Development of Senior Biochemistry Laboratory

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The purpose of this project was to completely restructure C486, Biochemistry Laboratory, so that it was an inquiry based course. As a senior level course, I wanted to design a lab course that not only introduced new techniques, but required students to apply these techniques to solve new problems, while at the same time introduce them to the way laboratory work is done in the "real world." I redesigned and tested a semester of laboratory experiments in which students adapted protocols from the primary literature (the way research is really done), searched for prices and availability of reagents (what can you buy vs. what do you need to synthesize yourself), and compared protocols. Nearly all the experiments addressed real questions using state of the art techniques. An example asking students to find and read a paper from 2005 describing a new chemiluminescent detection method for cytochrome c. The students adapted this protocol to answer the question whether a particular cytochrome c in a bacterial extract was induced by arsenite. This is a research question that had never been addressed and was of potential use to my research program. Students were excited to find out something that no one in the world has ever known before.

In previous years, I had explored ways for students to be introduced to diagnostic kit design and production, since many local biotechnology industries are based on this. Building on students' experiences in this lab course from previous years, I realized that students needed more introduction to the techniques and chemical procedures required. This year, most of the semester was centered around making a kit that Dr. Peter Bushnell (from IUSB Biology Department) could use on a ocean research ship to measure the blood urea nitrogen levels in fish. Students invited Dr. Bushnell to describe what he needed and why a kit of this sort would help his research. The students then looked up differences between fish and human blood that would require adaptation of protocols developed for human diagnostics. They researched and designed an approach, synthesized an affinity resin to purify a key enzyme needed to detect and quantify the urea, characterized the enzyme and compared it with commercially available urease (the students' was more pure and cheaper), and tested two quite different procedures for quantifying urea. In designing the kit, students had to consider that the kit would be used by sophomore biology majors with little biochemistry experience on a ship with limited instrumentation. Reagents had to be safe for novices to use, easy to clean if spilled, and with simple protocols. After choosing a general approach, each team of students had to test their protocol for accuracy and reproducibility, and provide evidence that their kit was suitable for Dr. Bushnell's research. Instead of handing in a traditional lab report, students designed the kit insert (of course, they had to find inserts for other kits to see what kind of information to include), complete with a statement of the chemical

principle, interfering reagents, calculations, proof of reproducibility, and procedures for outlying results. Brownie points were given for writing an ad for the journal, *Science.*

The students enjoyed the lab. They told me several times that they liked working on a project that was actually needed by someone and helping research projects. They also enjoyed looking up information instead of given handouts with cut and dried procedures. They didn't enjoy so much the amount of time outside of the scheduled lab required for preparation. I may need to look for ways to cut down some on the time they spent finding information. The students also enjoyed forming their own "company" and competing with other teams. I heard many boasts of exactly why one team's chosen reaction scheme was better than another. I guess they really learned some chemistry.