Teaching Philosophy

As astronomy professors in higher education, we serve two different populations. The first is the minority that will become the next generation of physicists and astronomers. The second is the majority that will make up our country's educated public.

I believe both these sectors are crucially important. It is often overlooked that citizens' taxes fund the bulk of physics and astronomy research. The survival of our field therefore relies not only on our training a bright generation of future scientists, but also on our ability to effectively communicate its importance to the public.

These two target audiences offer a different set of challenges. My teaching experience thus far is with the latter, so I begin where I am most familiar.

I believe we must develop a scientifically engaged public

I see the facts presented in a non-major course not just as an end in themselves, but more importantly as a vehicle for exemplifying outlooks and developing skills that will stay with students long after most of the facts are forgotten.

Astronomy is fascinating

I believe our field provides the most powerful avenue to exciting the world about science. The scales on which astronomy operates are simply so far beyond our everyday experience that they *demand* a sense of wonder. I taught physical science in a Namibian village for two years, covering a wide variety of topics. And in that classroom, the discussions that truly ignited—the kind that make you realize what teaching *should* be—were the ones on neutron stars, on whether we are part of a galaxy, on whether we will colonize Mars. We must capitalize on this opportunity to capture the public's imagination. It is a launching point for substantive learning.

Science Works

In an era of spreading skepticism about science from creationist and global-warming-denying fronts, it is imperative to impart an appreciation for the scientific process. In my introductory astronomy section, we sometimes discuss competing models in the literature. They are intended to reinforce and supplement concepts from lecture, but I also emphasize that it is this very process of debate and prediction that makes science self-correcting, and therefore reliable.

Developing critical thinking skills

I believe the most pragmatic impact we can have on students is to develop their critical thinking skills. Not only does it carry over to many other aspects of their lives, it generates a richer and more complex understanding of the course material. As such, I strive to mold my classroom into one that fosters critical thinking.

In Namibia, my claim that the tides were the result of the moon 400,000 km away was met with much skepticism. The students proposed that water simply moves because it is alive. This was a detour I had not anticipated, but I had them break into groups and try to design an experiment that might falsify their hypothesis. It was decided as a class that we would carefully pour water onto the concrete walkway outside the classroom—whether or not it moved would settle the matter. I was mentally rehearsing my speech on the power of prediction and the progress of science when, much to my dismay, the water slowly started flowing. It turned out the walkway was slightly inclined! The resulting roar of excitement was perhaps a step back from truth, but surely a stride forward toward creating sharp, independent thinkers.

I will help define the next generation of astronomers

I am excited by the prospect of teaching classes for majors, as this poses a fascinating set of challenges. While the content I teach will provide a foundation for their understanding, I believe we are uniquely positioned as educators to provide knowledge and develop skills at a higher level of cognition:

Teaching how to think like an astronomer

An ultimate goal of our training should be to create scientists who can tackle unsolved problems. Every course should develop students toward that end. Too often, the presentation of a derivation takes an unexpected turn that happens to lead to the right answer. This misses an invaluable opportunity for student learning.

The derivation itself is not the important piece; it will likely be forgotten within hours. The learning opportunity lies in seeing how one might approach such a problem *without* the solution at hand. How do we think clearly about the problem and set it up? Is the problem analogous to others we have already learned how to solve, or do we need to develop new methods for it? What elements of our solution approach should we internalize to solve a broader class of problems in the future? Modeling problem solving will develop innovative and creative thinkers.

Providing perspective

A teacher can provide fundamental insights inaccessible to the student, simply as a result of the instructor's broader perspective.

Such insights allow students to understand the material on a higher metacognitive level, creating connections between diverse areas of physics. It also provides motivation for attacking the topic at hand. For example, students might consider it a waste of time to spend two to three lectures working out a system of masses connected by springs. However, if it is introduced as a model for quantum field theory or to explain the interactions between planets in the solar system, students are more likely to engage the material and internalize it.

Students are different

Research is clear that students have diverse learning styles. I address this through an amalgamation of lecture, demonstrations, think-pair-share questions and in-class technologies. Each of these has both power and limitations. My teaching has evolved to try to maximize their efficacy and will certainly continue to do so.

Furthermore, it is valuable for students to critically reflect on both class content and the learning strategies that prove most effective for them. I recently encountered the idea of student journaling, and will implement it in the next course I teach.

I also believe that students' diverse cultures and ethnicities enrich a class. The Herero tribe in my Namibian village happened to have a base-6 number system. I created a lesson on number systems for my mathematics class, which had the satisfying effect of bringing students into the discussion that previously had been reticent.

Finally I am painfully aware of the gross underrepresentation of minorities and women in scientific fields, and I am committed to fighting it. One of my most rewarding memories of Africa is of mentoring six students through to the regional science fair. For some it was the first time out of the village.

Students will learn what you test them on

Students are conditioned to fixate on grades. I therefore spend significant time aligning my course assessments with the learning outcomes I consider most important. My exams do not simply test recall; rather, they force the student to think critically and utilize more than one course concept simultaneously. I think it is appropriate for an introductory astronomy course to include a paper assignment that allows a student to tackle a course topic or the philosophy of science more deeply.

How do I test myself?

It is easy to focus only on teaching successes. I recognize, however, that I still have much to learn—that's part of what makes instruction exciting! The feedback I find most useful is from those who observe me most often, my students. I also greatly value input from my peers; I like to attend teaching workshops and read from the scholarship of teaching and learning. Like stars, teachers evolve—and that's good, even if it takes us a little bit off the main sequence.