The events of the past year are dramatically stimulating discussions concerning access to education and careers in our disciplines. Some members of the physics community had dismissed issues of diversity, thinking, "we are just here to study particles and manipulate equations," but are now coming to realize that to get in the door (admission to graduate studies) and have the opportunity to do these things is more complex and socially constructed than they had previously believed. Obtaining a high-quality education depends significantly on socio-economic realities and other factors that control access and marginalize some—not exactly an "equal-access" model that we think is fair or that is welcoming to the next generation.

This is a complex problem with far-reaching consequences that permeate our culture and is well beyond the scope of this short note for me to adequately address. However, we can look at our own houses and see some issues that lie there. A few years ago, the American Physical Society (APS) looked at the fraction of underrepresented racial and ethnic minority (URM) students who were receiving bachelor's degrees and the fraction who received PhDs. In a just and inclusive world we might expect those two fractions to be the same (a bachelor's degree is pretty much required to enter a PhD program in physics). About 9,000 bachelor's degrees in physics are earned each year by domestic students, roughly 13% of these by URM students. At the doctoral level, we award about 1,900 PhDs, with roughly 1,000 going to domestic students. Of these 1,000 PhDs, only about 7% are earned by URM students. Sadly, these percentages have not changed in several decades.

Math is not that different. According to the National Center for Education Statistics, for domestic students, about 15% of the bachelor's degrees in mathematics go to URM students, falling to 8% at the doctoral level, and math is not alone: the trend is the same in every STEM discipline.

We are failing to advance and retain URM students across the critical boundary between undergraduate and graduate degrees.

Do we understand some issues causing this? Is there something we can do?

Yes, and yes.

The answers to the first question are complex and deeply rooted in our culture, but there are interventions we can enact to begin to address some of these issues. If physics is at all similar to math from an academic cultural viewpoint, which based on many discussions with mathematicians I am pretty sure it is, there are a number of issues in both fields that lead to our failing to support these students. One critical reason is that students on the lower end of the socio-economic ladder (which disproportionately affects students of color) are often not provided opportunities to receive high-quality educational experiences. This might start as early as preschool, but is certainly at work throughout elementary, middle, and high school. Poorly paid teachers, lack of support in schools, crowded classrooms… you get the idea. All of this adds up to students who may be underprepared to jump into challenging classes in college—if they even pursue college. In physics we may perceive this as students who do not have adequate mathematics preparation, or who have not been afforded an introduction to basic concepts that other, better resourced and supported students experience. They may make it through and earn a bachelor's degree but starting without adequate preparation often doesn't position them well for entering a competitive graduate program—especially one that is inflexible when considering a student's preparation or access to opportunities to demonstrate their potential.

Theodore Hodapp is the director of project development at the American Physical Society. His email address is hodapp@aps.org.
Students may not have received academic advising to help them choose appropriate courses and/or do not have the social/familial support necessary to focus on their coursework. We have seen students who did consistently “par” work (i.e., not exceptional enough to be considered for graduate studies under some admissions criteria) subsequently excel in graduate school when they are given a stipend which allows them to devote all of their time to their studies, rather than working at several full- or part-time jobs to support themselves and family members. Other students end their senior undergraduate year not knowing about advanced degrees, the benefits of earning one, or the role the GRE often plays in admissions. Still others are not told how graduate admissions operate and consequently miss key milestones or apply to an inappropriate selection of universities. One young man I met applied to a single, highly competitive program as that was all he could afford, and upon receiving a rejection came to the conclusion he should not pursue graduate studies—spoiler alert: he is about to receive his PhD having been accepted through the APS Bridge Program into a different, but still highly prestigious university.

Suffice it to say, there are many systemic hurdles facing students attempting to make this transition into graduate studies, and measures used by many admissions committees are biased against those who are not well resourced. There are also clearly cases of blatant racism, but biases we may not recognize, such as those mentioned here, are significant and pervasive.

Let me be clear: there are many issues facing students of color, but preparation and access is something we can work to overcome—we just need to provide the opportunity.

So, what can we do (our second question)?

APS recognized that there were a few graduate programs that had had significant success in helping URM students bridge this gap, notably a partnership between Fisk and Vanderbilt Universities, Columbia University, and the University of Michigan’s Applied Physics program. All had Bridge Programs that were recruiting, accepting, supporting, and graduating URM students. We realized that APS could act as a centralized resource for programs like these and others who were interested in recruiting and supporting URM students to enter doctoral programs and complete their degrees. As a result, we now have over 220 URM students pursuing physics PhDs in more than 40 graduate programs across the country—none of whom would be in graduate school today without the dedication of the many mentors and educators and, significantly, the unique role that a professional society can play in advancing these efforts within the community.

AMS could pursue this same course of action.

A glimpse of how this works. APS contacts every undergraduate program in the US (there are about 760 departments that award bachelor’s degrees) and asks them if they know of a URM student that they feel could do well in a PhD program, but for whatever reason is unlikely to be accepted (see some of the many reasons above). We ask them to first encourage these students to apply to graduate programs using the traditional processes, but if they are unsuccessful, APS has established a portal to accept applications from students and to distribute completed applications to departments interested in supporting students using a more equitable and inclusive mindset. We start the process after April 15th (when most physics departments have finished making offers) to ensure that every bridge student is an additional physics graduate student—increasing the number of URM students pursuing PhDs. In a typical year we will receive on the order of 100 applications from students and ultimately place about half of these into graduate programs. When these students graduate (we currently have an 85% retention rate), they will represent enough additional URM doctoral graduates to bring the percentage of physics PhDs earned by URM students up to match that of bachelor’s degrees in physics!

Key advantages of involving the primary professional society in the discipline is that the organization can:

• recruit for every graduate program in the country that wants to participate (APS is not recruiting for ourselves, but for the community);
• provide this service for free (students pay no fees to apply);
• work with departments to help them adopt effective practices in mentoring and supporting students that benefit everyone, but that can be essential for those who may need slightly different approaches to succeed; and
• track students’ progress in order to continually learn and adapt strategies that can be shared broadly with the community.
Two years ago, the American Chemical Society and the American Geophysical Union joined APS and are now participating in a broad coalition of professional societies in the physical sciences to adapt and improve on the program begun by the APS. The new coalition is called the Inclusive Graduate Education Network (IGENetwork.org) and is funded by an NSF INCLUDES Alliance award—a funding program working to provide resources for projects that can fundamentally “move the needle” on broadening participation across the country.

We encourage the AMS to consider this route as well—we have learned a great deal about how to efficiently set up these Bridge Programs and think such a program would also work in mathematics.

Bridge Programs that facilitate and support this transition into graduate studies are not the final answer—we must all work to find ways to make our programs more inclusive and equitable—but they offer a rapid way to help us respond to a system that does not give everyone the same opportunity. It takes all of us working together to understand injustices in our current system and to find constructive ways to overcome these barriers and equitably welcome future generations.