

THE TIME IS NOW

Systemic Changes to Increase African
Americans with Bachelor's Degrees in
Physics and Astronomy



TEAM+UP

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TEAM-UP Report Summary

TEAM-UP, the National Task Force to Elevate African American representation in Undergraduate Physics & Astronomy was chartered and funded by the American Institute of Physics (AIP) Board of Directors to examine the reasons for the persistent underrepresentation of African Americans in physics and astronomy in the US as measured by bachelor's degrees in these fields and to produce a detailed report with recommendations.

There were several motivating factors for the task force. First, while there is widespread acknowledgment that physics and astronomy must improve diversity, equity, and inclusion overall, the number and percentage of bachelor's degrees awarded to African Americans in these fields has been appallingly low, dropping from about 5% in the late 1990s to less than 4% in recent years (Figure 1). Furthermore, over the past 20 years, the overall number of bachelor's degrees awarded in physics in the US has more than doubled and is now at an all-time high (Figure 2). Yet, for much of this period, African American representation among physics bachelor's degree earners stagnated, only recently increasing to reach 1995 levels.

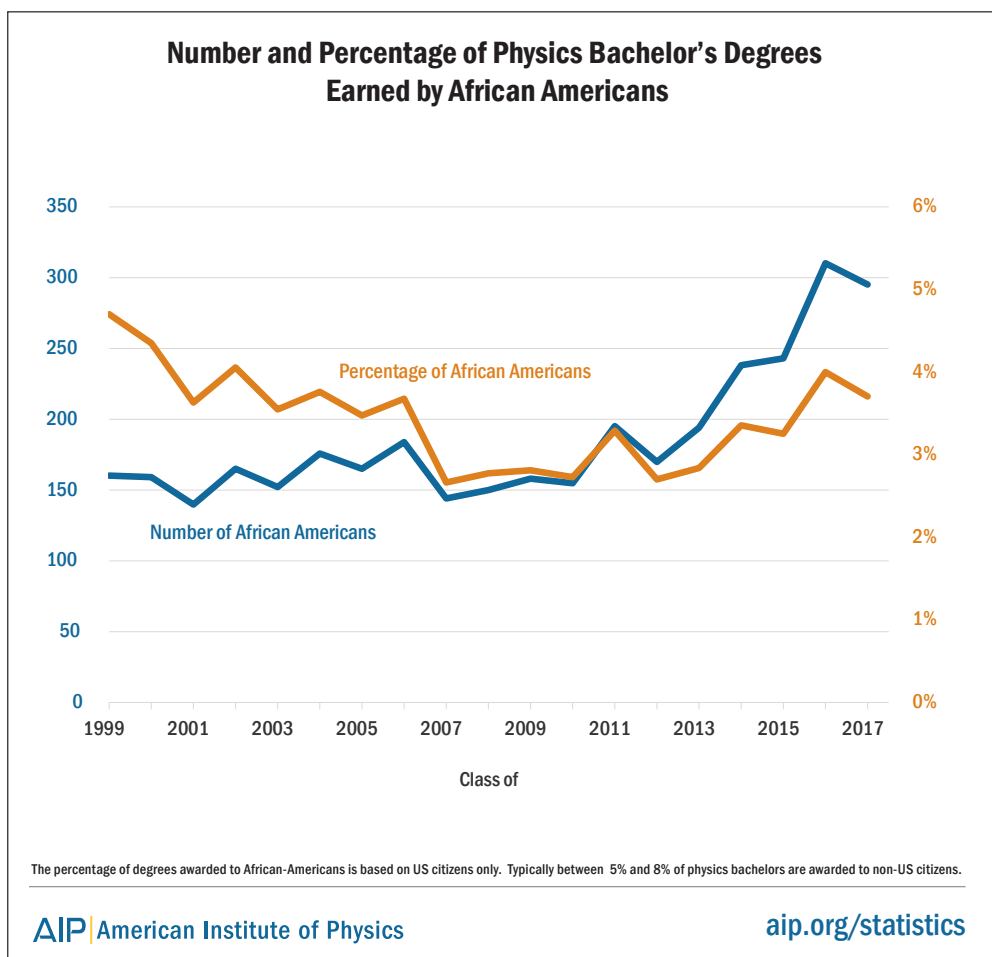


Figure 1

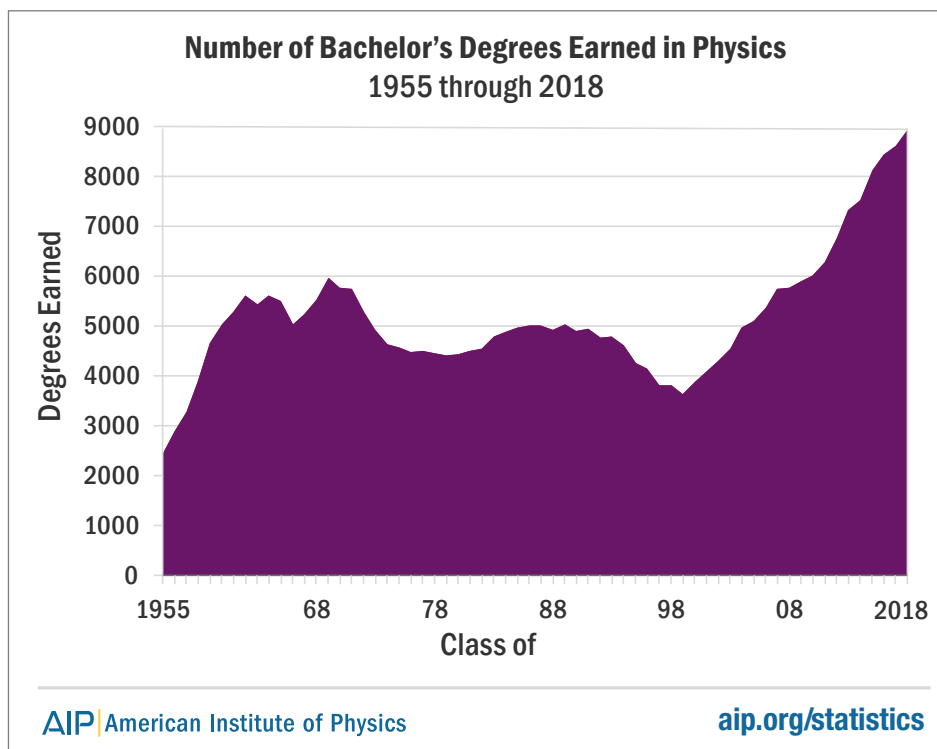


Figure 2

Second, during this same period, the percentage of African Americans earning bachelor's degrees in all fields has grown much faster than the overall population (degrees more than doubled between 1995 and 2015, while the population grew by 23%).¹ But physics has not benefited from this growth. From 1995 to 2015, the number of physics bachelor's degrees awarded to African Americans increased by 4% compared with a 36% increase for all physical sciences (Merner and Tyler 2019, and Figure 3). In contrast, the fraction of Latinx students among physics bachelor's degree earners—while still well below the Latinx representation in the US population—has increased significantly in the past 20 years (Figure 4).

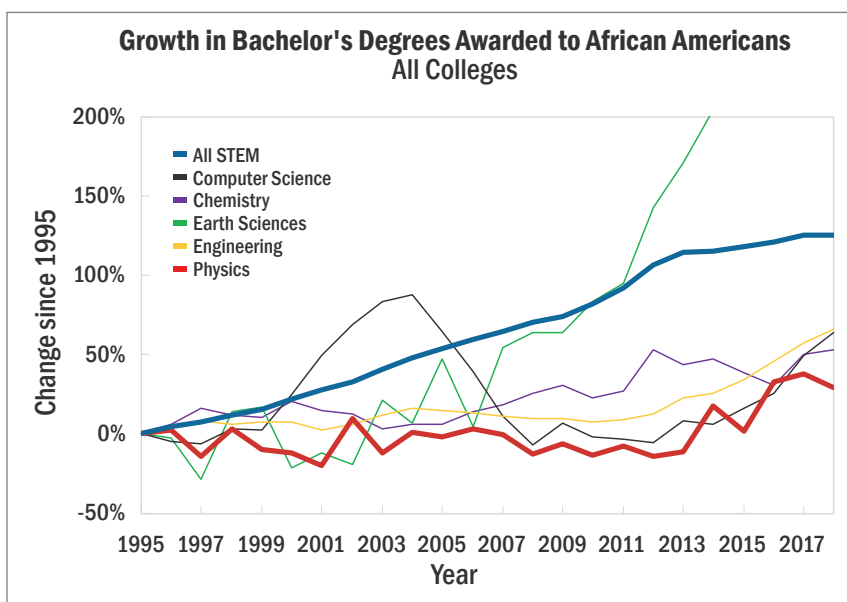


Figure 3

¹ Data from the National Center for Education Statistics' Digest of Education Statistics.

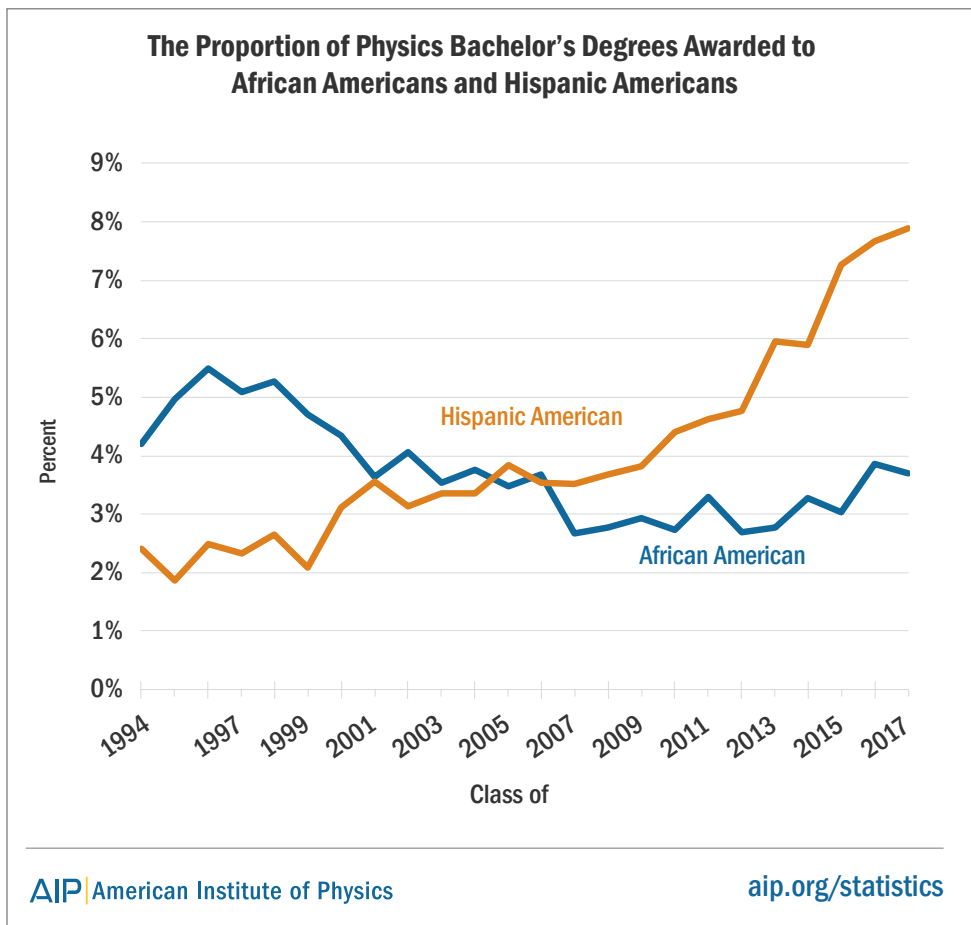


Figure 4

To determine the key factors supporting or diminishing student success, TEAM-UP conducted a major two-year research study that included student surveys, department chair surveys, interviews with African American students, and site visits to five high-performing physics departments. In addition to these data collection efforts, the task force reviewed the research literature and received input from several hundred individuals to guide the work. The resulting report combines original research with a review of the research literature to provide a set of research-based findings and recommendations.

TEAM-UP identified five factors responsible for the success or failure of African American students in physics and astronomy: Belonging, Physics Identity, Academic Support, Personal Support, and Leadership and Structures. Each factor is supported by four research findings and four corresponding recommendations for individual faculty, departments, and/or professional societies. A fifth recommendation is made for each major factor to address the interactions among individuals, departments, colleges and universities, and professional societies. The recommendations are far-reaching and challenging, requiring philosophical and practical changes in the way the community educates and supports students. To support the adoption of the recommendations, the report provides an additional set of five recommendations on Change Management. Together, the five factors and the topic of Change Management provide six themes around which the report is organized.

The task force finds that African American students have the same drive, motivation, intellect, and capability to obtain physics and astronomy degrees as students of other races and ethnicities. Many African Americans who might otherwise pursue these fields are choosing majors that are perceived as being more supportive and/or rewarding, resulting in a loss of talent to physics and astronomy.

The briefest summary of the TEAM-UP report is this: the persistent underrepresentation of African Americans in physics and astronomy is due to (1) the lack of a supportive environment for these students in many departments, and (2) the enormous financial challenges facing them and the programs that have consistently demonstrated the best practices in supporting their success. Solving these problems requires addressing systemic and cultural issues, and creating a large-scale change management framework.

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The overarching goal of the TEAM-UP report is to at least double the number of bachelor's degrees in physics and astronomy awarded to African Americans by 2030. The report calls on departments and professional societies, working with funding agencies, foundations, and donors, to commit to achieving this goal. Every recommendation in the report is a means to this end.

Below is a summary of the task force's key findings and recommendations, organized by the five factors responsible for the success or failure of African American students in physics and astronomy and the sixth topic of change management. It starts with themes that are the most centered on the individual student and ends with those reflecting the broadest academic context. The highest priority recommendations are identified at the end of this summary.

FACTOR 1: BELONGING

Fostering a sense of belonging is essential for African American student persistence and success.

A sense of belonging is defined as an individual's feeling of being a welcomed and contributing member of a community. TEAM-UP's research on the student experience shows that fostering a sense of belonging is essential for African American student persistence and success. Faculty and peer interactions have a powerful effect on students' sense of belonging, which increases with the number of faculty who get to know students as individuals and demonstrate support for their success. Student peers play a role in either mitigating or exacerbating African American students' sense of not belonging experienced through microaggressions, the



imposter phenomenon, and stereotype threat.² Peers of the same race/ethnicity/gender provide valuable social and academic supports, often through counterspaces³.

The recommendations around belonging emphasize the faculty role in fostering a sense of belonging for students and also note the essential roles that departments and professional societies play. In summary, TEAM-UP recommends that departments support faculty in improving and practicing skills that promote students' sense of belonging. Departments should establish and consistently communicate norms and values of respect and inclusion through policies, physical spaces, programmatic offerings, and all forms of communication with students. Professional societies should pursue coalition-building efforts that seek to eliminate identity-based harassment including microaggressions and acts motivated by bias and racism.

FACTOR 2: PHYSICS IDENTITY

To persist, African American students must perceive themselves, and be perceived by others, as future physicists and astronomers.

Physics identity is defined as how one sees oneself with respect to physics as a profession.⁴ It evolves with one's perception and navigation of experiences within physics, including recognition by others. How students perceive themselves with respect to physics is predictive of career intentions and achievement. Here too, faculty play an important role in helping shape physics identity among African American students, who have already had to contend with and overcome stereotypes about who is interested in or capable of becoming a physicist or astronomer. TEAM-UP found that faculty encouragement, recognition, and representation are key enablers of physics identity. Physics identity is strengthened in African American students when they

²Microaggressions are the "everyday verbal, nonverbal, and environmental slights, snubs, or insults, whether intentional or unintentional, which communicate hostile, derogatory, or negative messages to target persons based solely upon their marginalized group membership" (source: Derald Wing Sue, https://www.uua.org/sites/live-new.uua.org/files/microaggressions_by_derald_wing_sue_ph.d._pdf).

Imposter Phenomenon - The belief that past accomplishments and demonstrations of skill and competence are attributed to luck rather than hard work and growing capabilities. See report Glossary for expanded definition.

Stereotype Threat - The debilitating cognitive load caused by fear that one's performance on a specific or extended task (e.g., an exam or whole course) could confirm a negative stereotype about an identity group to which one belongs. See report Glossary for expanded definition.

³ Physical, virtual, or social safe space in which the needs, aspirations, social proclivities, and learning and communication styles of marginalized identity group members are centered and of paramount concern.

⁴ Astronomy identity development is important, too, but unlike physics identity, it has not yet become a commonly used term in the education research literature.

have same-race role models in the faculty, are routinely invited and financially supported to participate in the established activities of the profession, and are able to connect their physics education to activities that benefit their communities (Figure 5).

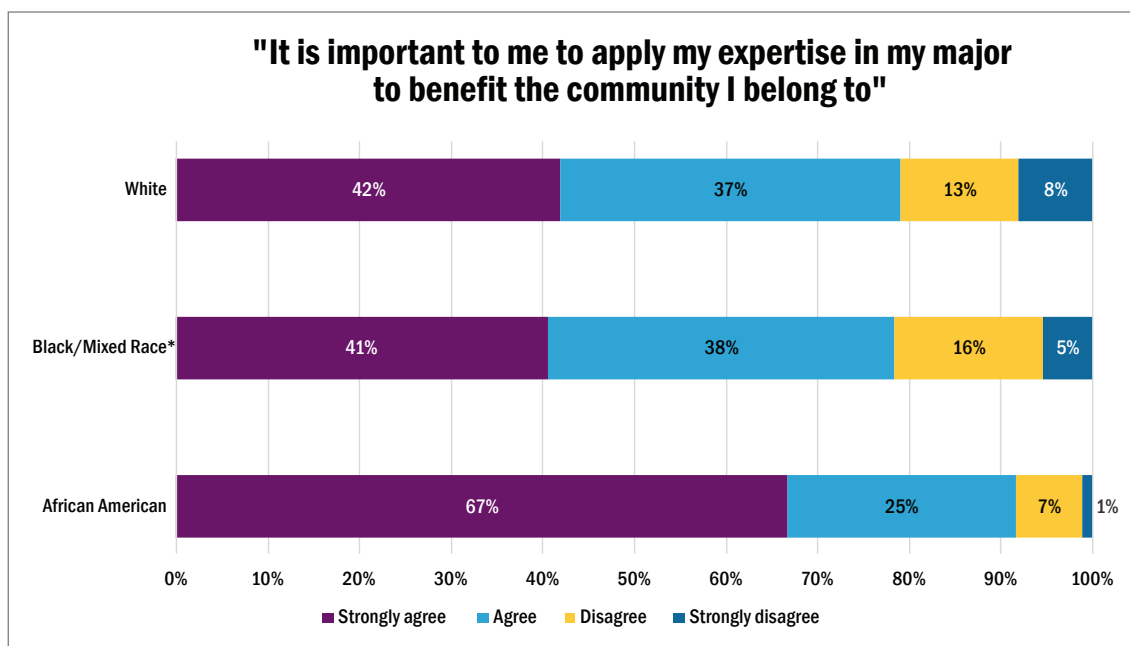


Figure 5

Source: Team-Up Student Survey

*Black/Mixed Race refers to students who selected Black or African American and at least one other race.

The TEAM-UP recommendations provide departments with the means to create a strong sense of physics identity in their students. Departments should take a strategic approach to building physics identity in students by determining whether current activities foster physics identity, assessing their efficacy across race/ethnicity/gender and other social identities, and using evidence-based strategies to modify those activities as necessary. Departments should also work to diversify their faculty across race/ethnicity/gender and other social identities. Departments and faculty should utilize resources, such as the AIP Careers Toolbox and African American alumni, to discuss a broad range of career options with undergraduates and communicate the ways in which physics and astronomy degrees empower graduates to improve society and benefit their community.

FACTOR 3: ACADEMIC SUPPORT

Effective teaching and a strengths-based approach to academic support are necessary for African American student retention and success.

Academic support is perhaps the first topic many physics faculty think of when considering how to address the underrepresentation of African American students since providing such support is traditionally regarded as the responsibility of those who educate students. Indeed, effective teaching, mentoring, and student-centered support are important for retention and success of African American students, as they are for all students. However, it is a damaging myth that minoritized students—members of underrepresented groups who are marginalized in society—have, as a consequence of their identity, learning challenges or needs, and that if

they work harder to bridge those gaps, they will achieve greater success. This sentiment, whether intentional or not, is played out every day on virtually every level, from interactions with peers to those with faculty and beyond. TEAM-UP site visits and the research literature show that recognizing student capabilities and building on their strengths lead to better outcomes than focusing on their presumed weaknesses. Further, faculty who teach well, care about students, and demonstrate commitment to them by affirming their academic abilities,

“I actually had pretty terrible professors who didn’t care, didn’t encourage. My academic advisor would make me cry, and my faculty advisor hinted at me dropping out of college and just learning how to code on my own because my midterm grades weren’t what she expected them to be.”

encouraging their success, and helping them find additional academic resources when needed, are critically important in fostering student success. Advising systems contribute to retention by providing early warning of student difficulties and allowing timely intervention. Providing multiple pathways into and through the major helps to recruit and retain African American students.

TEAM-UP’s recommendations for academic support strengthen the services that departments are expected to provide to students—teaching, mentoring, and advising—with a focus on African American student success. Departments should encourage and support new faculty in improving teaching and mentoring by attending campus workshops or those provided by professional societies and other organizations. They should also adopt policies and practices that encourage faculty, including those who are not members of marginalized groups, to formally and informally mentor students, and should provide recognition and rewards for these efforts. Faculty and staff undergraduate advisers should work closely with campus advising offices to provide cohesive support and comprehensive resources for students facing academic or other difficulties, and departments should ensure that all students are aware of support services. Finally, departments should regularly assess their activities and curricular pathways from recruitment through degree attainment, identifying points at which students leave or stop out⁵ before graduation, and should develop evidence-based action plans to increase student persistence.

FACTOR 4: PERSONAL SUPPORT

Many African American students need support to offset financial burdens and stress.

Colleges and universities provide students with many kinds of support in addition to academic support. African American students often face challenges that require assistance from non-faculty experts, and awareness and referral by faculty can improve students’ utilization of these resources. TEAM-UP research identified financial challenges as one of the greatest difficulties facing African American students (figure 6). These financial stressors, much like a lack of academic support, can lead to an increased need for mental health care and a

⁵ To take a break for one or more terms of college or university with the intention of returning.

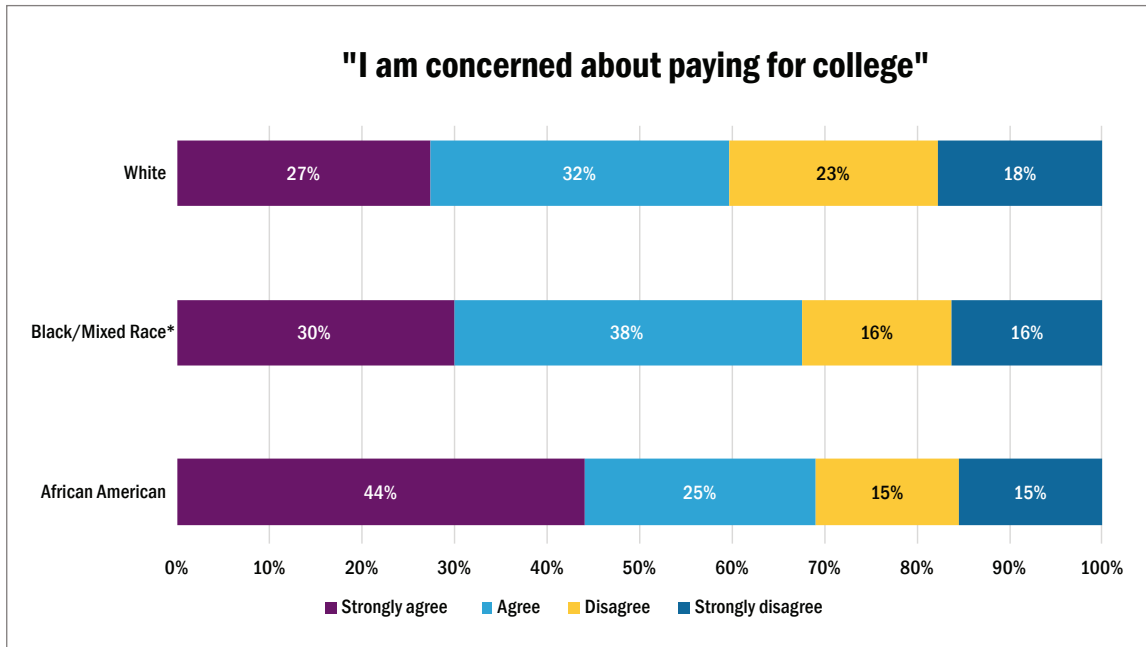


Figure 6

Source: Team-Up Student Survey

*Black/Mixed Race refers to students who selected Black or African American and at least one other race.

greater risk of students leaving the major or school. Student retention improves when faculty recognize and respond to students as unique individuals with a wide range of intersecting social identities and acknowledge that their experiences of being minoritized in physics and astronomy departments may impact



their academic performance. Access to jobs related to their major, such as paid research internships, help ease financial burdens and allow students to earn needed income while supporting their academic progress and reinforcing their physics identity.

Several of TEAM-UP's recommendations on personal support for students help faculty and departments navigate what may be unfamiliar or difficult territory. Faculty should seek funding for undergraduate students to work in research groups, and as Learning Assistants, for example, to help students advance academically while earning money. Similarly, departments should be aware of emergency and auxiliary financial aid and help students take advantage of these resources. Faculty should normalize seeking help for mental health needs by discussing self-care with students and pointing them to resources, and they should recognize the unique identity and promise of each student from a perspective of students' strengths rather than weaknesses.

The final recommendation within this category seeks to minimize the financial burden for African American physics and astronomy students in a larger way. A consortium of physical science societies should be formed to raise a \$50M endowment to support minoritized students in physics and astronomy who have unmet financial needs. Half of the endowment income would go to direct support of African American physics and astronomy students and half would go to support departments' implementation of the TEAM-UP report's recommendations and to support other financially marginalized groups in the future. As an interim step, physics and astronomy societies should raise \$1.2M per year to relieve the debt burden of African American bachelor's degree students. The latter figure corresponds to the typical unmet need of \$8K/year for 150 students, which is the number of additional African American students who should be earning physics bachelor's degrees at HBCUs (Historically Black Colleges and Universities) in order to achieve parity with the growth in physics degrees at Predominantly White Institutions since 1995.



FACTOR 5: LEADERSHIP AND STRUCTURES

For sustainability, academic and disciplinary leaders must prioritize creating environments, policies, and structures that maximize African American student success.

Effective departments create and sustain a supportive environment for their students. Department chairs play a key role in setting and acting on departmental priorities. Whether a department adopts the goal of increasing the number of bachelor's degrees awarded to African American students, and what steps it takes to support that goal, are functions of the leadership. Effective academic leadership utilizes committees, existing decision-making bodies, internal funding and other resources, and coalition building with campus programs and external organizations to effect change. Sometimes a singularly dedicated faculty member, or a lone champion, creates a supportive environment for African American students. However, evidence shows that the efforts of a lone champion are unsustainable. By contrast, in the most successful departments, a significant fraction of the faculty consistently value and support African American students as part of the department's culture and established practice.

Department chairs should also incentivize and reward multiple faculty members, including those who do not identify as faculty of color, to actively support underrepresented students.

In keeping with the findings, TEAM-UP's recommendations on Leadership and Structures advocate that department chairs set departmental norms and values of inclusion and belonging and that they actively partner with campus programs that provide scaffolding to support student belonging, STEM identity development, and personal and academic support of African American students. As well, department administrators should support and encourage students to utilize these important resources. Department chairs should also incentivize and reward multiple faculty members, including those who do not identify as faculty of color, to actively support underrepresented students. Professional societies should encourage relevant groups within their organizations to examine ways to advance the recommendations of this and similar reports.

CHANGE MANAGEMENT

A new level of thinking is required to solve a persistent problem.

The underrepresentation of African Americans in physics and astronomy is a systemic problem that cannot be solved through the work of individual faculty, departments, or professional societies. It requires coordinating the efforts of stakeholders acting at all of these levels. In addition, standard approaches of strategic planning are unlikely to succeed because the underlying norms, values, and culture of the profession need to be addressed before lasting changes can occur. Fortunately, there is a growing body of literature on successful culture change in higher education to inform this work. This literature posits that preparatory work must be

done prior to modifying processes toward a stated goal. First, a theory of change must be developed to guide the change process.⁶ Effective change management considers the broader context for change and creates a shared understanding among key stakeholders of the need for and approach to creating the change.

Professional societies have a leading role to play in this effort, as they did in the early 2000s with the SPIN-UP project, which succeeded in its goal to increase overall physics bachelor's degree production.⁷ Professional societies and individual departments should each develop a theory of change around doubling the number of African Americans earning bachelor's degrees in physics and astronomy, utilizing sensemaking and shared leadership.⁸ Representatives from all groups should jointly produce a unified change management model highlighting the interactions among the societies, universities, departments, and individual physicists and astronomers needed to support these efforts. Professional societies should facilitate these activities by holding discussion forums on this topic; empowering and preparing change agents through skill-building activities; and establishing recognition, rewards, and other incentives for efforts by faculty members to improve the success of African American students in physics and astronomy.

Finally, it is TEAM-UP's intention that the report not sit on a shelf but be used to inform, inspire, and serve as a guide toward real and lasting change. The last chapter of the report provides several means to encourage progress, including by recognizing the social responsibility of physicists and astronomers, and by providing assessment rubrics for high school students, parents, and faculty members to evaluate departmental environments for African American students. Departments should review and learn from the report and the related reports and programs of other professional societies that address different aspects of diversity, equity, and inclusion. Professional societies and individual departments should gather relevant data about their organizations, disaggregated as appropriate by race/ethnicity/gender, and address disparities.

All appropriate groups should begin to implement the recommendations found in the TEAM-UP report, and an organizational body, to be determined, should assess and publicly communicate progress toward the recommendations of the report every two to four years, including quantitative and qualitative data similar to those used within it.

⁶ A theory of change is a comprehensive description and illustration of how and why a desired change is expected to happen in a particular context

⁷ Indeed, SPIN-UP helped double the number of physics bachelor's degrees in just over a decade, thus demonstrating that a community-wide, goal-driven change effort can succeed.

⁸ Theory of change, sensemaking, and shared leadership each have a specific meaning in research on higher education. Sensemaking is a learning process of creating meaning around concepts and ideas through a variety of social inputs including dialogue with others. Research in change processes in higher education suggests that culture change cannot happen without it. Shared Leadership is an arrangement in which power and decision-making authority are shared among top-level leaders (e.g., department chairs) and individuals with the most to gain from change but the least power to achieve it themselves (e.g., students, or faculty working on behalf of students).

Priorities

We cannot emphasize enough the systemic nature of the problem under discussion: the persistent underrepresentation of African Americans in physics and astronomy is due to the lack of a supportive environment for African American students in many departments, and to the enormous financial challenges facing these students in general. Solving these problems requires changing not only the way physicists train students, but how they think about training students. The challenges are too difficult to be solved by individuals or even departments alone; physics and astronomy overall must be engaged through their professional societies. The solution requires both will and money.

Perhaps the first thing individual physicists and astronomers should do is consider their role in establishing their departmental cultures and commit to creating an environment where African American students and those from other marginalized communities can thrive. Consequently, the report's highest-priority recommendation is to read and discuss this and related reports (Recommendation 6b under Change Management). Professional societies, working with departmental representatives, should utilize sensemaking and shared leadership to develop theories of change for individual departments and professional societies and should also establish faculty networks, learning communities, and skill-building workshops (Recommendations 6a and 6c under Change Management). The APS Inclusion, Diversity, and Equity Alliance (APS-IDEA) provides a framework for these efforts.

For professional societies, the first step is to support these change management processes and encourage existing and new groups within their organizations, such as the new APS Forum on Diversity and Inclusion, to examine ways to advance the recommendations of this and similar reports (Recommendation 5e). The second step is to raise substantial funding to support minoritized students with unmet financial need in physics and astronomy and to support the implementation of this report's recommendations by departments (Recommendation 4e).

For department chairs, the highest priority is to identify campus and external resources that provide financial relief to students and help students with unmet needs take advantage of them (Recommendation 4a). Next is to begin the hard work of culture change by setting norms and values of inclusion and belonging; recruiting, developing, and supporting a diverse faculty; and overseeing structures, policies, and practices that enhance the success of African American students (Recommendation 5a).

After physicists and astronomers have understood the nature of the problem, they can begin to undertake actions addressing the five factors in student success (Belonging, Physics Identity, Academic Support, Personal Support, and Leadership and Structures). For individual faculty, the top priority should be to learn, practice, and improve skills that foster student belonging in their interactions with undergraduates (Recommendation 1a). The next priority for individual faculty is to seek funding for undergraduate students to work in research groups, as Learning Assistants or find other ways to help students advance academically while earning money (Recommendation 4b).

After undertaking these steps, individual researchers, department chairs and officers, and professional societies will be able to identify the next steps appropriate to their context from among the many other recommendations in the report.

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AIP provides the means for its Member Societies to pool, coordinate, and leverage their diverse expertise and contributions in the pursuit of the shared goal of advancing the physical sciences in the research enterprise, in the economy, in education, and in society. Through their partnership in AIP, Member Societies broaden their impact and achieve results beyond their individual missions and mandates.

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This booklet is a preview of the TEAM-UP report, *The Time is Now: Systemic Changes to Increase African Americans with Bachelor's Degrees in Physics and Astronomy*, which will be published in full and available in print in early 2020. For copies and other inquiries go to aip.org/teamup



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