

## “Tutorial” Projects

In my upper level organic chemistry course (Organic Synthesis), taken mostly by chemistry majors but also by some other interested parties (approximately 10 students per semester), I have two assignments in particular which are intentionally inclusive in nature. Students are required to give two presentations (one shorter and one longer) on a given topic and I use a tutorial approach to allow for students to develop a deeper understanding of the material that they need to present.

In order to allow for students to highlight their different abilities, the assignments have three subsections, each of which is graded individually. In addition to being graded on their oral presentations and a written assignment, students are also required to meet with me to discuss their projects and really to hone their projects until they get it right. This approach allows for the incorporation of aspects that appeal to different learning styles and allow students to express themselves and what they know in the forms of different media. This approach is of course easier to do with a smaller class, but I think would also be beneficial in my larger organic chemistry courses (45-60 students).

A little bit about the course: Organic chemistry is the study of the behavior of molecules that contain carbon, which are pretty much all of the important molecules in biology and medicine. While chemistry is obviously an experimental science, this is a lecture course, primarily focusing on the theoretical aspects. The synthesis portion of the title of the course is the more interesting piece: one of the unique aspects of organic chemistry is that it is possible for a chemist to make in the lab (“synthesize”) any molecule that she chooses, by starting from a simpler molecule and then conducting a series of chemical reactions on that starting material. In practice, this is as much art as science, as molecules don’t always behave as we want them to and also because this practice takes a great deal of experimental acumen. This course is taught in a case-study format, in which we learn new chemical reactions and concepts in the context of published syntheses of known drugs or other interesting molecules (penicillin, lunesta, etc.) Each case study involves several new reactions and learning about the strategies and tactic involved in making these molecules in the lab.

### 1. Short Project

- I pick one reaction from each case study that I will not talk about myself, but rather have a student present to the class. Students are allowed to choose the reaction they want to present, on a first-come, first-served basis.
- The student then researches the reaction on her own and meets with me to talk about the research. The student receives credit just for meeting with me, with the proviso that they have to meet with me until their level of understanding of the reaction is sufficient.
- The student then makes a handout to distribute to the class and gives a short in-class presentation on the reaction. Both aspects are graded equally.
- This project is worth about 5% of the final grade; half of that grade comes from the meetings and the other half is graded as follows:
- The presentation is worth 10 points and each of the following five aspects will be graded on a 0 (poor), 1 (adequate), 2 (excellent) scale:
  - Accuracy of presentation
  - Quality of explanation
  - Neatness and organization of board work
  - Style (did you talk loud enough and stay within time limit)
  - Handout (neatness, accuracy, references)

## 2. Final Project

- Each student has to present his own case study of the synthesis of a drug, chosen by the student from a pre-selected list
- Each case study involves several chemical reactions and concepts, some that are brand new, and some that we have talked about in class.
- Again, the student has to research the reactions on her own, and for some of them, the “answers” are only partially available. Through a series of one-on-one tutorial meetings with me, again the student will be able to practice the presentation, see that the research is sufficient, and also the student can review concepts learned in class that he was not that strong on in the first place, in what is, I hope, a less-threatening environment.
- This project is worth about 20% of the final grade and of that 20% come from the tutorials, 40% from the presentation, and 40% from the written assignment.

### Advantages of tutorial method:

- Students who feel uncomfortable participating in in-class problem solving exercises and who fell uncomfortable asking questions can meet with me in a non-graded, but for credit meeting
- Students gain a greater understanding of the material through individual sessions

### Disadvantages:

- Large investment of instructor’s time
- Students may rely on tutorial sessions to “fill in the blanks” of spotty research efforts.

### Results and Future Plans

- I have a relatively small sample size, but students uniformly have done well on the final project, several of them performing much better on that assignment than on tests. Several students who NEVER participated in class and came across as quite shy gave excellent presentations in which they spoke confidently about very complicated concepts. I did not give the students the answers...I told them when they were wrong, pointed them in the right direction (gently) and gave guidance when appropriate.
- In the future, I would like to try making the tutorials small group efforts, in which students can work on problems collaboratively and even start a dialog about problem solving strategies and the concepts at hand with me serving as a facilitator.