

SPECIAL TOPIC

Visions by WIMIN: Global Mentorship to Retain Underrepresented Trainees

Kimberly J. Edwards¹, Eman Akam², Jenny N. Ijoma^{3,4}, Keyara N. Mack^{5,6}, Patricia M. R. Pereira⁷, Savita Dhanvantari⁸, Hang T. Ta⁹, Xiaowei Wang¹⁰, Karen Alt¹¹, and Kelly E. Henry¹²

¹University of Pennsylvania, Philadelphia, PA, USA

²Massachusetts General Hospital and Harvard Medical School, Charlestown, MA, USA

³Robert Wood Johnson Medical School, New Brunswick, NJ, USA

⁴Princeton University, Princeton, NJ, USA

⁵Memorial Sloan Kettering Cancer Center, New York, NY, USA

⁶Weill Cornell Medical College, New York, NY, USA

⁷Washington University School of Medicine, St. Louis, MO, USA

⁸Lawson Health Research Institute & Western University, London, ON, Canada

⁹Griffith University, Brisbane, QLD, Australia

¹⁰Baker Heart and Diabetes Institute, Melbourne, Australia

¹¹Monash University, Melbourne, VIC, Australia

¹²Invicro, LLC, Boston, MA, USA 2022

Abstract

Mentorship is a fundamental aspect that contributes to the success of a career in science, technology, engineering, and mathematics (STEM), particularly in academia. Research suggests that underrepresented minorities (URMs) often experience less quality mentorship and face barriers to finding successful mentor–mentee relationships. URM trainees in STEM face challenges that are not encountered by their majority peers or mentors, adding another level of complexity to establishing important relationships. Mentors of URM trainees must therefore mentor beyond general scientific training and tailor their mentorship to be more culturally appropriate and inclusive, allowing URM trainees to bring their whole selves to the table and leading to their effective socialization. Herein, we present the perspectives of group leaders and trainees from around the globe to highlight key aspects of creating successful mentor–mentee relationships that are sustainable and productive for both parties.

Key words Mentorship · URM · Trainee · Mentor · Mentee

Introduction

Mentorship is a critical element of navigating a career in science, technology, engineering, and mathematics (STEM), and particularly so in an academic STEM career. Studies have demonstrated that long-term success of an individual's STEM career depends on the quality of mentorship they receive which fosters positive science identity,

maintains mental well-being, and increases chances for overall success. [1–4] Mentorship in STEM is especially pivotal in the success of those individuals with identities that are historically underrepresented in STEM- specifically women and underrepresented minorities (URM) such as Black, indigenous, and people of color (BIPOC) [5, 6]. Research suggests BIPOC/URM students receive less mentoring [3] and have poorer experiences/relationships with mentors compared to their majority peers, which in turn affects how and if they develop meaningful, fruitful connections. [7]

Correspondence to: Kelly E. Henry; e-mail: Kelly.henry89@gmail.com

The importance of mentorship in the success of minoritized scientists is to a large extent due to the role those mentoring relationships play in successful socialization of trainees [8]. Socialization in the context of academic science is the process by which trainees learn the norms and culture of the scientific (academic) community and acquire the skills that would allow their integration and acceptance into this community. In addition to knowledge acquisition, socialization of trainees requires them to be involved in the community and to form social groups within the scientific community [9, 10]. Successful socialization by default then addresses other social issues that minoritized trainees face like stereotype threat and imposter syndrome. Recent articles discuss mentors' specific roles in socialization of minoritized mentees [6, 11, 12]. URM trainees require mentors to go beyond providing research experience and training. Mentors of URM trainees must function as supportive guides and take the time to care for their trainees as individuals and guide them through understanding of the nuances of professional relationships that foster socialization.

The essence of a good, effective, and fulfilling mentor–mentee relationship between a minoritized mentee and a mentor is the same as that for *any good and effective* mentor–mentee relationship but requires strong emphasis on mentoring from a culturally responsive perspective.

It is important to note that it could be argued that culturally responsive mentorship of an URM would be best accomplished by pairing mentees with their respective background. Indeed, URM trainees often crave the support and guidance of mentors and role models who look like them, [13, 14] and often benefit from such mentorship [15]. In reality, this type of same-race/same-gender mentorship is difficult to achieve because institutions continue to fail to recruit BIPOC in STEM in numbers that are proportional to their representation in the general population. Additionally, failure to retain recruited URM and the leaky pipeline of STEM training results in even wider gaps in representation between students and faculty/mentors of color [16]. Appointing the task of URM mentorship to the limited number of URM faculty would contribute to an existing source of inequity in STEM/academia, which is often referred to as the “minority tax.” The minority or cultural tax is essentially a load of additional responsibilities placed on URM faculty/leaders in the name of diversity [17]. For these reasons, cross-cultural mentorship is realistically the most common and most feasible type of mentorship for trainees from underrepresented backgrounds.

Several articles outline the features and essence of effective mentorship, and strategies specific to people of color have also been outlined extensively [6, 11, 12, 18–21], and will therefore not be the focus of this contribution. The goals of this article are to 1) highlight the perspectives of URM trainees, mentors, and mentors of URM trainees on

mentorship, 2) highlight race-centric experiences and issues that a mentor of a Black (or minoritized) trainee should be aware of as they mentor through a culturally responsive approach, and 3) to emphasize socialization of trainees as a central facet of effective mentorship of URM trainees.

Perspectives

Historical underrepresentation of an identity in any setting or field presents challenges for those attempting to join and succeed in that field. Lack of representation, racial/gender/ability bias, and microaggressions contribute to lack of confidence and imposter syndrome, feelings of isolation and not belonging, all of which contribute to a diminishment of the initial enthusiasm to join. In STEM fields, effective mentoring can counter the negative effects that trainees may experience because of being an URM. In a recent publication focusing of mentoring relationships of Black and Latinx STEM students, Griffin et al. identify critical aspects of mentoring URM trainees that leads to positive outcomes [6]. These mentoring roles extend beyond simple access to research and include facilitating community engagement, fostering STEM identity through providing examples of future roles, and offering affirmation, encouragement, and motivation to counter imposter syndrome and lack of confidence.

The perspectives below are representative of collective experiences shared by contributors in this article and provide contextual examples of effective mentorship of URM from the perspective of mentors and mentees.

Kimberly J. Edwards, University of Pennsylvania, USA

I'm fortunate to have had mentors who were willing to engage with me in conversations and truly listen. The most effective conversations I've had with mentors were those reinforced by a genuine desire to get to know me. Rather than making assumptions based on heuristic stereotypes of my race and ethnicity, they were more interested in discussions about my goals, aspirations, motivations, and how former experiences influenced my identity. In doing so, they were able to help me make good decisions, grow as an individual, deconstruct and address insecurities, and bolster my strengths.

I'm fortunate to have had mentors who were my biggest cheerleaders. I have had mentors who complimented the small wins, while also applauding the bigger ones. Their cheers and words of encouragement, no matter how small, have helped fuel the motivation I've needed to start, continue, and repeat good efforts, especially during times of discouragement and difficulty. Their support reassured me that achieving my goals is possible, that I could trust they had my best interest at heart, and that they would help me along my journey to becoming the best possible version of myself. Some mentors even took this a step further, by also

challenging me to step outside of my comfort zone and untap potential I didn't know existed.

I'm fortunate to have mentors who are proactive about diversity, equity, and inclusion. Over the past year, the ongoing racial unrest in the USA, prompted many individuals, communities, and institutions, to take a stand against racism. My P.I., without hesitation, joined the movement. He facilitated laboratory-wide discussions about antiracism, diversity, and inclusion, and avidly educated himself about white privilege, as well as racism against minorities in this country. He also tried to understand how my experiences thus far, as a minority and a unique individual, have shaped my identity without making assumptions based on information he had gathered from other sources. His actions reminded me that diversity can be unifying, and differences can be understood.

Nevertheless, as an Afro-Caribbean woman in STEM, my path may continue to be affected by unique challenges and unequivocal racial- and gender-based inequities. With this in mind, I work harder, have become more resilient, and am invested in developing good professional relationships with my mentors. Some mentors have nudged me, questioning why I attempt to “overachieve” or “do the most,” with most eventually realizing that I do so because my unyielding desire to beat the odds isn't groundless. I am grateful to those mentors who have willingly supported me along this journey, supported my efforts to excel, and accepted me for who I am. Without their support and active mentorship, I would not have made it this far. To them, I say, “*Thank you. You have made a positive difference in my life.*”

Jenny Ijoma, Rutgers University and Princeton University, USA

I have been shaped and forged by the advice and criticism of those around me. I've become who I am by internalizing the expectations of the people who have sat in seats higher than my own, with the belief that I may one day be able to sit in the same seat. My STEM training has always encompassed a one-size-fits-all model that consistently benefits the majority but leaves stragglers struggling for effective guidance. I have bounced from mentors denouncing my efforts and criticizing my place in academia to mentors pointing out places they saw me inhabiting as a future scientist, as their colleague. To say that I'm happy to be who I am today because of this conglomerate would be an understatement. I am actively grateful for the Black woman I am today because I know how easily I could have been someone else, slipped out of the system, or left behind with ignored ambitions and dreams.

Patrícia Ribeiro Pereira, Washington University of St. Louis, USA

I am a Portuguese woman, a first-generation high-school student, and my scientific career has spanned several countries (Portugal, Germany, and the USA). My experiences taught

me that mentors are crucial for motivating students to follow a career in science and to attain their future professions. I consider myself fortunate for having those researchers who always saw more potential in me than what I saw in myself. Although my family always encouraged me to follow my professional dream of a career in science, they could not explain what a career in science would be like. These mentors were essential for me to stay above the water while I chased my scientific dream, as I came to them without any experienced guidance from home. I continue to reach out to these mentors for advice and some of them have become friends through the years. More importantly, these mentors molded me into the scientist that I am today!

I am currently an Assistant Professor at Washington University School of Medicine in St. Louis. The richness of interactions during my training enabled me to engage with culturally, ethnically, and gender-diverse groups, providing an excellent model for the enriching experiences I want to provide to my trainees. As a mentor, I prioritize my roles as a woman scientist who engages young students for a career in science or professions underpinned by science. I strive to create a research environment that combines performance and moral character in an inclusive and diverse environment. I genuinely believe that diversity of experiences results in diversity of ideas, which in turn contributes to better science. I am underrepresented myself and I am committed to building others up along with me and serving as a role model. Below are some of the lessons learned:

- 1) *The mentor–mentee pairing:* Mentors should always investigate the best interest of their mentees and be sure they have the resources, time, and energy necessary for their trainees to achieve success. I make an attempted effort to ensure that the pairing will be favorable to both parties and will ultimately result in a relationship founded on mutual respect.
- 2) *A personalized mentoring approach for everyone:* Every trainee has different goals, interests, and challenges. I work with my mentees in individual development plans that provide as many opportunities as possible for them to pursue their scientific and professional goals, whatever those may be.
- 3) *Work–life balance:* My research experiences were important for me to develop skills that contribute to most effective productivity and a good work–life balance that contributes to everyone's success in the laboratory. In my role as a mentor, I commit time and energy to perceive the individual struggles of my trainees and give thoughtful and thorough training and advice that contributes to productivity and a good work–life balance.
- 4) *Mentoring relationships do not end when the mentee leaves the laboratory.* With every important scientific decision, I have to make in my career, it is comforting to know I can ask my previous and current mentors for

advice. They always share with me their own experiences, which will ultimately help me make the best decisions. Mentor–mentee relationships are important after trainees leave the laboratory, and mentors should do their best to help them navigate their future careers and continue to advocate for them.

Savita Dhanvantari, Lawson Health Research Institute, Canada

I live and work on the traditional lands of the Anishinabek, Haudenosaunee, Chonnoton, and Lunaapéewak peoples. This is the location of Western University, London, Ontario, Canada. To let students from equity-deserving groups know that our laboratory is welcoming and inclusive, my graduate students and I wrote a Laboratory Code of Conduct. In this document, we state that “Equity, diversity, and inclusion are integral to scientific excellence. In our laboratory, individual members are welcome to bring their whole selves to work. We strive to create an environment where everyone, from all backgrounds and with different lived experiences, can pursue their passion for science freely and without barriers. By being representative of the whole of society, our research has the potential to be translated into improved health for everybody.” We have also outlined five tenets of conduct in the laboratory: Respect, Teamwork, Inclusivity, Allyship, and Responsibility. We discuss how these tenets are applied and how they align with Western University’s Policy on Discrimination and Harassment. Every student who interviews with me is given this document to read and agree to before starting work in the laboratory. Once per month, we devote our laboratory meeting to discussions on equity, diversity, and inclusion and how to make academia and medical schools more welcoming and inclusive. We have curated a resource list that includes podcasts, social media accounts, websites, books, and research articles on topics such as antiracism, gender and mentorship, and incorporating Indigenous ways of knowing into science. My students understand that the Code of Conduct enables them to hold me accountable, which in turn empowers them, knowing that their supervisor and mentor will support them when they encounter uncomfortable situations.

The Australian Perspective from Several Group Leaders in the Molecular Imaging Field

Australia is a multicultural country, composed largely of migrants from all over the world, with a strong presence of BIPOC. As such, everything from differences in culture diversities to language barriers can make mentor–mentee relationship more challenging. Culturally responsive/adaptive mentoring is therefore particularly important in this context to ensure support and engagement of mentees [19, 20]. Open and honest communication is key to adapting to the specific needs of a mentee and overcoming language and cultural barriers. Mentoring is intended to provide guidance to help aid

mentees in formulation of their skills and interests, and open questions should be used and will change based on an individual’s professional needs.

Hang Ta, Griffith University, Australia

Mentorship is the influence, guidance, or direction given by a mentor. A mentor can influence the personal and professional growth of a mentee. A successful mentorship requires effective contribution from both mentor and mentee. Both mentor and mentee can benefit from a mentoring process. For mentors, it is a way to give back as most mentors are those who received good mentoring during their career and their life. It is also an important development and learning experience as teaching and guiding others is the best way to learn, to become more competent leaders and communicators. For mentees, there are lots of benefits to being mentored by a more experienced/senior person. A mentor can accelerate mentee’s learning and development and help develop their full potential in the workplace, provide networking opportunities allowing mentee to gain access to important career contacts sooner, and help mentee to establish and refine their future direction and goals.

I am currently a tenured Associate Professor of Material Science at Griffith University, Australia, and leading a team of 10 students and 2 postdocs. To achieve what I have gotten so far, I have received good mentorship from different senior people in science. One of the mentors was a retired senior and was not in my research field but he was still actively involved in leadership and management/advisory boards at different organizations. Although he could not give me specific advice on my work and my research, he taught me how to make good plans, see the big picture, give me strategies to recruit students so that I could successfully recruit my very first students working on my projects, provided me useful contacts when I needed, and also lifted me up whenever I felt down or concerned. We remain in touch nowadays.

Now being a mentor myself, I am constantly in the process of learning. In my perspective, to establish an effective coaching or mentoring relationship, initially, mentor and mentee should build rapport, establish trust, establish permission (what is allowed and not allowed in the relationship), and clarify the relationship details. Communication plays a key role in a mentoring relationship. One of the challenges in communicating is making sure we are understood and when we are listening, ensuring that we effectively understand the other person. Mentoring is to provide guidance that helps mentee to find the solution themselves, a process in which mentee will develop their skills further. Mentoring is not to provide direct solutions at the beginning. As such, open questions should be used in a mentoring or coaching session.

Within a research group, research mentorship is the influence of other people (e.g., laboratory head) on the research-related behavior, attitudes, or intellectual capacity of others (group members). There are three specific features of professorial research mentorship. They include influence that

enhances people's capacity to (1) make appropriate choices, (2) to achieve requisite standards, and to (3) affect processes, within research activity. Research mentorship may incorporate the capacity to affect researcher development including behavioral development, attitudinal development, and intellectual development. In my perspective, to be an effective research mentor, we need to (1) believe in what we do, our ideas, our research program, believe that we can make significant changes in the field to benefit community and society; (2) share/communicate that vision with others to reach the goal and produce expanded results; (3) help team members to establish and refine their goals and plan; and (4) encourage and challenge team members to bring out the best in the team so they grow and excel. These are what I am employing in mentoring the students and young postdocs in my group.

Xiaowei Wang, Baker Institute, Australia

Australia is a multicultural country therefore the Baker Mentoring Program has approximately 50% of our participants who are BIPOC. A mentoring program will be challenging if the participants feel that they have to hide or mask part of themselves, either because they are feeling unsure or "invisible"; this will prevent them from being honest and engaging in the conversations. Therefore, our Program's success is highly related to the diversity of the participants because they feel safe to be themselves, which in turn results in motivation and their willingness to engage. Overall, diversity and inclusion in the Program and workplace lead to a happier environment.

As a member of the Gender Equity and Diversity Committee and the Chair of the Baker Mentoring Program at the Baker Heart and Diabetes Institute (Melbourne, Australia), I recognized that mentorship is a personal journey between a mentee and a mentor. A good mentor maintains confidentiality by listening and acting in the role of an advisor, providing individualized guidance to their mentee. They support and encourage the mentee to explore their paths through experience and help their mentee build confidence. At the same time, it is a learning opportunity for mentors themselves, mainly because every mentee has a different background and personality. Therefore, mentors must be understanding and empathetic. Being the inaugural chair of the Baker Mentorship Program, we have matched approximately 50 mentor-mentee pairs within the institute. We based our Program on the mentees' needs, where mentees were instructed to contact their mentors for meetings and to drive their conversations. This allows the mentee to determine their interactions and build trust with their mentor, as well as to be in control of the relationship.

Nevertheless, we also understand that sometimes, the match might not be the most suitable for an individual. In this instance, the mentee can choose to stop their interaction with their mentors. Furthermore, they are encouraged to reach out to the committee if an issue arises and a confidential discussion will be conducted to provide a solution. The

Baker Mentorship Program started at the beginning of the COVID-19 pandemic (May 2020), a time when mentoring was needed, and as a result, a huge portion of our Program was built for resilience. At the one-year mark, we conducted a survey and received exceptional responses from mentors and mentees. They commented on the usefulness of mentorship, especially during periods of uncertainty and instability. These comments highlight the benefits that our Program has achieved.

Karen Alt, Monash University, Australia

All mentorships or supervisors are different as well as their mentee or students. There are different types of leaders, and everyone's personal style is unique to their set of skills. I often ask myself "What are the qualities of a good leader and/or how can I improve these skills?" Leadership is not something people are born with; it is a skill that can be learned over time if you are willing to go the extra step.

I am currently a group leader at the Australian Centre for Blood Diseases, Monash University, Australia. I migrated to Australia from Germany and 80% of my team was not born here. I oversee and have supervised many people in different stages of their career and acted as a direct supervisor or within the Learning programs I established at Monash University and the Alfred Hospital. I am also in a mentor-mentee relationship program at Monash University to receive and give guidance. I have also attended many leadership courses and STEM workshops. However, I have learned the most by establishing a personal and meaningful relationship with individuals from different backgrounds just by listening to their stories, problems, and happiness. It is important to just talk—ignoring the anxiety of saying the wrong thing or using the wrong word which could accidentally insult or offend someone is not productive. Unfortunately, a few times misunderstandings can happen between non-native speakers just by virtue of the language barrier that exists among more diverse teams. Instead of being angry, be open to a respectful conversation to avoid any further escalation. Respectful and clear communication is a key skill to be successful in today's world regardless of people's specific interests or career goals. Furthermore, diverse teams mean more people who think differently, and possess varied experiences and perspectives. This all leads to more creativity and innovation in solving research problems, and it is a lot more fun to work with. Supervision is a learning curve for both supervisor and mentee and its development over time is influenced by many factors.

My journey of mentorship started from my own supervisors. I pass along what I have learned from the good ones and learned what not to do from the bad ones. I consider myself lucky to have lived both experiences, as they have been equally beneficial lessons. As mentors, you must be aware that your influence and behavior will affect your students in the near and distant future. The impact of mentoring does not stop at the end of the day when the student leaves the laboratory and goes home.

Mentor–mentee relationships have become increasingly more difficult and important during COVID. Two of my students, one from India and the other from Egypt, left Australia to join their families in March 2020, just as the outbreak began to spread. Since August 2020 they have been waiting for the border to re-open and come back to Australia to finish their Ph.D. Staying connected, supporting my students over great distance with regular communication is another step which I had to learn and getting better with each single communication and discussion we have via zoom or email. I am very proud to lead a diverse team guiding students to share their experiences creating a productive and effective environment to learn, grow and research.

Discussion

Through multiple perspectives from both group leaders and trainees, in STEM, we outline roles and actions mentors can take to improve their communication, leadership, and commitment to DEI:

- Make deliberate efforts to develop mentoring competence (classes, workshops, milestones, and be willing to take constructive feedback and learn from it).
- Make deliberate efforts to be antiracist (being “not racist” is not enough)[22]
 - o Create a safe environment in which trainees can discuss structural racism at the individual, institutional and societal level (this might overlap with a point below, but might be included here instead)
 - p Encourage and empower colleagues and trainees to speak up when witnessing racist behavior/language
 - q Promote BIPOC excellence in science by actively seeking out trainees, collaborators, and mentors who identify as racialized/minoritized
- Facilitate formation of mentoring teams to meet trainee needs
- Keep an active, up to date catalogue of relevant societies, conferences, and meetings that caters specifically to mentees’ in-groups and racial/ethnic identities.
 - o For example, student unions for URM, national organization of URM scientists, etc. and make appropriate suggestions to mentees. A list of national science organizations for URM populations can be found through this referenced web link. [23]
 - p Take interest in, respect, honor, and celebrate mentees’ cultures and identities outside of science
 - q Learn the difference between appropriation (selecting of certain aspects of a culture, ignoring their original significance by unacknowledged or inappropriate

adoption of the practices, customs, or aesthetics of one social or ethnic group by members of another (typically dominant) community or society) and appreciation (involves community, connection, and learning about said culture without disrespecting its origins or taking it on as one’s own)²⁴

- Encourage mentees to nurture their own networks of support and to prioritize their mental health and well-being

Conclusion

Active and productive mentorship is a key to the success and retainment of minoritized scientists. A crucial part of this is the effective socialization of trainees to mitigate stereotype threat and imposter syndrome that manifests in URM trainees in STEM. We introduce and encourage a toolbox for group leaders to provide and encourage dynamic and mindful mentorship.

Future Work

Color-blind attitudes employed in STEM fields require URM trainees to hide significant parts of themselves. Lack of representation, racism, and microaggressions serve to lay the groundwork for stereotype threat, all of which cultivate feelings of inadequacy and otherness and further isolate trainees of color. Imposter syndrome can affect and minoritized scientists and prevent the confidence needed to succeed. Future articles will focus on personal anecdotes of themes that create boundaries to successful retainment of URM scientists. We welcome perspectives on individual experiences related to color-blindness, microaggressions, stereotype threat, and imposter syndrome.

Declarations

Conflict of Interest The authors have nothing to disclose.

References

1. Stelter RL, Kupersmidt JB, Stump KN (2021) *Ann N Y Acad Sci* 1483:224–243
2. M. Estrada, P. R. Hernandez and P. W. Schultz, 2018 *CBE-Life Sciences Education*, 17.
3. Brunnsma DL, Embrick DG, Shin JH (2017) *Sociol Race Ethnic* 3:1–13
4. Chemers MM, Zurbriggen EL, Syed M, Goza BK, Bearman S (2011) *J Soc Issues* 67:469–491
5. Singleton KS, Tesfaye R, Dominguez EN, Dukes AJ (2021) *Nat Rev Neurosci* 22:71–72
6. K. A. Griffin, V. L. Baker and K. O’Meara, 2020 in *Socialization in Higher Education and the Early Career, Knowledge Studies in*

- Higher Education*, eds. J. C. Weidman and L. DeAngelo, Springer Nature, Switzerland AG, vol. 7, ch. 13.
7. Felder PP, Stevenson HC, Gasman M (2014) *Int J Dr Stud* 9:21–42
 8. Williams MS, Burnett TJB, Carroll TK, Harris CJ (2018) *J Coll Stud Retent-Res Theory Pract* 20:253–278
 9. V. Sweitzer, 2009 *Journal of Higher Education*, 80, 1–+.
 10. A. E. Austin, 2002 *Journal of Higher Education*, 73, 94–+.
 11. Boyce AS (2021) *Can J Program Eval* 35:350–362
 12. Wyatt GE, Chin D, Milburn N, Hamilton A, Lopez S, Kim A, Stone JD, Belcher HME (2019) *Am J Orthopsychiatry* 89:321–328
 13. Santos SJ, Reigadas ET (2004) *Journal* 6:337–357
 14. Hernandez PR, Estrada M, Woodcock A, Schultz PW (2017) *J Exp Educ* 85:450–468
 15. J. R. Gladstone and A. Cimpian, 2021 *International Journal of Stem Education*, 8.
 16. N. C. f. S. a. E. S. National Science Foundation, *Women, minorities, and persons with disabilities in science and engineering: 2002, NSF 03–312*, Report 0895–6308, Alexandria, VA, 2019.
 17. J. E. Rodriguez, K. M. Campbell and L. H. Pololi, 2015 *BMC Medical Education*, 15.
 18. Griffin K, Baker V, O’Meara K, Nyunt G, Robinson T, Staples CL (2018) *Studies in Graduate and Postdoctoral Educ* 9:19–37
 19. Griffiths M, Sawrikar P, Muir K (2009) *Youth Studies Australia* 28:32–40
 20. Villanueva C, Cain J, Greenhill J, Nestel D (2021) *ANZ J Surg* 91:2026–2031
 21. Mattocks K, Briscoe-Palmer S (2016) *Eur Political Sci* 15:476–492
 22. V. B. Chaudhary, A. A. Berhe. Ten simple rules for building an anti-racist lab. *PLoS Comput Biol.* 16(10):e1008210.23.W. H. O. Institution, Engineering & Science Organizations Serving Minoritized Populations, <https://web.who.edu/cdi/minority-science-organizations/>, (accessed 02/04, 2022).
 23. A. Wells. Appropriation and Appreciation: What’s the Difference? 2021, NIH Communities. <https://www.edi.nih.gov/blog/communities/appropriation-and-appreciation-whats-difference>. Accessed 02/26/22.

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.