Chemistry 4322/8322: Advanced Organic Chemistry
Spring 2022
Smith Hall 331, MWF 11:15AM-12:05PM

Professor Chris Douglas
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Office Hours: Tuesdays 5-6 PM, Thursday 11AM-noon or by appointment

Teaching Assistants: none!

Course Objectives: The overall objective of this course is for the student to develop skills in logic-based synthesis planning of organic compounds. We will work to achieve this objective by focusing on several concepts: retrosynthetic planning, relay of stereochemical information in reactions, the conservation of orbital symmetry in organic reactions, and mastering reactions that are either new to the chemical literature or new to the student.

Prerequisites: One year of introductory instruction in organic chemistry. Chemistry 8321/4321 is strongly recommended.

Required Materials:

Textbooks (3)

1) A comprehensive undergraduate text in organic chemistry to use as a reference. Feel free to use whichever textbook you used in your undergraduate organic chemistry class. If you don't have one handy, get a cheap one on the used market or talk to me.

2) Kirby, A. J. *Stereoelectronic Effects*

3) Kurti L. & Czako, B. *Strategic Applications of Named Reactions in Organic Chemistry*

Additional reading assignments will be assigned in the form of references from the literature and the internet. I will provide these on the course's Canvas site. If you are on campus, or logged in to your Minnesota account via a secure connection, you will have access to journal articles via the library: www.lib.umn.edu

Model Kit (1)

A model kit for organic chemistry is required. We will use these in class.

Expectations: (1) I expect the class to operate with an atmosphere of mutual respect, between the students & the instructor and between students.

(2) Attendance is required. Absences will be felt most strongly on days with teamwork.

(3) Students are expected to come to class ready to learn. This includes reviewing concepts from earlier organic chemistry classes, particularly those reactions and concepts identified by the instructor. Do the reading ahead of class & ask questions about it! We will conduct in-class exercises that will require you to prepare by doing reading assignments and review prior to class. So really, do the reading ahead of class.

Canvas Participation & Assessment: There will be canvas surveys and "quizzes" to give you practice with concepts, assess your retention from class, and give me feedback on what is or isn't working well for you. They will be graded on participation, correctness, or both.

Synthesis Friday Group Work: Fridays will consist of team projects on synthesis planning. Groups will be assigned, and group members will shuffle throughout the semester. Absence from group work must be first cleared with the instructor or as quickly as possible after the fact.

Projects: There will be two projects due at various times in the semester, with milestone portions due ahead of the final due dates. These dates and the project's grading rubrics will be published later. One will involve a literature project, and another will involve an original synthesis proposal.

Academic Dishonesty & the Student Code of Conduct

Academic Dishonesty is defined in the Student Code of Conduct by the Regents of the University of Minnesota - Twin Cities at the following URL:
http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf

You are responsible for following the code of conduct. Instances of academic dishonesty in my class will be referred to the appropriate authorities. Other violations of the Student Code of Conduct will also be referred. Consequences may include probation, suspension, or expulsion. Since some projects will involve the chemical literature, plagiarism is to be strictly avoided.

Learning how to push arrows will help develop your 'chemical intuition'. The following "12-steps" have been very helpful to me.

A Twelve-Step Program for Arrow Pushers

Adapted from Prof. K. A. Woerpel

1. Electrons flow from sites of high electron density to sites of low electron density.
2. Balance the Equation: it really helps.
3. Don't violate the basic rules of physics.
    a. Conservation of mass and energy (a corollary to step 2)
    b. Conservation of charge (a more common error than you might think)
4. Three Arrow Rule: Don't push more than 3 arrows at one time.
    a. Some Rules were made to be broken – this one gets broken a fair amount, but do follow it as you are starting out.
5. Draw out all intermediates.
    a. Take your time here: a common mistake is to improperly draw an intermediate.
    b. A 3-D depiction can be useful. Use models if necessary.
6. Use your lone pairs.
7. All steps are, in principle, reversible.
8. Contemplate your options and carry each to its conclusion before discarding.
9. The correct mechanism gives the observed product.
10. Use connectivity to tell you how the puzzle fits together.
    a. A logical numbering system works wonders.
    b. "Principle of least action."
11. Always identify the nucleophiles and electrophiles at every step.
    a. At times it may be useful to substitute oxidants & reductants above.
    b. High HOMO's or low LUMO's might also be helpful here.
12. Work backwards from the product to likely precursors.