

An effective workshop on “How to be an Effective Mentor for Underrepresented STEM Trainees”

Andrea G. Marshall^{1,†}, Zer Vue^{1,†}, Caroline B. Palavicino-Maggio^{2,†}, Kit Neikirk³, Heather K. Beasley¹, Edgar Garza-Lopez⁴, Sandra A. Murray⁵, Denise Martinez⁶, Amber Crabtree¹, Zachary C. Conley⁷, Larry Vang¹, Jamaine S. Davis⁸, Keesha L. Powell-Roach⁹, Susan Campbell¹⁰, Lillian J. Brady¹¹, Angyth B. Dal¹, Bryanna Shao¹, Stefanie Alexander¹, Nancy Vang¹, Neng Vue¹, Mein Vue¹, Haysetta D. Shuler^{12,13,#}, Elsie C. Spencer^{1,14,#}, Derrick J. Morton^{15,16,*,#}, Antentor Hinton, Jr.^{1,*,#}

¹Department of Molecular Physiology and Biophysics, Vanderbilt University, Nashville, TN 37232, United States

²Department of Neurobiology, Harvard Medical School, Boston, MA 02115, United States

³Department of Biology, University of Hawaii, Hilo, HI 96720, United States

⁴Department of Internal Medicine, University of Iowa, Iowa City, IA 52242, United States

⁵Department of Cell Biology, University of Pittsburgh School of Medicine, Pittsburgh, PA 15213, United States

⁶Department of Family Medicine, University of Iowa, Iowa City, IA 52242, United States

⁷Collaborative for STEM Education and Outreach, Department of Teaching and Learning, Vanderbilt University, Nashville, TN 37232, United States

⁸Department of Biochemistry, Cancer Biology, Neuroscience, Pharmacology, Meharry Medical College, Nashville, TN 37232, United States

⁹Department of Community and Population Health, The University of Tennessee Health Science Center, Memphis, TN 38163, United States

¹⁰Department of Animal and Poultry Sciences, Virginia Tech, Blacksburg, VA 24061, United States

¹¹Department of Pharmacology, Vanderbilt University, Nashville, TN 37232, United States

¹²Department of Biological Sciences, Winston-Salem State University, Winston-Salem, NC 27110, United States

¹³Shuler Consulting, Winston-Salem, NC 27110, United States

¹⁴Teachers College, Columbia University, New York, NY 10027, United States

¹⁵Department of Biological Sciences, University of Southern California, Los Angeles, CA 90007, United States

¹⁶Kaiser Permanente Bernard J. Tyson School of Medicine, Department of Biomedical Science, Pasadena, CA 91007, United States

*Corresponding author: Department of Molecular Physiology and Biophysics, 750 Robinson Research Building, 2200 Pierce Ave, Nashville, TN 37232-0615, USA. Tel: 319-383-3095; E-mail: antentor.o.hinton.jr@vanderbilt.edu; Department of Biological Sciences, University of Southern California, Los Angeles, CA 90007, USA. E-mail: mortond@usc.edu

One sentence summary: The authors provide a framework for how to be an effective mentor to URM trainees; this workshop helps to establish mentees, especially URM trainees, to have a more effective mentoring environment where they feel welcomed and can comfortably develop new ideas without feeling threatened by external factors.

†These authors share co-first authorship: Andrea G. Marshall, Zer Vue, and Caroline B. Palavicino-Maggio.

#These authors share co-senior authorship: Haysetta D. Shuler, Elsie C. Spencer, Derrick J. Morton, Antentor Hinton Jr.

Editor: Aníbal Valentín Acevedo

Abstract

Despite an increase in programming to promote persons excluded by their ethnicity or race (PEER) scholars, minorities remain underrepresented in many STEM programs. The academic pipeline is largely leaky for underrepresented minority (URM) scholars due to a lack of effective mentorship. Many URM students experience microaggressions and discrimination from their mentors due to a lack of quality mentorship training. In this workshop, we provide a framework to show trainees what effective mentoring looks like. Mentees, especially URM trainees, can flourish in effective mentoring environments where they feel welcomed and can comfortably develop new ideas without feeling threatened by external factors. Effective mentoring environments provide motivational support, empathy, cultural competency, and training. This workshop explains facets of effective mentoring to students, as well as highlights to URM trainees why mentors can serve as valuable resources.

Keywords: diversity, STEM, professional development, higher education, mentorship, culturally supportive, cultural competence

Abbreviations

EI: emotional Intelligence
 IDP: individual development plans
 MARC: Maximizing Access to Research Careers
 PEER: person excluded by their ethnicity or race
 STEM: science, technology, engineering, and mathematics
 URM: underrepresented minorities

minority (URM) trainees, a blueprint for selecting mentees based on the mentorship environment, and strategies for maintaining nurturing mentor–mentee relationships. Mentor–mentee relationships require navigating unique challenges to ensure the success of URM trainees. Frequently, URM students face microaggressions, imposter fear, and difficulties in building networks and mentorship relationships, which increase the risk of falling out of the academic pipeline (Hinton Jr *et al.* 2020a, National Academies of Sciences 2020, Shuler *et al.* 2021, Uddin and De Los Reyes 2021). Despite the nature of these challenges, based on scientific findings, URM trainees perform better under supportive mentorship relationships, which can help them overcome the daily challenges

The framework of the workshop

Designing an effective mentorship workshop requires examples of the characteristics of effective mentors of underrepresented

Received: March 16, 2022. Revised: June 4, 2022. Accepted: June 14, 2022

© The Author(s) 2022. Published by Oxford University Press on behalf of FEMS. All rights reserved. For permissions, please e-mail: journals.permissions@oup.com

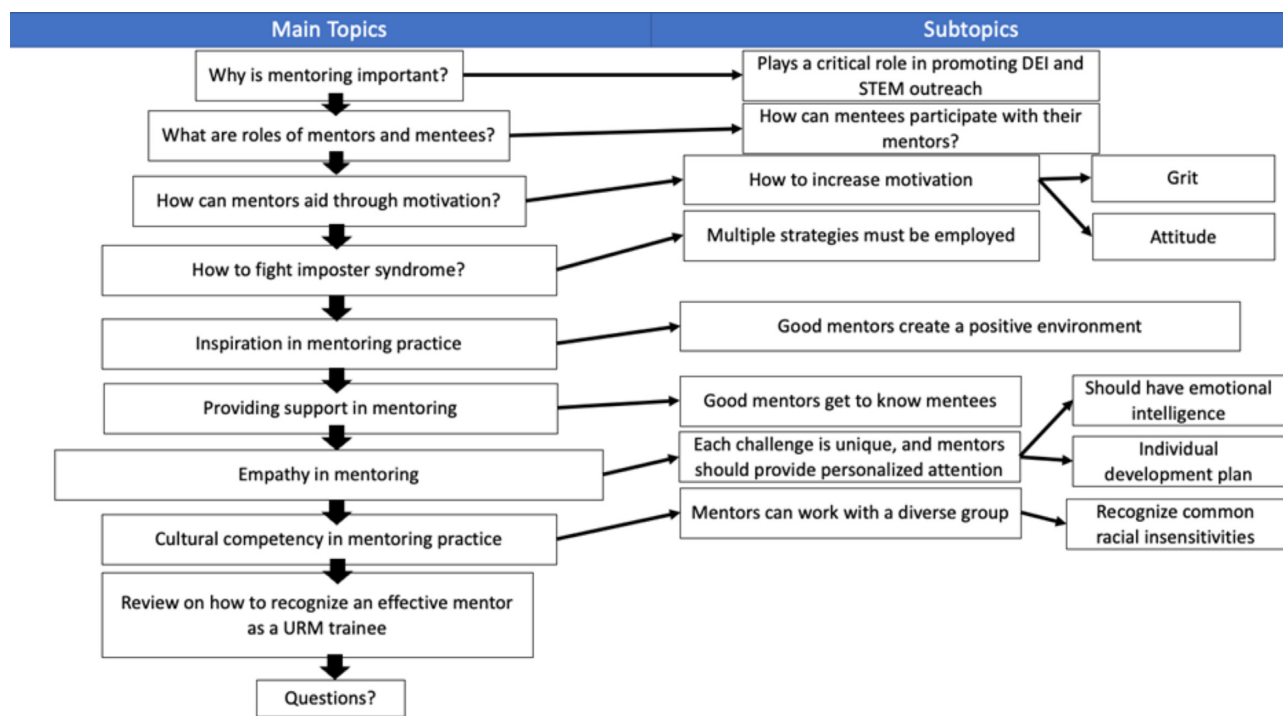


Figure 1. Flowchart of workshop presented to participants.

that deters them from staying in the academic pipeline (Hinton Jr et al. 2020a, Termini et al. 2021a). However, often times, URM trainees may not be able to recognize supportive mentors, or not understand the importance of effective mentors.

During the workshop strategies were presented to help students identify mentors who showcase best practices for effective and motivational mentoring (Fig. 1). Mentors should be able to identify mentees in need of special guidance. These strategies encouraged mentors to reframe how they think about students, work to have a more authentic mentor–mentee relationships, and develop a motivation-based mentoring approach based on emotional intelligence (EI; Gardenswartz et al. 2010, Opengart and Bierema 2015, Montgomery 2017, Hinton et al. 2020, Hinton Jr et al. 2020b, Shuler et al. 2021).

In the workshop, all participants were presented with a model of intentional mentorship. This mentoring model emphasizes a willingness to learn and establish credibility while facilitating the formation of positive relationships through networking (Shuler et al. 2021). Workshop participants were also exposed to effective and ineffective mentorship practices (Neikirk 2021). Furthermore, the workshop discussed using motivational mentoring as a way to cultivate the mentee’s spirit of excellence as they navigate their career development—through the use of individual development plans (IDP; National Academies of Sciences 2020, Shuler et al. 2021). These strategies are especially useful for mentees during times of hardship, such as classroom challenges. (McReynolds et al. 2020, Termini et al. 2021b).

Introduction

Mentoring relationships are essential for the development of a mentee’s career, especially those from URM groups. Successful mentoring requires environments that bolster motivational ambition, provides empathy, and utilizes cultural competency. Toxic mentoring environments arise from poor communication, lack of

commitment and experience, conflicting personalities, perceived competition, poor perceived performance, and difficulty in forming interpersonal connections with the mentee. Despite the need of URM trainees for strong mentors, oftentimes trainees may not be able to recognize strong mentors. Furthermore, as the progress in their career they may not know how to be effective mentors themselves. Therefore, this workshop aimed to educate trainees in what constitutes a strong mentor. By doing this, we aimed to see if we could also demonstrate to students the importance of having an effective mentor as a resource in their academic journal.

Key traits effective mentors teach their diverse trainees

- Practice meditation and mindfulness.
- Be aware of your own biases.
- Create a positive environment.
- Respond, do not react.
- Learn self-motivation, encompass your inner resources to act, reach, and achieve goals and aspirations.
- Improve cultural competence.

Motivational support: mentors should motivate and support diverse trainees simultaneously

Motivation is the inner drive to excel, which is often changed by internal and/or external conflict. This inner drive is important for cultivating goals and providing direction. A trainee’s motivation governs the direction of the trainee’s behavior in any mentoring environment, such as their effort, grit, and attitude. Minority trainees not only face external barriers during their educational and career journey, such as toxic mentorship and institutional inequities, but also experience internal challenges, such as

John Henryism (Rolle et al. 2021). Furthermore, URM also face barriers including imposter fear, also known as imposter syndrome which is discussed in the workshop as a stigmatizing phrase that places the responsibility on the individual as opposed to the environment (Hinton Jr et al. 2020b, Rolle et al. 2021). These barriers stimulate a lack of confidence, which affects their perseverance. Since all trainees have different motivations, mentors should personalize their mentorship approach based on their mentee's goals and motivations. A single mentorship strategy is often insufficient for a diverse group of mentees. Mentees differ physically and emotionally, including in their motor and learning abilities. This means that effective mentors will employ one-on-one meetings with their trainees to ensure their support is personalized.

Mentors set an example for their trainees. Quality mentoring comes from being an inspiration (Shuler et al. 2021). Mentorship is an investment, not only to their institutions but to society as their mentees may make substantial contributions (Hinton Jr et al. 2020b, Shuler et al. 2021). Thus, the mentor's character can play a big role in how mentees view themselves. An inspiring mentor listens, serves, shares, focuses on positivity, stays authentic, is willing to learn, and remains humble. Minority trainees excel with positive reinforcement. Mentors foster positivity in their relationships with mentees. Mentors must also identify and restrain negative beliefs in their mentees and guide them being willing to accept constructive feedback. Therefore, trainees should not feel as though mentors are putting them down, but rather lifting them up and support them.

Providing support and empathy

Mentors need to invest time in getting to know their mentees. Active listening is as important as intentional mentoring. An effective mentor sets aside time to speak with their mentees and pays attention to what they have to say (Shuler et al. 2021). Active listening, instead of passive listening, entails action. For example, if your mentee makes you aware of a concern or question, the mentor might not have an answer to a specific situation, which would require seeking out advice from their network. Intentional listening is essential to effectively communicate with mentees. For example, if a mentor does not completely understand their trainees' questions or concerns, the mentor may consider asking for clarification, which ensures a clear line of communication between the mentor and mentee (Shuler et al. 2021). Active listening also requires avoiding distractions, such as emails, while providing their mentees with undivided attention. Therefore, it should be clear to trainees that the mentor is taking time to listen to their needs, both personal or professional, depending on the context of the relationship. Focus on clarifying the situation to best provide an answer or suggestion. It is also important a mentor maintains an open mind. Obstacles and setbacks are a good way for mentees and mentors to grow and develop their skills.

Furthermore, each challenge is unique. Although mentees may be of the same gender, racial/ethnic background, socio-economic background, or school systems, they are all individuals with different journeys and motivations. No racial/ethnic group is monochromatic hence it is essential to develop a personalized "individual development plan" (IDP; Hinton Jr et al. 2020b). An IDP is a critical tool effective mentors may consider making for their trainees to aid in their career development. Effective mentors also seek to maintain transparency by breaking down communication barriers, including seeking out alternative approaches, media, or technology to carry out conversations.

It is also important for mentors to focus on developing their EI, which is also known as emotional quotient or EI quotient (Hinton

Jr et al. 2020b, Shuler et al. 2021). EI is the ability to understand feelings, emotional language, and signals conveyed by emotions (Hinton Jr et al. 2020b, Shuler et al. 2021). EI involves distinguishing and managing our personal feelings and interactions from those of other people (Hinton Jr et al. 2020b, Shuler et al. 2021). EI assists with managing your behavior, navigating social areas, and helping others make critical life choices (Hinton Jr et al. 2020b, Shuler et al. 2021). EI also helps identify personal biases in thinking (Hinton Jr et al. 2020b, Shuler et al. 2021). It is like a window to determine why a mentee or colleague behaves a certain way or avoids making certain decisions. Practicing empathy towards their mentees can help mentors and mentees communicate more efficiently. Mentors should find and employ methods both to measure EI, as well as improve it in themselves and their mentees.

Cultural competency and training

Cultural competence is the knowledge and skills needed to work with a diverse group in a meaningful relevant and productive way. Cultural competence involves an understanding of the role of religion, community, and culture in the lives and careers of URM mentees. Mentors should familiarize themselves with common racial insensitivities. These may present themselves in the form of microaggressions, such as not interacting with PEERs at conferences or expressing surprise at the strong English ability of a PEER (Marshall et al. 2021). Therefore, mentors should develop methods to ask questions on these topics with sensitivity and avoid perpetuating racial macro- and microaggressions.

Methods

Based on these concepts, we tested how students perceived the information and whether they could apply it to their career development and IDP. In this particular questionnaire, we used four questions to gauge interest. The questions consisted of a 10-point scale that was based on rating the following concepts: overall presentation, support team, verbal and nonverbal communication skills, and networking.

A total of 24 students from Winston-Salem State University (a historically Black public university) attended a 90-minute virtual workshop. All participants were enrolled in the Maximizing Access to Research Careers (MARC) research, all were STEM undergraduates, and all were PEERs. All students were recruited through MARC, which allows for STEM speakers to speak to URM students enrolled in the program for research. All participants were unpaid, and participation was completely optional. The participants completed an anonymous questionnaire before and after the workshop to gauge their expectations and satisfaction regarding the workshop (Table 1). The data were compared using nonparametric Wilcoxon matched-pairs and signed-rank tests to determine differences between measures. Differences were considered statistically significant when P -values were less than .05. **** show $P < .01$.

Results

We summarized the data from the questionnaires using box and whisker plots in which the red centerline denotes the median, and error bars denote the standard error. Individual values are represented by circles. Overall, participant feedback was positive. Responses to the preworkshop questionnaires suggest that mentees did not initially believe the workshop would be beneficial (Fig. 2A-D, PreTest).

Importantly, inconsistent mentorship may alter the mentee trajectories (Packard 2003, Thomas et al. 2007, Janis and Barker

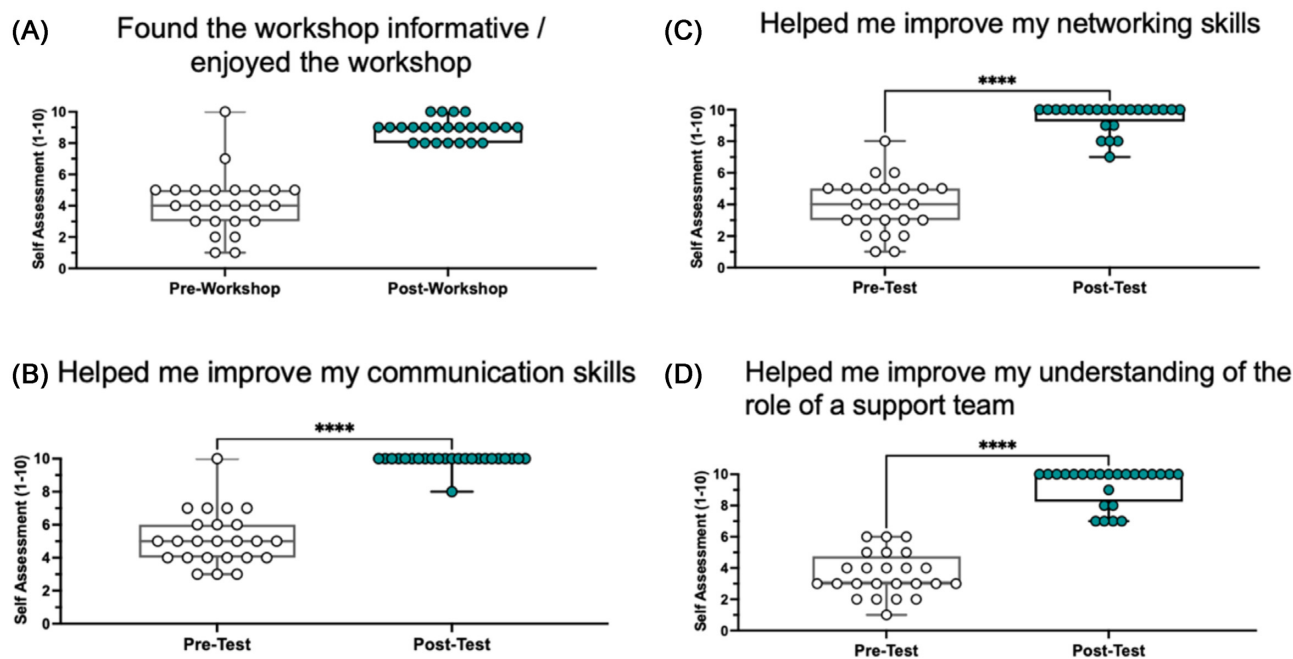


Figure 2. Results from pre- and postworkshop evaluations. These pre- and postworkshop questions were also used to evaluate mentees' knowledge regarding mentee-mentor relationships. (A) The initial expectations for informativeness of the workshop, followed by the reported enjoyment of the workshop. (B) How much the workshop improved communication skills. (C) How much the workshop improved networking skills. (D) How much the workshop improved understanding of support teams and assistive roles.

Table 1. Pre- and postworkshop evaluations.

Preworkshop survey questions	Postworkshop survey questions
On a scale of 1–10, do you think the presentation will keep you well informed?	On a scale of 1–10, how did you like the presentation?
On a scale of 1–10, how do you think the talk will improve your verbal and nonverbal communication?	On a scale of 1–10, how do you think the talk helped you improve your verbal and nonverbal communication?
On a scale of 1–10, how well do you think the talk will improve your networking skills?	On a scale of 1–10, how much do you think the talk helped you improve your networking skills?
On a scale of 1–10, how do you think the talk will improve your understanding of what a support team does?	On a scale of 1–10, how much do you think the talk helped you improve your understanding of what a support team does?

2016). However, after the workshop, feedback scores increased by an average of 5.2 points on a 10-point scale. The median score was a 9 or higher for every question asked (Fig. 2A–D, PostTest), indicating that the workshop was found favorable and helpful for identifying mentors or considering mentors for other parts of their lives.

All postworkshop questionnaires show a significant difference compared with preworkshop questions. Initially, on average, participants believed the workshop to be low to moderately informative with an average evaluation of 4.1 (Fig. 2A, PreTest). However, after the workshop, there was an overall average of 8.9 when asking if students enjoyed the presentation (Fig. 2A, PostTest). Although students had low expectations, they ended up liking the content. Similarly, the average initial score for believing the workshop would help improve communication skills was 5.2 (Fig. 2B, PreTest). Postworkshop, the average score increased by 4.8 points

to an average of 9.9 (Fig. 2B, PostTest). The belief that the workshop would increase networking skills increased by 5.6 points; the average pretest score was 3.9, while the average post-test score was 9.5 (Fig. 2C). More so, initially, participants did not strongly believe the workshop would underscore the importance of having a support team, giving an average score of 3.6 (Fig. 2D, PreTest). Following the workshop, this score rose by 5.7 to an average of 9.3 (Fig. 2D, PostTest). The metrics measured showed that, on average, mentees found the workshop informative and beneficial to developing their networking, communication, and collaboration skills (Fig. 2A–D, PostTest).

These workshops allow for trainees to explore concepts about effective and meaningful mentorship (Fig. 2A–D). It is possible to interpret the data that initially students did not see the benefit of the workshop because they may have felt it was not specifically targeting them or irrelevant to their goals of developing a career at the undergraduate level (Fig. 2A–D, PreTest). It is important to highlight that the students did achieve a sense of award from gleaning new information about mentorship. Participants also gave numerous examples of positive written feedback (Table 2). Taken together, these results suggest that career development workshops focused on mentorship may have a large impact on student development and performance level at the undergraduate level (Fig. 2A–D).

Discussion

Mentoring is an important aspect of a mentee's career, especially those from URM groups (Hinton Jr et al. 2020a, 2020b). Taken together, the data from the questionnaire highlights the need for more career development opportunities focused on mentorship. This workshop also provided an opportunity for self-reflection for students to understand the importance of mentors, and how they may be an important asset to achieving career goals. This work-

Table 2. Quotes from participant feedback for workshop.

I would like to continue to participate in PD [personal development] sessions related to this topics.
 [The workshop] provided tips with examples for improving professional relationships in our daily basis.
 Really interesting and valuable presentation.
 I feel much more prepared for the next step of my career in medical school and beyond.
 [The workshop] helped me put things into perspective and organize my thoughts when it came to mentoring.
 It was very interesting to hear different views on mentorship and other aspects of research.

shop also provided a unique understanding of different mentoring practices, and which may be most effective or ineffective in a mentee–mentor relationship. Initially, enthusiasm for this type of program was low, potentially signifying that students thought career development workshops were not essential to their development (Fig. 1A–D, PreTest). We believe that mentees' low expectations may be a result of low exposure or lack of mentorship, so they did not understand the relevance of learning about mentoring. However, the post-test results suggest that the students found this workshop offered a robust set of strategies and tools to use in their career development and an understanding of what type of mentor–mentee relationships they may need (Fig. 1A–D, PostTest; Table 2).

Although our sample size was small, the data suggest that career development workshops are important for career advancement. We would further speculate that career advancement can be done within mentee–mentor relationships, as well as, through skill and knowledge-building workshops. We also suggest that students that experience this workshop can improve their overall skill set and help build an understanding of the need for introspection and evaluation of what may be helpful in their career advancement.

Limitations and considerations.

Notably, our dataset does not reflect a large stratification of participants by race and ethnicity, age, or sex. We suggest these workshops be given in other languages based on institutional demographics to effectively communicate the importance of career development to non-native speakers. Additionally, our study participants, although involved in STEM fields, may not represent the entire student-body population. Thus, we suggest that this workshop and others be used to create a series to further enrich undergraduate career development across a wide variety of demographics. Equally, we suggest that workshops like these continue to be a resource to individuals that do not have access to career development opportunities. These workshops should be open access for others to disseminate the information and help broaden the true participation and motivation needed to pursue a STEM career. Furthermore, additional study is needed to identify additional areas that may aid in student success.

Availability of data and materials

A PowerPoint presentation of the workshop is available in English and Spanish upon request. Survey data may be made available upon reasonable request.

Ethics declaration, project title

Promoting Engagement in science for underrepresented Ethnic and Racial minorities (P.E.E.R), 21-MortonD-HSR-SOM-01, Kaiser Foundation Research Institute FWA: FWA00002344.

Acknowledgments

We would like to thank the students who participated in our workshop. We would also like to thank Dr. Heather K. Beasley for helping to make the figures in BioRender.

Ethics approval, consent to participate, and consent for publication

Yes.

Funding

This work was supported by the NIH grants 1K99DA052641-01 MOSAIC grant to L.J.B., 1K99GM141449-01 MOSAIC grant to C.P.M., and The United Negro College Fund/Bristol-Myers Squibb E.E. Just Postgraduate Fellowship in the Life Sciences Fellowship (HKB), The United Negro College Fund/Bristol-Myers Squibb E.E. Just Faculty Fund, Burroughs Wellcome Fund Career Awards at the Scientific Interface Award, Burroughs Wellcome Fund Ad-hoc Award, National Institutes of Health Small Research Pilot Subaward to 5R25HL106365-12 from the National Institutes of Health PRIDE Program, DK020593, Vanderbilt Diabetes and Research Training Center for DRTC Alzheimer's Disease Pilot and Feasibility Program and A.H.J. NSF grant MCB 2011577I and NIH T32 5T32GM133353 to S.A.M.

Competing interests. Authors declare that they have no competing interests.

References

- Gardenswartz L, Cherbosque J, Rowe A. Emotional intelligence and diversity: a model for differences in the workplace. *J Psychol Iss Organ Cult* 2010;**1**:74–84.
- Hinton AO, McReynolds MR, Martinez D et al. The power of saying no. *EMBO Rep* 2020;**21**:e50918.
- Hinton Jr AO, Termini CM, Spencer EC et al. Patching the leaks: revitalizing and reimagining the STEM pipeline. *Cell* 2020a;**183**: 568–75.
- Hinton Jr AO, Vue Z, Termini CM et al. Mentoring minority trainees: minorities in academia face specific challenges that mentors should address to instill confidence. *EMBO Rep* 2020b;**21**: e51269.
- Janis JE, Barker JC. Medical student mentorship in plastic surgery: the mentor's perspective. *Plast Reconstruct Surg* 2016;**138**:925e–35e.
- Marshall A, Pack AD, Owusu SA et al. Responding and navigating racialized microaggressions in STEM. *Pathog Dis* 2021;**79**:ftab027.
- McReynolds MR, Termini CM, Hinton AO et al. The art of virtual mentoring in the twenty-first century for STEM majors and beyond. *Nat Biotechnol* 2020;**38**:1477–82.
- Montgomery BL. Mapping a mentoring roadmap and developing a supportive network for strategic career advancement. *Sage Open* 2017;**7**:2158244017710288.
- National Academies of Sciences E and Medicine. The science of effective mentorship in STEM. 2020.
- Neikirk K. Unique struggles and the ways mentorship can fail. *Cell Mentor*. 2021.

- Opengart R, Bierema L. Emotionally intelligent mentoring: reconceptualizing effective mentoring relationships. *Hum Resour Dev Rev* 2015;**14**:234–58.
- Packard BW-L. Web-based mentoring: challenging traditional models to increase women's access. *Mentor Tutor* 2003;**11**:53–65.
- Rolle T, Vue Z, Murray S et al. Toxic stress and burnout: John Henryism and social dominance in the laboratory and STEM workforce. *Pathog Dis* 2021;**79**:041.
- Shuler H, Cazares V, Marshall A et al. Intentional mentoring: maximizing the impact of underrepresented future scientists in the 21st century. *Pathog Dis* 2021;**79**:ftab038.
- Termini CM, Hinton Jr AO, Garza-López E et al. Building diverse mentoring networks that transcend boundaries in cancer research. *Trends Cancer* 2021a;**7**:385–8.
- Termini CM, McReynolds MR, Rutaganira FU et al. Mentoring during uncertain times. *Trends Biochem Sci* 2021b;**46**:345–8.
- Thomas KM, Willis LA, Davis J. Mentoring minority graduate students: issues and strategies for institutions, faculty, and students. *Equal Oppor Int* 2007;**26**:1–11.
- Uddin LQ, De Los Reyes A. Cultivating allyship through casual mentoring to promote diversity. *Trends Cognit Sci* 2021;**25**:813–5.