It's Not About You: A Simple Proposition for Improving Biology Education

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THE Genetics Society of America's Elizabeth W. Jones Award for Excellence in Education recognizes significant and sustained impact on genetics education. Consistent with her philosophy of linking research and education, the 2014 Awardee Robin Wright includes undergraduate students in all of her research. She seeks to teach how to think like and to actually be a biologist, working in teams and looking at real-world problems. She emphasizes a learner-centered model of classroom work that promotes and enhances lifelong skills, and has transformed biology education at the University of Minnesota through several efforts including developing the interactive, stimulating Foundations of Biology course sequence, encouraging active learning and open-ended research; supporting the construction of Active Learning Classrooms; and establishing Student Learning Outcomes, standards that measure biology education. She serves as founding editor-in-chief of CourseSource, focusing national effort to collect learner-centered, outcomes-based teaching resources in undergraduate biology.

Why did you decide to become a biologist?

Since I started graduate school, I've asked this question of my peers and professors alike. Many point to an influential teacher. In fact, Beth Jones was one of my most influential teachers, so being recognized as a winner of the Elizabeth W. Jones Award for Excellence in Education is especially meaningful to me. Without a doubt, Beth was also my all-time scariest teacher. If *anyone* didn't provide a well-reasoned, plausible, articulate answer, she didn't suffer the indignity in silence. She pointed out the flaws immediately and with gusto, whether in the classroom, the lab, or in a seminar. On the occasions I was able to earn a "Robin's right!" from her, it felt like the heavens opened and a beam of light streamed onto my head. Her high standards helped me become the biologist that I was capable of being.

In addition to influential teachers, an intense experience is often pivotal in the decision to pursue biology. These experiences often happen in a lab, where the person realized how curiosity could fuel determination and resilience. Others point to a moment in which they felt that they had made a leap of understanding or saw something that no one else had yet seen. In essence, they had fallen in love with "doing biology."

In the 30 or so years of my probing, I have yet to meet anyone who says, "I decided to be a biologist while I was listening to a great lecture."

Instead, these moments of clarity were earned by their own actions, thinking, and struggles. The influential teachers were those who motivated this effort, who encouraged the hard work and "stick-to-it-ness" needed for deep learning. If I think about the thousands of hours I sat in lectures as an undergraduate, it looks like I may have just been lucky. I made my way into biology almost in spite of how it was taught, not because of it. I suspect many of us have the same story. But, what about equally capable students who didn't have the patience or independent learning skills we did? Who have we lost to science because we emphasize facts over process?

Years later, after the facts of biology are distant glimmers, they may still be able to call upon the process, the logic, and the utility of science to make important life decisions.

—R.W.

One hypothesis for this state of affairs is that professors just don't care about teaching. Although professors do negotiate decreased teaching duties so they have more time for their research, I have never met anyone who didn't honestly care about her/his students' learning, even if that caring was couched in complaints about what their students weren't able to do. It is therefore surprising that many faculty act as if they are ashamed that they care about teaching at all. For example, I systematically interviewed almost all of the faculty in my college about their

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teaching. Each person offered some variation of, "I really care about my students and their learning, but none of my colleagues do." Think about that. We all belong to a secret society that no one dares speak about!

We seem to have inherited a culture that we perpetuate by consciously divorcing our teaching mission from our research mission and, in some cases, even from our own values. As a result, our classrooms are treated like clandestine cloisters. We feel uncomfortable or even threatened if another person asks to sit in on our classes. We'd never feel that way about a visitor to our labs! We can't imagine that our colleagues would be interested in our teaching innovations or successes, or have suggestions on solving our teaching challenges. Shrouded in the mantle of academic freedom, we view teaching as a personal rather than a public endeavor. We look at teaching as if it is about *ourselves as individuals*—what I choose to teach, how I choose to teach it—rather than how my course builds on and fits in with my students' other courses.

It's not about you.

That is my simple proposition: To improve biology education, teach as if the only thing that matters is what your students are able to do, or do better, at the end of the course than at the beginning.

What might such a "doing biology" classroom look like in practice?

First, by simply assigning readings and holding students accountable, you can relax a bit. That expensive textbook becomes your ally. Because your students take a reading quiz at the start of Monday's class, you can be pretty sure the basic content was "covered." So, your role moves from presenting biology concepts to creating a safe, exciting environment in which your students willingly wrestle with the implications of those concepts and apply them to real, unanswered problems that biologists face. Through your homework assignments, in-class activities, and exams, you demand that your students *do the intellectual work of biologists*. You are also conscious that your job includes helping your students build skills that will be critical for success in biology and elsewhere: working effectively in a team; communication skills; information literacy; critical thinking skills; problem solving skills; all of the so-called "soft skills" that are actually more difficult to master than the hard facts. Through most of the class period, you wander through the room, checking in with each group of students, listening to their ideas, critiquing their thinking, making suggestions for improvements, helping them to navigate the research literature. From time to time, you call the class together so groups can share potential solutions, critique them, and build on them.

Your relationship with your students is fundamentally different in this scenario. You no longer have to be the knower of all things. What a relief! After all, the sum of human knowledge is in the air around you, available almost instantly via Google. So instead of lecturing, you can model how a skilled biologist navigates this vast ocean of facts, ideas, false leads, and outright untruths. In the "doing biology classroom," your relationship with your students feels more like your relationship with the researchers in your lab. You are their mentor, the person who expects excellent work, and who doesn't pull your punches when they don't deliver the quality you and your discipline expect. You open doors for them. You expand their horizons. You help them become professionals. You demand that they do the work of biologists.

Robin Wright has transformed biological education at the University of Minnesota, ensuring that biology is taught in ways that improve student understanding and allow them to become independent thinkers.

—David Kirkpatrick, University of Minnesota

Because it's no longer about you, you no longer have to (try to) give a compelling lecture about meiosis that holds the attention of a room full of 18-year-olds who have electronic devices and aren't afraid to use them. It's about what *they do*. Instead, your job is to create a problem about meiosis that is so compelling, delicious, and authentic that they work diligently during class to apply what they know about meiosis to solve it and, if they haven't figured it out in time, will continue even after class is over. Working through the problem, they do the hard, frustrating work of biology. Some of them will fall in love with the work, but all will understand what that work requires. Years later, after the facts of biology are distant glimmers, they may still be able to call upon the process, the logic, and the utility of science to make important life decisions.

Given the constraints on our time and resources, can we afford to teach in a way that is all about our students? What about students who will not pursue biology as a career? Do they really need to learn the day-to-day, business-end of biology? I believe that we cheat our students of understanding the beauty and limitations of science if we don't teach biology to all students, regardless of major, in a way that reflects how biology is done. In fact, because there are so many more nonmajors, the total impact of a "doing biology" class is likely to be greater for nonmajors than majors. The good news is that requiring students to do biology costs no more in time or effort than lecturing. For example, instead of preparing a lecture, you can require students (major or nonmajor) to read a chapter in the text and then work in a team to interpret research results related to those concepts.

More importantly, investing teaching effort in what students themselves *do*, rather than what a lecturer *says*, produces more than just biology content knowledge: It strengthens students' problem solving skills, their ability to be skeptical, their ability to think critically. Teaching by lecture is akin to burying your money in your mattress; it doesn't yield any additional benefits. In fact, isolated and stuck in the mattress, the money becomes worth less and less as inflation whittles away its value, much as specific knowledge often becomes less valuable as new knowledge emerges. Teaching by focusing on what students do is like investing in a low-risk stock; your investment in each student will grow as they themselves do.

Most of us will likely have greater impact on biology through our work in the classroom than our work in the lab. So, choose the approach that will leave the largest impact, the richest legacy.

A simple proposition: teach as if the only thing that matters is what your students do.