Letter to the Editor

Putting the Upper-Division Cart before the Introductory Horse

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In the dawn of time, I assume that the original course curricula had a hierarchical organization that made sense. That is, the first course was designed, every faculty member knew what was covered in that course—and what the students were expected to learn—and based on the content, the instructors of that time developed the second course, and so on. Unfortunately, curricular development often no longer involves rational and integrated course design. New courses are added based on faculty members' expertise rather than students' needs, and new instructors are plugged into the existing curriculum, so they often give no thought as to learning goals. And typically, no one has a clue as to what is *taught* in the other courses in the curriculum, and certainly no idea at all as to what has been *learned* in previous courses. The result of this approach is chaos, repetition, and wasted time and effort by both students and faculty members. From my own experience, our happenstance approach, often in fact a backward approach, to curricular design is epitomized by the frequent attempts to modify the introductory course.

In thinking about the current approach to curricular modification, a particular phrase came to mind, "Don't put the cart before the horse." In this idiom, the order of events has been reversed from what we consider proper. The most common problem I encounter in this regard has to do with introductory biology. Numerous times I have been told that our current introductory biology course "does not adequately meet the needs" of a particular upper-division course. However, designing an introductory course to meet the needs of later courses is largely equivalent to putting the cart before the horse.

I am not suggesting that introductory courses should not be designed with subsequent courses in mind. Rather, the source of the problem has to do with the fundamentally flawed way in which most curricula develop. Are new courses added to the curriculum of your department? If so, what is the justification for teaching this new material? Has

an equivalent amount of class time been removed from the requirements so that students can complete their education in a timely manner? In my experience, new courses are added because new faculty members are told that they can, and should, develop a course in their area of expertise, with little thought as to whether the target audience will actually benefit from this material. Indeed, there seems to be a certain logic to this approach. After all, we are always learning more, and as educators shouldn't we convey this (latest and greatest) information to our students? Not necessarily. It is important to remember that the purpose of a university education is not to produce a finished product. Rather, it is to produce a lifelong learner who will continue to seek out information as necessary and apply it to solve unforeseen problems. Thus, it is much more important to show students how to learn and think than it is to try (in vain) to fill their heads with the latest esoteric facts. Yet I contend that it is the desire to add these new facts to the curriculum that in part drives the negative comments about the introductory courses.

Furthermore, it is essentially impossible, and in my opinion quite mistaken, to try to retrofit introductory courses to adapt to the needs of advanced courses. Put another way, we have to start somewhere, and it makes the most sense to start (e.g., designing the curriculum) at the beginning. By definition, one particular course must be the first course. That course should have certain learning goals. For biology, one goal of this first course is to introduce students to a scientific vocabulary. This is essential so that we can communicate with each other. Most introductory cell and molecular biology courses begin with simple biochemistry and build up to the level of the cell. There are many topics that can be covered in this type of course, in fact too many to fit into a single semester. So the instructors need to make some decisions about what to retain.

Considering the goal of showing students how to synthesize information and solve problems, it becomes clear that the exact topics covered are not critical. Certainly most introductory instructors can agree on five to 10 "crucial" topics, but anything beyond that is a matter of individual

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opinion or preference. The important point is that this is the course that lays the foundation for subsequent courses. This initial course covers a certain amount of basic material, and should cover it well; the students should actually be held accountable for learning the material so that this information does not have to be repeated in subsequent courses. If this outcome is met, then it makes sense to design the next course in the series based on the material covered in this first course. Course number two is then designed based on course number one and not the other way around. But the upper-division instructors often want to design their own specialty courses and then figure out how the introductory course can be modified to fit their own needs. These instructors need to

consider the skills and knowledge base that students bring with them from their previous courses and then design their own course to continue from this point.

So the next time a colleague teaching an upper-division course complains that an introductory course needs to be revised to better meet their needs, consider informing them that they are putting the cart before the horse: their course needs to follow the lead, not establish it.

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