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Feature
Approaches to Biology Teaching and Learning

Learning to See Inequity in Science

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INTRODUCTION

I have often wondered whether I have persisted as a scientist in part because I was not a very keen observer of inequity in science during my education and early career. It was rather late in my scientific training that I began to see inequities in science, which I'll loosely define here as unfairness or injustice that is linked to an individual's personal characteristics such as gender, culture, race, ethnicity, linguistic background, and sexual orientation, among others. As stewards of our discipline and scientists who are also educators, we all have a special responsibility to be alert to issues of inequity, to address these issues, and to make careers in science accessible for all.

Interestingly, my attentiveness to inequities in science did not arise from my own experiences, at least not initially. It came instead from my skepticism of those who had already learned to see inequities in science and were doing something about it. In my case, I was deeply skeptical about the founding of an after-school science club program designed to encourage middle school girls to persist in science (Chatman *et al.*, 2008). At that time, I thought having a single-sex science club unfairly implied that girls needed some special treatment. I also worried that as an unintended consequence, girls would think something was wrong with them, that the existence of a special girls science club would imply that they needed extra remedial help. Somewhat in protest to this girls-only science club program, I did two things one spring. First, I initiated a coeducational after-school science club, which seemed eminently fairer to me at the time. Second, I began critically reading the literature on gender inequity in science and in science education (American Association of University Women [AAUW], 1992; Sadker and Sadker, 1994).

What happened that spring, in a relatively short period, profoundly altered my thinking about gender equity in science. My readings suggested differential treatment of and participation by girls and boys in science classrooms (AAUW, 1992; Sadker and Sadker, 1994). My coed science club became a living laboratory in which I personally witnessed inequities in the participation of girls and boys. Most striking, the science club was also a setting in which I saw differential treatment of girls and boys that mirrored what I had been reading. And I, a woman scientist, was the person treating girls and boys differently! Research has shown that the gender of a teacher is not a predictor of the equity climate in the classroom (Tobin and Garnett, 1987), and I was a shining example. I called on boys to answer questions more often than girls. I was more likely to tell a boy how to focus a microscope, and more likely to do it for a girl. My skepticism about inequity and unfairness in science, in particular gender inequity, was replaced that day by an ability to see inequity in a way I had never seen it before. The inequity that I witnessed was in my own classroom and was not, as I had imagined it would be, sinister or grotesque or even very obvious. Rather, the gender inequity that I observed and help promulgate in the coed science club was quite everyday, easily passed over, and largely invisible if you didn't think about what to look for or know how to look. As a result of my skepticism, and more careful observation (with the guiding help of the literature) of what was happening around me, I have developed an "equity eye" that has never allowed me to see science classrooms, science conferences, or anything else in my discipline quite the same way ever again.

Learning to see inequity in science is critical to anyone who is actively encouraging young people to invest their education, career, and life in the discipline. If the culture of science is grossly inequitable, why should students take the risk of entering this discipline over careers in other arenas? Many scholarly publications from the fields of psychology, science education, and sociology have described inequities in science; proposed theoretical frameworks for understanding them; and explored practical strategies for addressing such inequities (Tobias, 1990; Seymour and Hewitt, 1997; Brown, 2004; Johnson, 2007; Tanner and Allen, 2007; Chamany *et al.*, 2008), but progress in jettisoning these inequities from our discipline has been slow. I illustrate this by examining three seemingly simple examples of inequity in science: the ad campaign *Rock Stars of Science*, the documentary *Naturally Obsessed: The Making of a Scientist*, and the story of a University Seminar Series Committee, made anonymous. I chose to share these three examples for several reasons. First, these examples underscore that messages of inequity can be found in materials that are very well meaning and well inten-

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Figure 1. Sample advertisement portraits from the *Rock Stars of Science* campaign by Geoffrey Beene Gives Back. (Photo credit: Geoffrey Beene Gives Back,® GQ, and Ben Watts, Photographer)

tioned. Second, these examples illustrate that inequitable messages can be found in both very public places and in the everyday activities and routines of academic science. Finally, each of these examples has the potential to inadvertently discourage broad participation of women and people of color in the discipline of biology through subtle and implicit messages about who can be successful in research science. If we, as stewards of our discipline, can learn to recognize and address these instances of inequity, we can do much to prevent their reoccurrence. As scientists who are also educators and role models to our students, our attention to these issues and our responses to them is likely much more important than we may generally recognize.

EXAMPLE I: PORTRAYING BIOLOGY: WHO CAN BE ROCK STARS OF SCIENCE?

I know of no individuals or organizations in the biological sciences that would endorse the claim that only white males have the potential to become successful biology researchers. Most, in fact, would be mortified and vehemently oppose such a statement. Although minorities are still not proportionately represented in the profession, and the presence of women thins at higher levels of academia, most would agree that there is an extensive pool of women and minority scientists who are successful, practicing biology researchers throughout academia and industry. Why, then, do women and minorities often seem invisible in the portrayal of our discipline? Why do white males continue to dominate the popular portrayal of the biology research community?

Consider *Rock Stars of Science*, an advertising campaign sponsored by the Geoffrey Beene Gives Back (GBGB) foundation that launched in June 2009 (GBGB, 2009; Figure 1). The campaign seems to have been conceived as a way to highlight the importance of biomedical research, showcase career opportunities for young people, and promote support for funding of biological research, all of which are laudable goals. At first glance, *Rock Stars of Science* seems like a great idea. Bring biology researchers who are studying mechanisms of prominent diseases together with well-known and easily recognized rock stars. The association between the two will send the message that scientists are as cool as rock stars, and commentary from the high-status rock stars on how great these scientists are will influence the perceptions of young people and the general public about who does biological research.

However, analytical attention to the demographic characteristics of the scientists portrayed reveals inequity in this

popular portrayal of who can actually be a *Rock Star of Science*. Eleven scientists are highlighted. All are men. No female scientists are included. All are white. No scientists of color are included. There are women and people of color in the campaign portraits, but they are all actual rock stars—Sheryl Crowe, Seal, and Wil.I.Am. Inadvertently, the campaign implies to young people that if you are female or a person of color, you're more likely to become a rock star than a scientist. The process used to select the scientists highlighted in the ad campaign is, unfortunately, not discussed on the project's website, and though the Geoffrey Beene company makes a line of menswear, the affiliated foundation "has committed support for nonprofit programs with core missions of improving the emotional, health and life needs of women and children" (GBGB, 2009).

If the campaign itself wasn't disappointing enough in its unrepresentative portrayal of who does biology research, the response (or lack thereof) to the campaign was more disturbing. *Science* magazine highlighted the campaign in its Science Careers Blog in a post titled, *You Can't Make Science Any Cooler*, with apparently no notice or comment on the stunningly white and male portrayal of the entire discipline of research biology. Two months later, in response to criticism of the ad campaign, the Science Careers Blog put forth a second post entitled, *A Discordant Note About Rock Stars of Science*, in which it was reported that "the Association for Women in Science (AWIS) took note of the fact that the only scientific rock stars portrayed were male, and the Association is none too pleased." It does not seem that any further analysis of the campaign and or commentary on its portraits has been published. *Science* did not call out the inequitable presentation of those who do research in biology. It also did not comment on how the choice of biologists portrayed actually might work against one of the campaign's goals, that of making a scientific career attractive to young people—presumably all young people, and not just young, white males. Strikingly, there seems to have been little or no attention paid to the cultural and ethnic homogeneity of the biologists who were chosen to inspire young people to consider careers in the discipline by any commentary on the ad campaign that I have read.

EXAMPLE II: REINFORCING STEREOTYPES: IS BEING "NATURALLY OBSESSED" REQUIRED TO BE A SCIENTIST?

The second example of inequity in science and how it is portrayed arises in a recent documentary on becoming a scientist (Figure 2). *Naturally Obsessed* portrays three aspiring biology researchers. The aspiration to portray the "making of a scientist" that drove the filmmaking behind *Naturally Obsessed* is admirable and deeply interesting. However, the choice of *who* was portrayed and *in what biology research context* is problematic. All are white. Two are male, and one is female. The white male protagonist who is portrayed as successful fits a stereotypical profile of a scientist: often in a lab coat, with thick glasses, driven and competitive. Unfortunately, the website offers little insight into how the context and the particular young scientists portrayed were chosen. With *Naturally Obsessed* and *Rock Stars of Science* as just two recent examples, it becomes clear why some senior women and minorities in biology research seem more inured than enraged when asked about these portrayals of their discipline. It just gets old being invisible.

Figure 2. Photo of protagonist Rob Townley from the documentary *Naturally Obsessed: The Making of a Scientist*, directed by Richard Rifkind and Carole Rifkind. (Rifkind and Rifkind, 2009), (©Parnassus-Works Photo by Liza Politi)

In addition to the all-white demographics of the protagonists in *Naturally Obsessed*, the documentary tells a secondary story that implies that women scientists can't be happy in biology research laboratories. The one female student portrayed leaves her doctoral training program and is portrayed (likely correctly) as much happier when interviewed on a softball field, having time in her new position to engage in such play. There is no doubt authenticity in the particular story of this young woman scientist. Indeed, there are aspects of the culture of science that are deeply unsupportive and unwelcoming, not just for women but for any student who does not fit the traditional mold of a competitive, obsessive scientist, be they male or female, a student of color or a white student. Unfortunately, if you are a female student watching this documentary, you will not encounter a well-drawn example of a successful female academic scientist.

Finally, the portrayal of what a life lived as a biology researcher is like is singular, obsessive, exhausting, and competitive. Although some students will find the challenge exhilarating, many others will find it depressing. Even the title of the documentary, *Naturally Obsessed*, supports a notion—that to be successful in science it must be your whole life—that has influenced untoward numbers of women (and men) to abandon pursuing careers in biological research. This portrayal of science likely underlies, at least in part, the

drop off of women at the postdoctoral and junior faculty level in the biological sciences, a field in which half of the doctorates are currently awarded to women (National Science Foundation [NSF], 2007). Although life as a biology researcher can certainly be lived in an obsessive way, there are abundant examples of scientists who have families, enjoy life in the laboratory, and who are more collaborative than competitive with their research colleagues (Brady, 2007). Unfortunately, whether intentionally or not, *Naturally Obsessed* promulgates the notion that the only *real* science that is done is occurring at large, biomedical research institutions by people willing to devote all of their waking hours to the cause. Having experienced research at multiple institutions in my own career, the example presented is certainly familiar, but it is not all pervasive. The overarching conclusion that I have reached in my own experiences is that there are as many different ways to lead a life in science as there are scientists. A career in science can take many different forms, and we will all benefit if we can make this visible to our students.

EXAMPLE III: SEEING THE MECHANISMS OF INEQUITY: LESSONS FROM A UNIVERSITY SEMINAR SERIES COMMITTEE

This final example of inequity in science comes from a story that unfolded on a university seminar series committee. The details of the institution and individuals involved are omitted to protect privacy, and are unimportant. This example, unlike the *Rock Stars of Science* campaign and the *Naturally Obsessed* documentary, is probably not unique in its arc or outcome. The events were captured by a female biology graduate student who was serving as a student representative on the annual biology seminar series committee at her doctoral-granting institution. The story is recounted in the first person below.

"There were five faculty on the committee, and me. Of the faculty, one was a relatively new female Assistant Professor. The rest were senior male Associate Professors and Professors. All of us were white. There was a general feeling in the room that because this was committee work, we should get it over with quickly, but there was also an awareness that the seminar series could bring scientists, their ideas, and hot-off-the-press data to our campus for the benefit of faculty and student researchers alike. Over the course of the first 15 minutes, I waited for a discussion of process, some sort of method by which we would brainstorm, prioritize, and choose the select number of faculty (~30) that would be invited. I was looking forward to participating in such prioritization, choosing faculty with a range of research interests and from different types of institutions. As a young woman in science, I was eager to see role models among the line up, and I was curious to what extent the cultural and ethnic background of potential speakers would be considered."

"As the meeting began, I was eager to see the process by which decisions would be made. However, if there was an assigned committee chair who was supposed to be in charge of process, they never took charge of their duties. Instead, names just started to be tossed out, and one faculty member grabbed a pen and started listing the names on the whiteboard. In effect, there was no process."

"I watched as names accrued on the board. I was stunned that all of the names were male, and to the best of my knowledge, all white. How it happened was not sinister. Individual faculty suggested the names of colleagues and friends, all of whom just happened to be white and male. The single female faculty member also suggested only white male colleagues. As a naïve graduate student, I asked what the criteria were for putting a name on the board. The reply was that the invitees should be good speakers, so it was helpful to have heard them talk before, and that they should have published something recently. This also was not sinister, but did require that invitees were already in the elite group of researchers who were being invited to give talks all the time and as such would have been seen and heard by someone on the committee."

"As I held my own brainstormed list of potential speakers in my hand—a list that included women scientists, minority scientists, and scientists from some smaller institutions—I screwed up my courage and took what I thought would be a bold and controversial step. I shared my observation that all the names on the board were male, to my knowledge all Caucasian, and all from research-1 institutions, primarily on the east and west coasts. I suggested that as a female biologist in training, I'd like to have the opportunity to hear from a greater demographic variety of speakers, especially female biology researchers in the generation ahead of me. I offered that I was interested in their research, to be sure, and also in the stories of their career trajectories, which often came out during the informal lunches, dinners, and 30-minute appointments tucked in around their seminar."

"Perhaps to my surprise, my observations and suggestions were welcomed. The faculty in the room, both male and female, remarked surprise at the pattern of demographic characteristics on the board. They had simply not seen the inequity that had played out on the white board and immediately set to broadening their brainstorming. Did I change the way seminar speakers are chosen that year? Yes. Did I change the process of the seminar series committee in the long term? I doubt it. But at least I said something."

WHY SEEING INEQUITY MATTERS: THE BIG PICTURE

> *"When I asked my last professor what he was looking for in an applicant for a researcher position, he said, 'Somebody like myself.' I was very quiet and I thought, 'I guess I'm in trouble 'cause I don't look very much like you.' I didn't say that to him. I just thought it."* (male black undergraduate science student, Seymour and Hewitt, 1997).

> *"Showing you that this woman made it—that she accomplished what she wanted—that's powerful. And knowing there's a lot of capable women out here doing what they want to do—that they are not just exceptions."* (female white undergraduate science student, Seymour and Hewitt, 1997).

Although the three examples of inequity in science that have been presented may seem singular or trivial, I do not believe they are. What seem to be small events and subtle messages in the eyes of a senior scientist can be very large events and pivotal messages in the lives of students navigating career choices. The reality is that despite a variety of

diversity initiatives and efforts, the representation of underrepresented minorities in biological research at all levels and of women in the upper ranks of academia in biology still lags (NSF, 2007).

Attempts to understand and rectify the continued underrepresentation of minorities in biological research generally rely on one of two explanations. The first explanation assigns blame to poor precollege academic preparation, which in turn impedes these students from successfully pursuing advanced biology degrees and subsequently research careers. This argument often drives the development of supplementary workshop courses and academic remediation programs for minority students. A second explanation is that minorities have not had access to experiences in biological research and asserts that providing more minority students with firsthand experience in research laboratories will convince more to pursue research careers. This second explanation is the rationale for millions of dollars in research internships and graduate fellowship awards for minority students across the United States (National Institutes of Health, 2009).

With respect to participation of women in biology research, some are quick to assert that there is, in fact, no "gender problem" in the field of *biology research* anymore. Women make up the majority of undergraduate biology majors in many colleges and universities, and about half of the doctorates awarded in the biological sciences go to women (NSF, 2007). However, the increase in the number of female trainees in the biological sciences has not raised the numbers of women in the higher ranks of academia and in leadership positions to the same extent (National Academy of Science, 2009). If a gender gap in the participation of women in biology research is acknowledged, the more common and unfounded explanation is that women simply opt out of research careers in favor of other life choices, such as family (Bruer, 1984).

Strikingly, conversations about diversifying participation in biology research are primarily grounded in deficit models such as those described above. These deficit models put the origin of the problem squarely with the people who are not participating—women and people of color, and these models seldom question the inferred norms of the discipline or how the discipline is portrayed to the outside world. Yet, in each of the examples above, the implied norm for who does science is not broad. It is not diverse. Instead, students who are women and minorities—as well as white males who do not aspire to the portrayal of an obsessed scientist—are given little evidence that they belong in the discipline, little evidence that they are part of the face of science, little evidence that there is room for them in science. A modern-day career in science can mean so many things, and our profession would surely benefit from having a broad and diverse group of students be able to envision themselves in these science careers.

BECOMING AWARE, ANALYTICAL, AND EXPLICIT ABOUT INEQUITY IN SCIENCE

Why should biology faculty attempt to hone their skills and learn to see inequity in their discipline? Simply because they care about the future of the discipline. Generations of biologists before me have eliminated many of the most obvious and egregious inequities in our field, and not for altruistic reasons. Biology, as a discipline, thrives and moves forward when keen minds from diverse backgrounds ask questions about the natural world and push to discover, create, and innovate. But although the obvious inequities have been exposed and rejected, it is the more subtle inequities—like those examples described above—that remain and continue to send messages to many students that biology research does not include people like them.

Just as learning a new technique that enables you to see new things in a laboratory takes effort, learning to see inequity is a process and tuning up your "equity eye" takes practice. After quantifying who was participating in my coed science club and being analytical about how my interactions with girls and boys differed, I began to see inequities around me that had been there all along, but that had somehow been invisible to me. Once your eye is trained to detect something—whether it is a cellular abnormality seen using a microscope, or gender inequity occurring in your discipline—it then becomes almost impossible not to see it. Cultivating awareness requires only a willingness to look carefully and think broadly, something that scientists do in their work all the time. Consider calculating the number of women and minorities who are invited speakers the next time you attend a research conference. Similarly, do a quick count of the number of male versus female biologists highlighted in newsletters and other promotional materials of professional societies. Revisit the process by which seminar speakers are selected on your campus. How does the slate of speakers represent the culture and demographics of science to your students? In the next committee meeting in which you participate, make a map and tally who speaks and how often. How equitable is the conversation among your colleagues? Whose voices are heard? Whose voices are not heard? In your own classroom, which students do you call on? Record the proportion of female and male students that verbally participate in your class. Using your analytical skills as a scientist, you can collect concrete evidence and begin to assess the equity climate in a variety of your own professional venues with relatively little effort.

Once you've learned to see inequity in science and begin to identify instances in your local or national community, what does one do then? There are no easy answers to this question, but the hope would be that the more outspoken we collectively become about the inequities we see, the more we can raise awareness of inequity in science and the detrimental messages it sends to young people considering careers in the discipline. Creating visibility for all members of our community is critical if we want to encourage broad participation in science.

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