

How to Study Organic Chemistry

Adapted from *Organic Chemistry, 2nd Edition*, by Maitland Jones

The ideas that follow are advice from someone who has taken several organic chemistry courses and loved all of them in addition to someone who is teaching this course for the eighth time. I offer these ideas based upon my experience learning organic chemistry in addition to seeing how past students have succeeded in my class. Following this advice does not give you an “A” or guarantee that you will pass the course, but they should certainly help make organic chemistry easier and more enjoyable.

Don't Memorize. In the old days, courses in organic chemistry rewarded people who could memorize. Indeed, the notorious dependence of medical school admission committees on the grade in organic chemistry may have stemmed from the need to memorize in medical school. If you could show that you could do it in organic, you could be relied upon to be able to memorize that the shin bone was connected to the foot bone, or whatever. Nowadays, memorization is the road to disaster; there is just too much material. Those who teach this subject have come to see an all too familiar pattern. There is a group of people who do very well early and then crash sometime around the middle of the first semester. These folks didn't suddenly become stupid or lazy; they were relying on memorization and simply ran out of memory. Success these days requires generalization, understanding of principles that unify seemingly disparate reactions or collections of data. Medical schools still regard the grade in organic as important, but it is no longer because they look for people who can memorize. Medicine, too, has outgrown the old days. Now medical schools seek people who have shown that they can understand a complex subject, people who can generalize.

Work with a Pencil. Maitland Jones' organic professor (the author of my favorite Organic Chemistry textbook) told him, “Organic chemistry must be read with a pencil.” My organic professor told me the same thing. Truer words were never spoken. You can't read your text or any chemistry book; in the way you can read books in other subjects. You *must* write things as you go along, not just highlight the important points. There is a real connection between the hand and the brain in this business, it seems. In fact, sometime during my undergraduate and graduate education, I realized that I comprehended the material much better if I rewrote (and rethought) my lecture notes. When you come to the description of a reaction, especially where the text or notes tell you that it is an important reaction, by all means take the time to draw out the steps yourself. It is not enough to read the text/notes and look at the drawings; it is not sufficient to highlight. Neither of these procedures is reading with a pencil. Highlighting does not reinforce the way working out the steps of the synthesis or chemical reaction at hand does.

In addition to reading with a pencil, I would suggest the following note card system. The first note card should have the reactant and reagents on the front with the product ON THE BACK. Associated with this first note card is a second note card that has the mechanism for the reaction. These first two note cards must be kept together and are closely related. It is very easy to predict the product of a reaction if you can work through the mechanism. We will discuss the mechanism for nearly every reaction in this course, but there will be the occasional reaction where the mechanism is not fully understood or too complicated for this course. These note cards should NOT be used like typical note cards. You should use them with a pencil and paper!! Look at the front of the card and DRAW the mechanism and product on your piece of paper. Then check your answer with the back of the card. You will not get much out of looking at a mechanism; you need to draw the mechanism. A third note card, which should be kept in a different pile from the first two completely, should have the reactant and product on the

front and the reagent ON THE BACK. This note card will help you immensely when we start to synthesize molecules. At first, these cards will be few in number, and sparsely filled, but as we reach the middle of the course there will be an explosion in the number of synthetic methods available. This subject can sneak up on you and keeping a catalog will help you to stay on top of this part of the subject. Textbooks try to reinforce their points by interrupting the text with problems where the solutions follow immediately. These problems are important. You can read right by them of course, or read the answer without stopping to do the problem, but to do so will be to cheat yourself and make it harder to learn the subject. Doing these in-chapter problems is a part of reading with a pencil and should be very helpful in getting that material under control. There is no more important point to be made than this one. **Ignore it at your peril!**

Work in Groups. Many studies have shown that a very effective way to learn is to work in small groups. Form a group of your roommates or friends, and solve problems for each other. Assign each person one or two problems to be solved for the group. Afterward, work through the solution found in the chapter or solutions manual. You will find that the exercise of explaining the problems to others will be enormously useful. You will learn much more from “your” problems than from the problems solved by others. So, be careful not to be a “silent partner” in these groups. That defeats the purpose of the group work. Do not just meet in groups when you are working on a startup or workshop exercises, use your groups to tackle the Hornback (your text book, ☺) problems as well. As the semester progresses, I hope to increasingly replace lecture with small-group problem solving as the focus of the material switches to the synthesis of molecules. So, we will be doing a little more problem solving during class as well. This should give you some clue as to the importance that I give small-group problem solving.

Work the Problems. As noted above, becoming good at organic chemistry is an interactive process; you can't just read the material and hope to become an expert. Expertise in organic chemistry requires experience, a commodity that by definition you are very low on at the start of your study. Doing the problems is **vital** to gaining the necessary experience. Resist the temptation to look at the answer before you have tried to do the problem. Disaster awaits (or has found) you if you succumb to this temptation, for you cannot learn effectively that way, and there will be no answers available on the examinations until it is too late. That is not to say that you must be able to solve all the problems straight away. There are problems of all difficulty in Hornback and on the startups and workshop exercises, and some of them are very challenging indeed. Even though the problem is hard or very hard, give it a try. The answer may not be immediately obvious or obvious after a few minutes of thinking about the problem. Do not get discouraged. Just start working the problem. Do the most sensible step and see where it leads you, if it doesn't get you to the answer, try another step. This is how to solve difficult problems. When you are truly stuck, that is the time to gather a group to work on it. Only as a last resort should you take a peek at the Solutions manual. There you will find not just a bare bones answer, but, often, advice on how to do the problem as well. Giving hard problems is risky, because there is the potential for discouraging people, which I worry that I will do to a few of you. Please don't worry if some problems, especially hard ones, do not come easily or do not come at all. Each of us in this business has favorite problems that we still can't solve. Some of these form the basis of our research efforts, and may not yield, even to determined efforts, for years. A lot of pleasure in organic chemistry is working challenging problems, and it would not be fair to deprive you of such fun!

Ten One Hour Blocks are better than One Ten Hour Block. Organic Chemistry is a language and like any language you learn by being submersed in the subject. You will be much better off if you study in one-hour blocks, then if you only look at organic

chemistry once or twice a week for large amounts of time. You will probably survive for a few weeks or the first exam by cramming for exams and workshop sessions, but you will NOT survive the course. There is too much information in this course and the second semester to cram for exams. You need to learn AND understand the material.

Use All the Resources Available to You. You are not alone. Moreover, everyone will have difficulty at one time or another in this course. The important thing is to get help when you need it. I have office hours, we have a workshop session each week, and we have review sessions before the exams. I am here to help you, and will not be upset if you show enough interest to ask questions about a subject that I love. “Dumb questions” do NOT exist! You are not expected to be an instant genius in this subject, and many students are too shy to ask perfectly reasonable questions. Don’t be one of those people! Obviously, I do expect you to remember a great deal of your general chemistry and to have thought about the question, but you should come by and ask your questions. I think that your classmates that do stop by regularly will tell you that they find it very helpful to have the concept explained one on one.

If you feel uncertain about a concept or problem in the book—or lecture—get help immediately. This subject is highly cumulative (as you will notice), and ignored difficulties will come back to haunt you. I know that many teachers tell you that it is impossible to skip material and survive, but this time it is true. What happens in December or April depends on September, and you can’t wait and wait, only to “turn it on” at the end of the semester or year. Almost no one can cram organic chemistry. Careful, attentive, daily work is the route to success, and getting help with a difficult concept or a vexing problem is best done immediately.