READERS' FORUM

Commentary

Room to breathe: A sense of belonging is vital for fostering diversity in STEM

"I can't breathe!" were Eric Garner's last words, which he repeated while a police officer had him in a choke hold that would render him unconscious and ultimately dead. They were the words repeated by George Floyd when a police officer kneeled on his neck. And they have been used by at least 70 other people who have died while in the custody of law enforcement in the past decade.[1]

The phrase has become an expression of solidarity against racial oppression. It represents barriers that not only prevent living life itself but abate economic mobility and living to one's potential. It is a symbol of the need for broad, systemic change.

I have experienced this oppression firsthand in the academic community. "Do not think that you are getting a position here; you better go to the HBCU [historically Black college or university] downtown," I heard in one interview at a research university. "Do not think that we are going to hire any Black people after you," I was told at another. At a time when I had locs, one faculty member said to me, "You better cut your hair because people will think that you smoke weed."

Presently, as a professor, life coach, and engineering consultant, I can now breathe more easily. But I had to fight to get to this point, and nothing was ever given to me easily. Many Black students and faculty are still partaking in that fight, and STEM academics and professionals have an obligation to improve the situation, to whatever extent they can.

The need for change in STEM

In 2021, Black and African American people made up 12% of the US population ages 18–74 but only 9% of the STEM workforce.[2] That same year, only 8.9% of the US citizens and permanent residents receiving STEM degrees and certificates were Black.[3]

How do we increase the percentage of Black people in STEM degree programs and occupations? Strategies showing some success include culturally responsive pedagogical practices, hands-on learning, summer bridge programs, research experiences, counterspaces (supportive environments that provide safe and inclusive experiences that promote belonging), and mentoring opportunities. Regardless of the strategies, it is important for Black people to feel a sense of not only being welcome but also belonging.

A sense of belonging

One feels welcomed when the interactions they partake in are warm, sincere, caring, and appreciative. One feels a sense of belonging when they can bring their authentic self to the workplace or classroom. Carol Goodenow has defined belonging "as students' sense of being accepted, valued, included, and encouraged by others (teachers and peers) in the academic classroom setting and of feeling oneself to be an important part of the life and activity of the class."[4]

Research has shown that non-white students tend to report a lower sense of belonging than white students[5] and that students are less likely to succeed in an academic environment in which they feel they do not belong.[6] When Black students learn during the college transition that it is normal to experience struggles and feelings of not belonging, they experience higher self-perceived potential for college success than those who do not receive that type of message.[7]

Many strategies can nurture feelings of belonging. At heart, however, as I have learned through the cumulation of my academic experiences, there are three key components of the educational journey that must be fostered—at the adviser–student, classroom, program, department, and college levels—for students to experience a sense of belonging.

▶ **Positive interpersonal relationships.** In an academic environment, a student has relationships with peers, faculty, advisers, and staff members. The frequency of interactions and the intensity of the relationships matter. With strong interpersonal relationships, students and faculty feel socially connected to those in their major, department, or unit. The fostering of positive connections and structures that encourage healthy interpersonal relationships is thus key to sustaining a culture of belonging.

▶ **Connection to discipline.** Just as important as the connections to other people is the connection to one's field. A student's major or the faculty in their area serve as an integral part of their life and their sense of self. We need to give resources to platforms that foster discipline-specific identities as well as "science capital," which includes, among other things, one's scientific literacy, access to science museums, and ability to talk to others about science.[8] If you are an academic, you may need to ask yourself: Could any student, through hard work, learn my discipline?

▶ **Growth mindset.** The belief that intelligence is a fixed trait—for example, thinking "I'm not a math person"—can be undermining. In contrast, students who believe that ability is a malleable quality are more likely to improve their grades.[9] They are more likely to seek challenges and more open to learning how to improve in the face of setbacks.[10] Academics must, in their evaluations and assessments, encourage students to have a growth mindset.

In order to create lasting change, academic institutions must commit to actively dismantling the barriers that have historically excluded Black voices in STEM. By fostering belonging through intentional support and inclusive practices, we can ensure that all students have the opportunity to thrive and reach their full potential.

References

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LETTERS

More on William Fowler

"Manhattan Project astrophysics" (Physics Today, March 2024, page 34) by Michael Wiescher and Karlheinz Langanke correctly credits William Fowler for his Nobel Prize work on nuclear fusion in stars and for chairing the Project Vista activity at Caltech, but it also states that he "developed ignition systems for nuclear weapons." I believe they may be thinking of a different Fowler, perhaps Clarence "Max" Fowler, who led high-explosives research at Los Alamos for many years, but not during the Manhattan Project. George Kistiakowsky led the wartime explosives division.

Willie Fowler was a prodigious lecturer. We students of his at Caltech proposed that the unit of lecture material be named the "Willie" in his honor, but that in practice, other lecturers' output could be measured in milliWillies.

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► **Wiescher and Langanke reply:** We welcome the opportunity for clarification. The phrase "developed ignition systems for nuclear weapons" may be a bit vague. We meant it first to refer to the development of the neutron trigger based on the use of a polonium-210 alpha-particle source, which in combination with the beryllium-9 material, causes the production of neutrons, a method that was developed at Caltech during William Fowler's early days there, where he was advised by Charles Lauritsen.[1] The second reference is, as we state in our article, to "the system that abruptly and symmetrically compressed the plutonium core of the Trinity bomb, causing it to detonate." In an article in *Nuclear Technology*, Thomas Chadwick and M. B. Chadwick mention Fowler being responsible for magnetic and x-ray studies of the approach.[2] Looking at the reference again, though, we admit it could have been a different Fowler.

In *History of the Naval Weapons Center*, J. D. Gerrard-Gough and Albert Christman describe how the detonators needed to work in nanoseconds, initiating each explosive block nearly simultaneously:

> Through the efforts of C. C. Lauritsen and his Caltech scientific staff, appropriate detonators were designed. Lauritsen's close association with [the Naval Ordinance Test Station] paid off as equipment, facilities and security were available at Inyokern for the development testing of these detonators, which were known as "sockets." Development and testing of the sockets were under the direction of William Fowler and Thomas Lauritsen, and while the program was not strictly within Bruce Sage's principal area of responsibility, China Lake Pilot Plant facilities were used to load and test-fire the detonators, which were made in Pasadena.
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> The other problem was infinitely more complicated and concerned the intricate high explosive blocks themselves, their process, manufacture, and test.
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> The scientists and technicians of Los Alamos pioneered the initial process. The explosive was cast to a uniform density in specially designed molds, and then the cast blocks were carefully machined into the required shapes. Machining explosives was virtually a new technique, and the military and civilian machinists, for the most part, had to teach themselves. The fact that they mastered the art in such an incredibly short time is almost beyond comprehension.[3]

We took that as sufficient evidence that Willie Fowler was involved in both aspects. We apologize that we could not provide all of our references, but Physics Today articles limit the number that can be included.

We hope this clarifies the situation. And both of us, as former postdocs of Willie Fowler at Caltech, fully subscribe to introducing the "Willie" unit in teaching.

References

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Correction

August 2024, page 22—The Huntsman Telescope lenses have a focal length, not diameter, of 400 mm. PT