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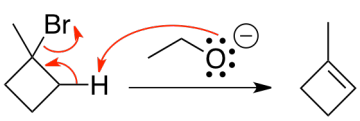
Part 1: Keep Calm and Push Arrows.

I am an organic chemist. Yes, the often-dreaded subject known to weed out pre-meds; it takes a special course to be discussed in the New York Times for its level of difficulty ("How to Get an A- in Organic Chemistry," Nov 1, 2013). It's the kind of course where people *don't* tend to keep calm; and that's why I have adopted the logo shown as my theme for organic chemistry: "Keep Calm and Push Arrows." What are arrows, and why push them? Organic chemistry is not best learned by memorizing countless index cards, then cramming in the weeks prior to the MCAT. That most often leads toward failure. Instead, an understanding of some basic themes can allow students to work the answer out, rather than memorizing it! A closer look at organic chemistry shows underlying themes that explain perhaps not everything, but almost everything. This prompted me to come up with my "Four Rules of Organic Chemistry." I have advocated these rules for nearly two decades, even to the point that I have found them plagiarized by a candidate for a position in my own department. To some degree, these rules guide our approach to the *mechanisms* of chemical reactions. These are the rules that arrows must follow. Mechanisms articulate the "nuts and bolts" of how compound A becomes compound B, and details every little step along the way. Mechanisms involve some simple artwork, where students draw curved arrows, or "push arrows," to guide themselves through a problem. There are strict rules about what position an arrow needs to start from and where it needs to end up, and correctly pushing the arrows should get you to the correct product. Thus if you can push arrows, you can understand perhaps 80% of organic chemistry, and maybe even more if you can apply some of the thematic rules. When a student can take chemistry and reduce it to smaller, bite-sized principles, all the while using one overriding theme for how to approach almost everything, the whole process gets a little less scary. And maybe then students will in fact stay calm, and apply the techniques and the processes they've learned along the way, as opposed to pulling an all-nighter and cramming for the next exam!



An example of pushing "curved arrows" in an organic reaction.

Part 2: Participate!

I am an organic chemist because, minutes after my first organic chemistry exam was handed back in 1993, a fellow student asked me to be her tutor. The subject became tremendously enjoyable when I began to take ownership of it, requiring an ability to explain a subject that was still new to me. A subsequent opportunity to join a research lab propelled me beyond anything a textbook could ever contain. Now, as a faculty member, I have had nearly 50 students, mostly undergraduates, do independent research in my group. My student colleagues design and execute chemical reactions, and my job is to guide them and keep everyone safe and scientifically developing. My latest aspiration is to have Villanova students become first authors on a peer-reviewed paper before they even *apply* to graduate school or for a job. The three students in the pictures shown have accomplished this over the last 2 years; moreover, these three developed novel chemistry that has led into two patent applications and a spin-off company from Villanova! We know that primarily undergraduate institutions face obstacles in their collective future, but the ability to engage students in cutting-edge research with enthusiastic faculty is something that we can do unlike any other type of institution. And the students can truly embrace a discipline, perhaps even to make it theirs for a lifetime. Maybe, with a nuts-and-bolts approach or with an exciting lab experience, some students will learn love this subject as much as I do.