoretical and practical aspects of the lab experiments, but they will not serve as a "walk-through" of the actual procedures. Topics will include the principles underlying important purification methods (including crystallization, extraction, sublimation, distillation, and chromatography) and analysis methods (including measurement of physical properties, thin layer chromatography, HPLC, and spectroscopic characterization).

Laboratory:

The laboratory sections will provide an introduction to the techniques of experimental organic chemistry, including methods of compound purification, characterization, and structural determination. Many of the experiments require that you work in groups of two to four students. It is important to compare your data to those of others and determine whether your findings are consistent with what is expected. Group work requires cooperation and sometimes patience. *Please note that no person in a group is to rush the other group member in order to finish early. If it is determined that this is occurring, the graduate student instructor has the prerogative to excuse the person involved, resulting in a score of 0/20 points for that lab report.*

Laboratory Attendance

Attendance in lab each week is mandatory. Requests for exceptions to this policy (as outlined below) should be emailed to Prof. Baranger (abaranger@berkeley.edu) with cc's to your GSI.

- Students who will be away from campus on a laboratory date for a sanctioned University event (e.g., university band, play on a university athletic team - not club) must email us at least one week in advance of the planned absence. Upon email notification, a reasonable attempt will be made to arrange participation in an alternate lab section prior to the travel dates.
- Students who have a personal or family emergency and have to travel home or be in the hospital (a signed and stamped doctors note is necessary), should contact us as soon as possible. All reasonable effort to accommodate the student in another laboratory section will be made. Unfortunately, a special individual laboratory experience cannot be arranged and so in the event that they are unable to make up the laboratory in another section, they will forfeit that laboratory grade (there is one dropped lab score included in the grading scheme to accommodate this circumstance).

Laboratory Schedule:

Week	Lab Lecture Date (Tues)	First Lab Date (Wed)	Lab Experiment	Procedure
1	-	-	No lab (partial week at start of semester)	
2	9/3	9/4	Lab Check-in, Safety, and Worksheet	
3	9/10	9/11	**Expt. A**: Thin Layer Chromatography	Pedersen textbook: p. 241 (called Experiment 7)
4	9/17	9/18	**Expt. B**: Separation of Organic Compounds Using Liquid-Liquid Extraction	Handout – posted on bspace
5	9/24	9/25	**Expt. C**: Column Chromatography (Handout)	Handout – posted on bspace
6	10/1	10/2	**Expt. A-C** Finish: Comparison of purity and relative yield from weeks 4 and 5 using TLC and HPLC	
7	10/8	10/9	**Expt. D:** Recrystallization and Melting Points: Separation of Salicylic acid and Adipic Acid **Lecture Exam 10/10**	Pedersen textbook: p. 230 (called Experiment 5)
8	10/15	10/16	**Expt. E**: Isolation of Trimyristin from Nutmeg	Pedersen textbook; p. 261 (called Experiment 11)
9	10/22	10/23	**Expt. E**: Finish Isolation of Trimyristin **Expt. F**: Asymmetric catalytic transfer hydrogenation (Handout)	Handout – posted on bspace
10	10/29	10/30	**Expt. E-F** Finish: Analysis of purity separation of products from Expts E and F by TLC, NMR (trimyristin), and HPLC (asymmetric transfer hydrogenation)	
11	11/5	11/6	**Expt. G**: Nucleophilic Substitution Reactions	Pedersen textbook; p. 257 (called Experiment 10)
12	11/12	11/13	**Expt. H**: Some Chemistry of α-Pinene Oxide **Lecture Exam 11/14**	Pedersen textbook: p. 291 (called Experiment 16)
13	11/19	11/20	**Expt. I**: The Grignard Reaction (Experiment 14, p. 278)	Pedersen textbook; p. 278 (called Experiment 14)
14	11/26	-	Lecture and Tuesday lab only. No lab Wed-Fri (Thanksgiving).	
15	**Exam**	12/3 (Tu)	**Lab Exam** (during lab lecture time), lab checkout (Tues-Fri).	

Laboratory Notebook Reports:

The following guidelines are provided to help you understand how the Chem 112A lab reports are graded this semester. Specific lab report instructions will be provided to supplement the lab manual as needed. Each report is to be written in the lab notebook, and is due at the end of the lab period in which the experiment is conducted unless otherwise specified. The following is a list of the types of information we are looking for each week. The particular emphasis from within this list may change from week to week, depending on the nature of the experiment.

Each lab is worth a total of 18 points, with credit assigned in whole-number increments. There are a total of nine lab experiments, but only the top eight scores will be counted (the lowest score will be dropped.)

It is important to be prepared for laboratory section and organized while in the laboratory section. *Therefore, if you are more than 15 minutes late leaving the laboratory at the end of the session, one point will be deducted for every additional 15 minutes you are in the laboratory.* You will receive warnings the first two times you are late leaving the laboratory. This way, if you have one or two long days in the laboratory, you will not have point deducted. However, if you repeatedly are late leaving the laboratory, then we will deduct points from your laboratory grade.

Please note that if you have not ***prepared a prelab prior to the start of the lab period****, you will be excused from lab and will not be permitted to complete the lab experiment. Additionally, if at any point your GSI determines that you are not adhering to* ***safety guidelines*** *you will be excused from lab and will not be permitted to complete the lab experiment.* ***This will result in a score of 0/18 for that experiment.***

- **Prelab Preparation** (2-3 points)
  - Title and introduction statement
  - Table of chemicals, including structures, physical properties, amounts to be used, etc.
  - Safety notes
  - Flow chart/procedure, detailed enough to follow during lab
  - Balanced equation and stoichiometry calculations if a reaction will be carried out
  - Tables set up for collecting/organizing data as needed
  - Good organization, set up to allow efficient work in lab, follow any specific format instructions provided by GSI
  - Answers to any questions and/or calculations or anything else explicitly listed in the "prelab checklist"

- **Lab Participation** (2-3 points) – (This score is subject to GSI discretion)
  - Active, productive participation during the lab period
  - Adherence to safety guidelines
  - Effective time management
  - Cooperation and communication with classmates
  - Cooperation and communication with GSI
  - Clean and considerate use of group supplies (such as keeping reagent bottles capped and putting them back where they belong)
  - Cleanliness of personal glassware and space.

- **Data/Observations** (8-10 points)
  - **Names of partners**, information about division of labor for any group work
  - **Descriptions of any chemicals used** (solid/liquid, color, shapes of crystals, etc)
  - **Code numbers** for any unknown samples used
  - **Use tables** where possible to simplify data collection/presentation (if possible, create these blank tables during prelab preparation.) Make sure columns/rows are labeled in an unambiguous way.
  - **Exact amounts** of any chemicals used, to the level of precision that the measurements are made. This applies even if you use the exact amount that was specified in the procedure.
  - Any **actions taken** (mixed these reagents, heated this flask, etc)
  - **Temperature** when heating anything ("*desired temperature was 70 degrees, actual temp of sand bath was 74 degrees after 10 min of heating time*")
  - **Time** used for any time-sensitive steps ("*heated 17 min, then cooled for 10 min" or "began stirring at 3:07 pm, took TLC samples at 3:25 and 3:43 pm, concluded stirring at 3:45 pm*")
  - **Sketches** of any unusual glassware or experimental setups
  - **Physical descriptions** of any mixtures (*"upon adding X solvent to the yellow powder of X compound, approximately half of the material appeared to dissolve, providing a clear solution with white solids suspended in it"*)
  - Any **color changes, phase changes, bubbling, heat evolved**, etc. that is noticed
  - **Details accompanying each TLC** sketch such as developing solvent, lane labels, visualization notes, Rf values, etc
  - Any TLC plates with major flaws (curved/overlapping lanes, missing spots that cannot be explained, big blurry spots, etc) should be run a second time to try correcting the error. Record both in notebook, with notes about why TLC was repeated.
  - **Detailed physical description** of any product collected (color, solid/liquid/oil/foam/film, powder/needles/flakes/clumps, etc.)
  - **Mass of any product collected** (including mass of empty flask/vial as needed to calculate this)
  - Any **melting point** should be reported as a range, not a single number
  - Notes about any **problems encountered** (spills, contamination, etc)
  - Any **other observations** explicitly prompted by the lab instructions
  - **Citations for classmates' work**: If data is obtained from a classmate, write down who obtained the data. If this is done due to an unanticipated problem which prevented you from collecting/using your own data, **get permission from GSI first**.

- **Discussion and Conclusions** (4-5 points)
  - **Interpret all analytical data** that was collected ("*based on TLC data, fractions 5-9 from this column contain acetaminophen*" or "*lane 4 of the TLC plate indicates the presence of an impurity in this sample*" or "*based on the pure and mixed melting point data, this sample must be mostly salicylic acid*")
  - **Show work for any calculations** requested, including formulas and units.
  - **Address all bullet points**, in order, from instructions list provided in the lab manual.
  - Keep answers **concise** (a few sentences each, not a few paragraphs each)

- If you are having trouble finishing this in lab, consider spending extra time thinking about the questions you will have to answer and making predictions while you are preparing your prelab.
- **Write a concise conclusion**, even if it is not specified in the list of instructions. This conclusion should demonstrate your understanding of the purpose of the lab experiment.