

Concepts, Not Cookbooks: Helping Students Get More Out of Lab

Amber Johnson
Department of Chemistry
University of California, Riverside



From our students' point of view, it's easy to understand why they don't like lab. It's four hours per week of following complicated directions; a large part of it is waiting in line for equipment or for "invisible" molecules to react; it's worth about as much as a midterm in the grand point scheme of the class, and too much effort goes into low point value reports. The start of most student confusion is the lab manual, the book they are supposed to use to gain an understanding of what will happen in the experiment. Most students use the manual as a cookbook, writing down precise directions. They often get more caught up in the specifics (do I put the aqueous layer in the 3 mL or 5 mL vial?) than the educational aspects (I'm washing away water-soluble byproducts from my reaction so I can isolate the desired product). Many students mechanically work through these

instructions and take away few of the important concepts of the experiment. Students are also more concerned about getting products from their reactions than they are in learning why they are performing each step or what is happening. TAs are there to clarify student questions and help them through the difficult parts of the procedure, but often don't have time to clarify the reason behind the step. One of the most effective strategies I've found for bridging this knowledge gap is bringing "real" chemistry into my teaching.

When students are confused about a concept, visual aids are often helpful. In the course of my research, I've taken pictures of things I thought were particularly interesting looking, and some of them have been applicable to my teaching. One of the experiments I teach features column chromatography. The students use crude equipment and get poor results, making them lose interest. By showing them columns I've run, I'm able to show what good results look like in an interesting way, and pique their interest in the concept. Another example is when a molecule I learned about in one of my classes features a reaction my students are learning about. I draw some of the intermediates, and my students enjoy being able to identify their reaction and predict what step comes next in the synthesis of a complex molecule.

Another useful technique I have found is sharing anecdotes about my research or my time as an undergraduate. I will give more background on the type of chemistry I'm teaching and how it can be used or times I've done a similar reaction and what happened (or went wrong). I've found that sharing mistakes I've made with my students is particularly helpful as it helps



them get over their fear of making mistakes. Engaging with students about the material in a more personal way piques their interest, and they ask better questions and perform better in lab.

While these examples have been taken from organic chemistry, these strategies can be applied to other fields as well with individual strategies depending on time constraints, experiment content, and the level of class. Making labs about more than just procedure engages students and turns a potentially boring, tedious experience into an enriching one.

