BREAKTHROUGH

INCLUSIVE ACTION TOOL KIT

science FRIDAY

hhmi | Tangled Bank Studios

Version 1.0
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CREDITS

Written by Ariel Zych

Additional writing and development by Jessica Deters and Teirra Holloman

Produced by Xochitl Garcia

Document design by Colorbox Industries

The Breakthrough Inclusive Action Tool Kit

Who is this for? The Breakthrough Inclusive Action Tool Kit is for anyone ready to become an agent of change to make academic STEM culture more inclusive–from individual students and faculty in STEM fields, to campus administration and student organizations, to multi-campus coalitions and governing bodies.

What is it? It is a collection of beginnings for advancing STEM inclusion. This kit contains interventions that have been demonstrated to weaken the facets of academic STEM culture that have prevented comprehensive inclusion of folks from underrepresented and marginalized groups in STEM. The actions in this kit are organized by the arenas where action is needed and are bolstered by full citations and resources for diving deeper.

The first six sections are focused on institutional and community work to move towards a more inclusive STEM academic culture. **The last section—**"For Students Underrepresented in STEM"—is for students. While this work is ongoing, we've collected strategies that have helped some students from minoritized groups in STEM in the hope that they are a resource for you.

About Breakthrough: Portraits of Women in Science

Breakthrough: Portraits of Women in Science is a short documentary anthology from Science Friday and Howard Hughes Medical Institute (HHMI) Tangled Bank Studios that follows women working at the forefront of their fields. Each episode blends deeply personal stories with innovative scientific research of women across STEM fields and takes viewers from volcanoes in Costa Rica to distant galaxies and beyond. By showing that challenges such as deeply-rooted cultural or institutional norms, grueling working conditions, or personal sacrifice are not insurmountable obstacles to becoming a scientist or engineer, "Breakthrough" hopes to inspire a future generation of women to lead careers in STEM fields.

Learn more about the Breakthrough film series and Science Friday at Breakthroughfilms.com.

The Breakthrough Inclusive Action Tool Kit was designed to be informed by research and community needs. To truly engage in feedback and listening as a community, this tool kit will run through revision and iteration cycles informed by a community dialogue. Those versions will be posted here with acknowledgments to reviewers.

Getting Familiar with Terminology

Throughout this document, we will be using language that may not be familiar to some. We have done our best to provide working definitions for some of these terms as they come up in the toolkit. However, there are a few terms we use rather frequently that we thought could use an explanation upfront.

Terms and definitions to familiarize yourself with

Bias | Prejudice or inclination—that is often learned—for or against something, someone, or a group; we are all biased; bias can be conscious (i.e., explicit) or unconscious (i.e., implicit) ("Unconscious Bias", n.d.)

Marginalization | a state of social exclusion where a person or group's participation in society, rights, power, and/or privilege are limited. To be marginalized is to have a sense that one does not belong, to feel that one is neither a valued member of a community and able to make a valuable contribution within that community nor able to access the range of services and/or opportunities open to others. In effect, to feel, and be, excluded. (Mowat, 2015)

Minoritized | The social construction of underrepresentation and subordination in U.S. social institutions; persons are not born into a minority status nor are they minoritized in every social space (e.g., their families, racially homogeneous friendship groups, or places of religious worship); instead minority status is imposed on them in certain situations and institutional environments (Harper, 2013)

Underrepresented | The representation of certain groups of people in science and engineering (S&E) education and employment differs from their representation in the U.S. population; Women, persons with disabilities, and three racial and ethnic groups—Black/African-American, Hispanic/Latinx, or Native American or Alaska Native—are underrepresented in S&E (National Science Foundation & National Center for Science and Engineering Statistics, 2019).

CITATIONS + RESOURCES

Peer-reviewed publications

Mowat, J. G. (2015). Towards a new conceptualisation of marginalisation. European Educational Research Journal, 14(5), 454-476.

Harper, S. R. (2013). Am I my brother's teacher? Black undergraduates, racial socialization, and peer pedagogies in predominantly white postsecondary contexts. Review of Research in Education, 37(1), 183-211.

Other Resources

UCSF Office of Diversity and Outreach. Unconscious Bias.

National Science Foundation and National Center for Science and Engineering Statistics. (2019) Women, Minorities, and Persons with Disabilities in Science and Engineering: 2019. Special Report NSF 19-304. Alexandria, VA.

DATA

Audit Representation

IN THIS SECTION

- ☐ Measure Student Representation
- ☐ Be Mindful Of Underreported Identities
- ☐ Audit Positions Of Power
- ☐ Monitor Retention
- ☐ Interpret Retention Data Correctly

DATA

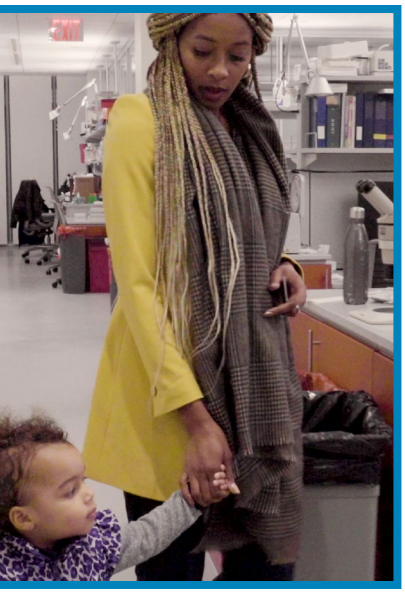
Audit Representation

Representation matters–for individuals in any STEM setting and at any career level, feeling a sense of belonging and proficiency in STEM is strongly influenced by whether or not they feel that they see themselves reflected in others in their field (e.g. Rincon 2019, Stout and Wright 2016). In order for a group to be well-represented in STEM, their representation should be proportional to their presence in the larger population. So, since African Americans make up about 12 percent of the U.S. population, they should also make up at least 12 percent of the STEM population in a department, institution, or company. Disproportionate representation in STEM contexts is an indicator that bias and discrimination have influenced the recruitment, training, advancement, and/or retention of STEM students or professionals.

Disproportionate representation indicates that there is work to be done to make STEM fields more equitable for everyone. It signals that processes are potentially advancing or excluding participants in STEM based on identity and that change is needed. A first step can be to document disproportionate representation. Most institutions and companies already collect this data and can likely share aggregated statistics with you.

> If you decide to gather data specific to your department, be aware that on smaller-scales (like departments vs. institutions) individuals can be identified based on the information you collect. For example, there may be only a small number of students or faculty who identify as part of a specific group or subgroup (e.g. race, gender, LGBTQ+).
>
> Be mindful that best practices for asking for demographic information are constantly evolving. Consult current resources about the best way to ask for race/ethnicity, gender, and other identity categories (examples: *Focus on Forms and Policy: Creating an Inclusive Environment for LGBT Patients*, *Inclusive Demographic Data Collection*; *More Comprehensive and Inclusive Approaches to Demographic Data Collection*). Presenting this data can be integral in convincing those in power that change is needed.

When you're done auditing representation, **remember that this is only the first step**: If you uncover disproportionate representation, there is serious work to be done to make the climate and culture of your department, institution, or company a truly inclusive and welcoming space for folks from underrepresented groups. Remember that unequal representation in STEM is not a reflection of anyone's potential to succeed in STEM, but instead is an indicator that there's work to do to change STEM culture to make it a truly inclusive space for all. Let's get to work!



Bianca Jones Marlin, subject of the film, *The Trauma Tracer*

As a neurobiologist, Bianca Jones Marlin researches the molecular mechanisms of stresses in parents that can affect the brain structure and sensory experiences of their offspring—AKA, how trauma can be passed down from generation to generation.

Measure Student Representation

Compare summary student demographic data at your institution or within your department with national averages (i.e., *Women, Minorities, and Persons with Disabilities in Science and Engineering*: 2019), other institutions (i.e., *By the Numbers*—IRA), and/or the U.S. population at large (US Census Bureau QuickFacts: United States), paying particular attention to how minoritized groups are represented *between and among* STEM fields and departments. The National Center For Education Statistics (NCES) is a clearinghouse for summary statistics of higher education settings by field, gender, race, socioeconomic status, learning setting, and more at the national level. How does the representation of students and faculty from historically underrepresented groups in your department, college, or university compare to the national average? Is representation improving and becoming more equitable each year, staying the same, or getting worse?

Be Mindful Of Underreported Identities

Many facets of personal identity that are the subject of bias and discrimination, especially (dis)ability, neurodiversity, and LGBTQ identity, are not always collected in large, national datasets (Stout and Wright 2016). When these facets of identity are collected, individuals do not always disclose this information because of associated stigmas (e.g. chronic illness and physical disability, Brown and Leigh 2018). On top of that, in the STEM context identities, like ability status, neurodiversity, and LGBTQ identities are studied significantly less often than race and gender (Stout and Wright 2016, Cech & Rothwell 2018). Review research and social media that document the experiences of disabled students (McCall, Shew, Simmons, Paretti & McNair, 2020, Twitter hashtags #AbelismTellsMe and #DisabilityTwitter), neurodiverse students (Stout & Wright 2016), and LGBTQ students (Cech & Rothwell, 2018, Twitter hashtag #OutInSTEM,) in STEM.

Audit Positions Of Power

Some of the most glaring inequities occur among positions of leadership at academic institutions (Lautenberger et al 2014, Holmes et al 2008, Hopkins 2002), and can have trickle-down impacts on the retention of junior faculty, graduates, and undergraduates who come from historically underrepresented groups (Hesli and Fink 2003, Sax et al 2019). Conduct a micro-audit of representation among the tenured faculty, chairs, deans, and other leadership positions at your institution. Actively work to recruit and hire diverse candidates (i.e., people of color, women, folks who identify as LGBTQ+) to these positions of power.

Monitor Retention

Pair summary statistics *at the beginning* of students' undergraduate experience or faculty's career advancement phase with statistics describing the *retention or completion* of that experience or phase, and consider comparing attrition between groups of interest. Summaries of "diversity" that describe the makeup of a department or institution may mask stark rates of departure from that department or institution. An institution that aggressively recruits students and faculty from historically underrepresented groups but does not support and retain them is a sign that the environment is violent (others might soften to say 'inhospitable,') towards minoritized groups (Rankin and Reason 2005, Rincón and George-Jackson 2016).

Interpreting Retention Data Correctly

Gaps in retention between groups can be misinterpreted. A lower graduation rate of a historically underrepresented group in STEM does NOT mean that individuals in that group are intrinsically *less capable of succeeding* in STEM! It is, however, indicative of the added barriers and toxic climate that these students face in pursuit of their degree. Multiple studies show that minoritized students with equivalent preparation match or outperform their majority peers in undergraduate and graduate programs in STEM, especially when they feel included and accepted in their local STEM context (Fisher 2010, Chang et al 2014, Fisher 2019).

> *"Just as stratification of opportunity in STEM did not emerge by mere coincidence, neither will a sustainable diverse STEM community."*
>
> –BABER, 2015, P. 267

CITATIONS + RESOURCES

Peer-reviewed publications

Brown, N., & Leigh, J. (2018). Ableism in academia: where are the disabled and ill academics?. Disability & Society, 33(6), 985-989.

Cech, E. A., & Rothwell, W. R. (2018). **LGBTQ Inequality in Engineering Education**. *Journal of Engineering Education*, 107(4), 583–610.

Fernandez, T., Godwin, A., Doyle, J., Verdin, D., Boone, H. Kirn, A., Benson, L., & Potvin, G. (2016). **More comprehensive and inclusive approaches to demographic data collection.** *Proceedings of ASEE Annual Conference & Exposition.*

Fischer, M. J. (2010). A longitudinal examination of the role of stereotype threat and racial climate on college outcomes for minorities at elite institutions. Social Psychology of Education, 13(1), 19-40.

Fisher, A. J., Mendoza-Denton, R., Patt, C., Young, I., Eppig, A., Garrell, R. L., ... & Richards, M. A. (2019). Structure and belonging: Pathways to success for underrepresented minority and women PhD students in STEM fields. PLoS One, 14(1), e0209279.

Hesli, V. L., Fink, E. C., & Duffy, D. M. (2003). The role of faculty in creating a positive graduate student experience: survey results from the Midwest region, part II. PS: Political Science and Politics, 36(4), 801-804.

Holmes, M. A., O'connell, S., Frey, C., & Ongley, L. (2008). Gender imbalance in US geoscience academia. Nature Geoscience, 1(2), 79.

Lautenberger, D. M., Dandar, V. M., Raezer, C. L., & Sloane, R. A. (2014). Association of American Medical Colleges. The state of women in academic medicine: the pipeline and pathways to leadership, 2013-2014.

McCall, C., Shew, A., Simmons, D. R., Paretti, M. C., & McNair, L. D. (2020).

Exploring student disability and professional identity: navigating sociocultural expectations in U.S. undergraduate civil engineering programs. Australasian Journal of Engineering Education, 25(1), 79-89.

Rankin, S. R., & Reason, R. D. (2005). Differing perceptions: How students of color and White students perceive campus climate for underrepresented groups. Journal of College Student Development, 46(1), 43-61.

Rincón, B. E., & George-Jackson, C. E. (2016). Examining department climate for women in engineering: The role of STEM interventions. Journal of College Student Development, 57(6), 742-747.

Sax, L. J., Zimmerman, H. B., Blaney, J. M., Toven-Lindsey, B., & Lehman, K. (2017). Diversifying undergraduate computer science: The role of department chairs in promoting gender and racial diversity. Journal of Women and Minorities in Science and Engineering, 23(2).

Stout, J. G., & Wright, H. M. (2016). Lesbian, gay, bisexual, transgender, and queer students' sense of belonging in computing: An Intersectional approach. *Computing in Science & Engineering*, 18(3), 24-30.

Popular Press + Blogs

How To Decolonize Your Science Curriculum, Aadita Chaudhury, March 2018

Yes, we must decolonise: our teaching has to go beyond elite white men

Books

Written/Unwritten: Diversity and the Hidden Truths of Tenure, Edited by Patricia A. Matthew

Other Resources

STEM by the Numbers, lesson plan, Teaching Tolerance

Women, Minorities, and Persons with Disabilities in Science and Engineering: 2019

By the Numbers – IRA

Inclusive Demographic Data Collection, Office of Regulatory Affairs and Research Compliance (ORARC), Harvard Medical School

Focus on Forms and Policy: Creating an Inclusive Environment for LGBT Patients, National LGBT Health Education Center

RESOURCES

Count Dollars And Cents

IN THIS SECTION

- ☐ Prioritize Compensation
- ☐ Account For Funding
- ☐ Measure Square Footage

RESOURCES

Count Dollars And Cents

In addition to impacting who is present, surviving, and thriving in STEM, inequity also informs how resources are allocated to individuals throughout their STEM careers. Unequitable resource allocation can make inequalities in STEM worse over time. If you are in charge of budgets in your organization, a lot of this work falls on you. Pay attention to and document resource allocation in your academic and professional community, focusing on where money is spent (and not spent) using the following examples as a guide. If you are not in charge of budgets, you can use these strategies to advocate for changes in how money is spent.

Prioritize Compensation

Taking or wasting someone's time, especially without compensation, is an often hidden side of resource allocation. As departments and institutions try to improve diversity and inclusion, they often rely on the unpaid labor of students, faculty, and professionals from underrepresented groups, which can lead to them doing more work than their peers without receiving adequate compensation and recognition. This can range from asking a question about the experiences of people who look like them to asking them to serve on a committee, all without compensation. So while the intention is to improve the climate and experience for underrepresented groups, this method can actually make the situation worse by exploiting the labor of the very people you want to help. Make a habit of always compensating folks for their time in ways that are intentional and meaningful (i.e., financial compensation, teaching reductions). Compensation can take many forms so engaging in conversations to see what would be most beneficial for individuals is a great first step.

In addition to asking for free help on diversity and inclusion initiatives, there are a variety of other tasks assigned to students, graduate students, and faculty that don't come with additional compensation, a bump in academic standing, or advancement opportunities. These types of "'housekeeping" tasks—things like taking and distributing notes from a meeting, setting up refreshments for a seminar, orienting new students or faculty, serving on an ad hoc committee—can take time away from compensated and rewarded tasks like research. Workplace housekeeping tasks also get assigned

Burçin Mutlu-Pakdil, subject of the Breakthrough film *The Galaxy Hunter*

Viewing an already rare galaxy through her telescope, Burçin Mutlu-Pakdil looked closer to find it had not one, but two rings—a completely new kind of galaxy!

disproportionately to women and people of color in a variety of workplaces, sometimes because representation is needed in those roles, but fails to account for the burden that places on students and faculty from underrepresented groups (Joseph and Hirshfield 2011, Hirshfield and Joseph 2012).

Account For Funding

Audit who receives competitive funding as well as the dollar amounts of that funding at all levels of professional advancement. Inequity in funding processes and outcomes have been shown to disproportionately affect women and minoritized groups (Oliveira et al 2019, Bornmann et al, 2007, articles below) even in federal grant initiatives. Model or suggest strategies for non-competitive support for women and minorities in STEM as a replacement for competitive funding (Prenovitz et al 2016).

Measure Square Footage

For laboratory researchers, square footage of laboratory space alone can be a useful metric for measuring discrimination on the basis of race, ethnicity, gender, or another protected identity (Hopkins 1999, 2002). Pay attention to how structural assets (equipment, transportation, computing power) are allocated, by whom, and under what procedures. Are these assets allocated equitably? Is the allocation process biased toward those with more power or privilege? Are the procedures designed to ensure an equitable outcome?

CITATIONS + RESOURCES

Peer-reviewed publications

Bornmann, L., Mutz, R., & Daniel, H. D. (2007). Gender differences in grant peer review: A meta-analysis. Journal of Informetrics, 1(3), 226-238.

Hirshfield, L. E., & Joseph, T. D. (2012). 'We need a woman, we need a black woman': Gender, race, and identity taxation in the academy. Gender and Education, 24(2), 213-227.

Hopkins, N. (2002, September). A study on the status of women faculty in science at MIT. In AIP Conference Proceedings (Vol. 628, No. 1, pp. 103-106). AIP.

Joseph, T. D., & Hirshfield, L. E. (2011). 'Why don't you get somebody new to do it? 'Race and cultural taxation in the academy. Ethnic and racial studies, 34(1), 121-141.

Prenovitz, S. J., Cohen, G. R., Ehrenberg, R. G., & Jakubson, G. H. (2016). An evaluation of the Mellon Mays Undergraduate Fellowship's effect on PhD production at non-UNCF institutions. Economics of Education Review, 53, 284-295.

Oliveira, D. F., Ma, Y., Woodruff, T. K., & Uzzi, B. (2019). Comparison of National Institutes of Health grant amounts to first-time male and female principal investigators. Jama, 321(9), 898-900.

Popular Press + Blogs

Another Obstacle for Women in Science: Men Get More Federal Grant Money, New York Times, March 5, 2019

Harassment and discrimination allegations roil a top US biomedical institute, Nature, April 30, 2018

OPPORTUNITIES

Bring Equity To Application Processes

IN THIS SECTION

- [ ] Value Diversity
- [ ] Widen The Search
- [ ] Anonymize Applicants
- [ ] Be Wary Of "Fit"
- [ ] Train And Diversify Power Holders
- [ ] Ditch Entrance Exams And Recommendation Letters

Bring Equity To Application Processes

Running admissions? Sitting on a faculty hiring committee? Refereeing a peer-reviewed journal or scholarship application process? Recognize that in these roles, you are a gatekeeper—that is, you control who is allowed to advance in STEM and who is not. In order to improve equity and access in STEM, you must work to make these processes more equitable, particularly for people from historically underrepresented groups in STEM.

Value Diversity

Take personal responsibility for advancing diversity, equity, inclusion, and access in all phases of recruitment and advancement processes for any STEM opportunity. This is particularly important if you're in a decision-making role or identify with a majority group. Stating a commitment to advancing diversity explicitly in a job posting or mission statement is a good first step, and must be followed up with intentional action to limit the influence of bias in the hiring process. Leaders, this means you: take responsibility for improving diversity, equity, and inclusion (Mclelland and Holland 2014). Read through and implement the following strategies to make your application and hiring processes more equitable.

Widen the Search

Word-of-mouth dissemination tactics are intrinsically biased so they rely on your already connected network. Be sure to proactively reach out to a variety of professional networks and even individual candidates by name to solicit applications. Additionally, ask for help sharing opportunities outside of traditional networks that might be majority-dominated. The key to making this strategy effective is following through on the other strategies listed in this toolkit to ensure that people are walking into a welcoming and safe environment.

Africa Flores Anderson, the subject of the Breakthrough film, *The Lake Sentinel*

To help underserved Guatemalan communities like the one she grew up in, Africa Flores-Anderson studies how to collect and interpret satellite data across huge landscapes and waterways.

Anonymize Applicants

Anonymizing applicants, keeping their name, age, gender, and race hidden throughout the application process, has proven to be an effective way of reducing the impact of implicit bias in the hiring process. For example, when symphony orchestras began allowing candidates to audition anonymously between 1970 and 1990, the likelihood of female musicians being selected increased by 30% (Goldin & Rouse, 2000). Other studies have found that applicants with white-sounding names are more likely to be contacted by the company they apply to (Kang et al 2016, Gerdeman 2017). Whether it is a job application, journal review process (Fox and Paine 2019), an open-access programming repository (Terrell et al 2017), or a fellowship application process (Eaton et al 2020), anonymization is an easy step that is particularly effective in *early rounds of applicant elimination*, when bias mingles easily with rapid applicant evaluation.

Be Wary Of "Fit"

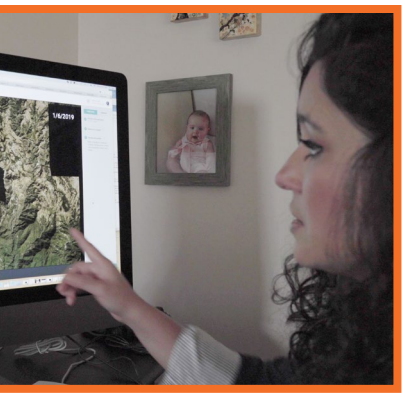
The idea of "fit" is often used to eliminate non-majority applicants in a search context. That is, "fit" is used to mask biased individual preferences as organizational consensus (White-Lewis 2019, Rynes, S., & Gerhart, B. 1990). Challenge yourself and your peers if you hear an applicant critiqued over their "fit" (i.e., "They wouldn't be a good fit"). Ask, "what do you mean by that?" and "why wouldn't they be a good fit?" These questions can help uncover the underlying bias behind the statement "not a good fit".

> *"African American and Asian job applicants who mask their race on resumes seem to have better success getting job interviews"*
>
> – GERDEMAN (2017)

Train And Diversify Power Holders

Educate decision-makers about implicit bias before they begin selecting, evaluating, hiring, or promoting anyone (Girod et al 2016, Carnes et al 2012, Sheridan et al 2010). You can have decisionmakers take *Harvard's Implicit Bias Test* or familiarize themselves with ways that bias typically presents itself in the application and hiring process (see other strategies in this section).

Secondly, you can work to ensure that your decision-makers are representative of the diversity of applicants you hope to recruit! Not only do social networks and linguistic cues differ among decision-makers from different backgrounds, so too do their biases during the selection process (Glass and Minnotte 2010). Anytime you are recruiting, hiring, or deciding among applicants for a competitive opportunity in STEM, diversify the people in charge of the process (**and don't forget to fairly compensate them for their time**).



Ditch Entrance Exams And Recommendation Letters

Consider ditching required entrance exams (SAT, ACT, GRE) and recommendation letters in application processes in order to make the processes more equitable. Studies have shown that required entrance exams are more predictive of a family's income than of how successful a student will be in college, and schools have found that eliminating tests or implementing test-optional policies can make college more accessible (Syverson, Franks, & Hiss, 2018; Sanchez, 2018). Ditching entrance exams is a way to make the admissions process more equitable. And the good news is, because of COVID-19, many universities are currently moving away from requiring the SAT and ACT for admission.

Recommendation letters have been shown to be strongly gender-biased, meaning that letter writers describe male applicants more favorably than female applicants (often because of unconscious biases—Aloisi & Reid 2020) (Dutt et al 2016). On top of that, applicants with more privilege are more likely to have connections to powerful letter writers. This "who you know, not what you know" unfairness can exclude first-generation STEM professionals from advancement opportunities due to variance in social networks. If you're asked to write a recommendation letter, use an open online tool or checklist (see resources) to try to limit the amount of bias you introduce through chosen adjectives, identified applicant strengths, and the length of your letter, and be sure to invite other qualified applicants to ask you for recommendation letters who may not have otherwise.

> *"Female applicants are only half as likely to receive excellent letters versus good letters compared to male applicants"*
>
> – DUTT ET AL (2016)

CITATIONS + RESOURCES

Peer-reviewed publications

Dutt, K., Pfaff, D. L., Bernstein, A. F., Dillard, J. S., & Block C. J. (2016). Gender differences in recommendation letters for postdoctoral fellowships in geosciences. Nature Geoscience, 9, 805-809.

Eaton, A. A., Saunders, J. F., Jacobson, R. K., & West, K. (2020). How gender and race stereotypes impact the advancement of scholars in STEM: Professors' biased evaluations of physics and biology post-doctoral candidates. Sex Roles, 82(3-4), 127-141.

Girod, S., Fassiotto, M., Grewal, D., Ku, M. C., Sriram, N., Nosek, B. A., & Valantine, H. (2016). Reducing implicit gender leadership bias in academic medicine with an educational intervention. *Academic Medicine*, 91(8), 1143-1150.

Goldin, C., & Rouse, C. (2000). Orchestrating Impartiality: The Impact of "blind" auditions on female musicians. *The American Economic Review*, 90(4), 715-741.

Kang, S. K., DeCelles, K. A., Tilcsik, A., & Jun, S. (2016). Whitened Resumes: Race and self-presentation in the labor market. *Administrative Science Quarterly*, 61(3), 469-502.

McClelland, S. I. & Holland K. J. (2014). You, me or her: Leaders' perceptions of responsibility for increasing gender diversity in STEM departments. *Psychology of Women Quarterly*, 39(2), 210-225.

McCullagh EA, Nowak K, Pogoriler A, Metcalf JL, Zaringhalam M, Zelikova TJ (2019) **Request a woman scientist: A database for diversifying the public face of science**. PLoS Biol 17(4): e3000212.

Rynes, S., & Gerhart, B. (1990). Interviewer assessments of applicant "fit": An exploratory investigation. Personnel psychology, 43(1), 13-35.

Syverson, S. T., Franks, V. W., & Hiss, W. C. (2018). **Defining access: How test-optional works**. *National Association for College Admission Counseling*.

White-Lewis, D. K. (2020). The Facade of Fit in Faculty Search Processes. The Journal of Higher Education, 1-25.

White papers

Aloisi, A., & Reid, N. (2020). (Un)conscious bias in the astronomical profession: Universal recommendations to improve fairness, inclusiveness, and representation. State of the Profession White Paper, Astro 2020 Decadal Survey.

Popular Press + Blogs

Letters of Recommendation: Just Say No, Inside Higher Ed, April 10, 2019

How to Fix Recommendation Bias and Evaluation Inflation, Scientific American, June 22, 2018

Intentionally Improving Processes for the 51 Pegasi b Fellowship, Heising-Simons Foundation, March 27, 2019

Minorities Who 'Whiten' Job Resumes Get More Interviews, Harvard Business School, May 17, 2017.

Study: Colleges That Ditch the SAT and ACT Can Enhance Diversity, NPR, April 26, 2018.

Books

Steele, C. (2010). *Whistling Vivaldi: And Other Clues to How Stereotypes Affect Us (Issues of Our Time)*. W. W. Norton & Company.

Other Resources

Harvard Implicit Bias Test, Harvard University.

Gender Bias Calculator, Tom Forth

Avoiding gender bias in reference writing, University of Arizona

CULTURE

Support Inclusive And Equitable STEM Culture

IN THIS SECTION

Support Inclusive And Equitable STEM Culture

Campus culture is old, complex, and can feel very rigid. However, when it comes to supporting students in STEM, several successful interventions are already on the books, and these interventions usually benefit all learners and early career professionals, regardless of identity or background.

Avoid Gaslighting And Microaggressions

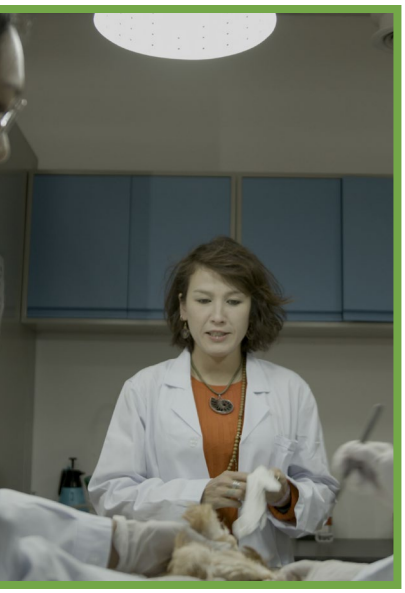
Microaggressions are brief phrases or actions that communicate slights or insults against a group of people; they are subtle ways in which those in the majority communicate—both consciously and unconsciously—who does and does not belong in a space (Sue et al 2007). Sometimes microaggressions in themselves seem small to the offender but have a significant impact on the people receiving them (Washington et al 2020). A recent review of the literature found that most racial microaggressions occurring in learning environments were often unconscious. This means to eradicate the occurrence of microaggressions in your language is to actively work to not use them. It is not enough to just be aware of them (Ogunyemi, Clare, Astudillo, Marseille, Manu, and Kim, 2020). Working actively to avoid microaggressions is a sign of respect for your students and colleagues, and is a way to signal that everyone belongs in a space.

Gaslighting is "when a hearer tells a speaker that the speaker's claim isn't that serious, or they're overreacting, or they're being too sensitive, or they're not interpreting events properly" (McKinnon, 2017, p. 1). Research common microaggressions and ways of gaslighting that are used against marginalized groups, and actively avoid making these statements.

Phrases to avoid

GASLIGHTING

- "They didn't mean anything by it. They're a really nice person."
- "It was only a joke! Don't take things so seriously." (example from Cullen, 2008)
- "I'm sure you just misheard him: you're on edge and expect to hear mispronouncing. I just don't believe that James would do that. He won a university diversity award



Jingmai O'Connor, subjet of the Breakthrough film, *The Avian Authority*

When paleontologist Jingmai O'Connor looks at the abdomen of a small, ancient avian fossil, she gets a thrill when she spots a jumble of nodules, no bigger than a scattering of goosebumps, protruding from the creature's bones.

for his supporting queer issues, after all. Besides, he's been a supporter of yours in the past, too. He really is your ally." (example from McKinnon, 2017)

MICROAGGRESSIONS (EXAMPLES FROM CULLEN, 2008)

- "I don't see difference. We're all part of the same race, the human race."
- "Where are you 'really' from?"
- "Why do 'they' (fill in the blank) always have to sit together? They are always sticking together."

Once you know what statements to avoid, you will be more apt to recognizing and addressing microaggressions when they do happen. Refer to existing resources (i.e., *When and How to Respond to Microaggressions* from Harvard Business Review) for tips on addressing microaggressions when they do occur.

End Weed Out Courses

"Look to your left, look to your right. One of you won't graduate." Most STEM graduates experienced some version of this demoralizing statement during their undergraduate career, whether at orientation or in the classroom. This mindset—that not all students will make it, and more that students need to be "weeded out"—is incredibly problematic, especially for the retention of students from groups that are historically underrepresented in STEM (Arnaud, 2020).

This "weeding out" typically happens in introductory STEM courses that are notoriously difficult to pass. These courses disproportionately lead first-generation college students and students of color to change their major or even change institutions (Boylan, 1999). Instead of supporting students and helping them learn, a "weed out" mindset actively makes the student experience worse. When studying this phenomenon, Rath et al (2007), noted that those students of color who passed introductory biology were equally likely to graduate in their major as their white peers, re-affirming that these biases do not reflect racial differences in student caliber. Instead, it demonstrates how "weed out" culture is not conducive to academic settings that aim for diverse, inclusive, and equitable spaces.

Teaching or planning a weed-out course? Begin to adopt culturally relevant teaching practices in your classrooms. Culturally relevant practices that connect curriculum, instruction, and assessment to the experiences, cultures, and traditions of students from racial and ethnic minority groups have been proven to be beneficial (video: Culturally Responsive Teaching in times of COVID-19; articles: Ladson-Billings, 1995; Barnhardt & Kawagley, 2005). Consider adding components that allow for peer collaboration on assignments (Rath et al 2007, Chang et al 2014), proficiency-based assessments (Lachlan-Hache & Castro, 2015), and more creative and authentic assessments and grading structures beyond the traditional preliminary and final examination structure.

Audit Syllabi

Course syllabi, like the academic fields and institutions they are produced within, are a product of the society that created them. In a variety of fields, but particularly in STEM, the contributions of women, Black, Indigenous, people of color, and those with LGBTQ+ identities have been omitted. This omission is a byproduct of discrimination that can leave students, and even their instructors, with a skewed sense of who has contributed to, even who belongs in, STEM. Without intentional inclusion, the textbooks, assigned readings, multimedia used in courses are likely to recreate the biased, inaccurate, and incomplete representation of STEM endeavors of the past (Veri et al 2019, Parson 2016). Auditing syllabi for representation is the first step towards making courses more inclusive, paving the way for larger conversations about power and discrimination in STEM fields.

Ditch Outdated Perspectives

No one is absolved from implicit bias which is the unconscious tendency, inclination, or prejudice—that is often learned—toward or against something or someone ("Bias",n.d.). We all have them and need to do the work to identify them through tools like the **Harvard Project Implicit tests** and work to discover tools to mitigate their negative impacts on students from underrepresented and minoritized groups.

Course culture, not *student* culture needs to change to meet the needs of diverse undergraduate students. Loudly refute the notion that students are the problem: persistence gaps in the sciences do NOT relate to differences in intrinsic aptitude among student identities. Instructional interventions like additional instructional support (Rath et al 2007) and contemporary teaching styles (Cabrera et al 2001) have been shown to benefit minority students in introductory science courses. Additionally, when these classroom interventions are implemented and pre-college preparation is accounted for, course and major completion rates are the same or higher for minority (Chang et al 2008) and women undergraduate students (Griffith 2010).

> *"Talent is equally distributed across all sociocultural groups; access and opportunity are not."*
>
> – "THE SCIENCE OF EFFECTIVE MENTORSHIP IN STEMM", NATIONAL ACADEMIES OF SCIENCES, ENGINEERING, AND MEDICINE

Promote A Growth Mindset

Practice and promote a growth mindset with yourself, your peers, and your students (Casad et al 2018). A growth mindset can help us remember that, with hard work, we can improve at things that don't seem to come easily to us. Remember that everyone has a mix of a fixed and growth mindset, but the idea that intellectual ability is malleable helps combat stereotypes that suggest otherwise (Dweck 2007). Mentorship relationships where the idea that abilities are flexible, benefit the achievement of all learners,

especially female students and students of color (Good et al 2003). Conversely, courses taught by faculty who believe that ability is fixed have wider racial achievement gaps and lower levels of student motivation when compared to courses taught by faculty who believe that ability can be grown over time (Canning et al 2019).

> *"Beware of assuming that because something doesn't come easily, you won't ever be good at it and then quit. Focus on the process—what you're learning—rather than the final product."*
>
> – ALINA TUGEND, "FEEL LIKE YOU'RE GOING OUT OF YOUR MIND? CONSIDER YOUR MINDSET"

Take Small Actions

It's easy to get overwhelmed and feel helpless as an agent of change in your community or field. Identify opportunities for small individual actions as you await (or instigate) larger collective, institutional, and policy actions that support STEM persistence. Smaller individual actions give us a sense of agency and potency and can help boost our hope and resilience, and importantly can change the collective *perceptions* of norms. For an example of individual action, check out **this letter** from Executive Vice President and Provost of Indiana University regarding the non-terminable social media behavior of a member of their tenured faculty, or **this *New York Times*** article authored by students after their campus promoted a not-so-inclusive homecoming video.

Amplify Inclusive Multimedia

Print articles can reinforce or erode STEM stereotypes. Reading articles about computer scientists that described them as no longer fitting stereotypes of computer scientists made female college students more likely to express an interest in pursuing computer science compared to those who read articles that reinforce stereotypes (Cheryan et al 2013). Share these articles that seek to disrupt the stereotype with your departments and research groups as they can aid in combating implicit bias others may have regarding who fits in the space and who doesn't.

CITATIONS + RESOURCES

Peer-reviewed publications

Arnaud, C. H. (2020). **Weeding out inequity in undergraduate chemistry classes.** *Chemical & Engineering News*, 98(34).

Barnhardt, R., and Kawagley, A. O. (2005). Indigenous knowledge systems and Alaska

Native ways of knowing. Anthropology and Education Quarterly, 36(1), 8–23.

Boylan, H. R. (1999). Exploring alternatives to remediation. Journal of Developmental Education, 22, 2-11.

Cabrera, A. F., Colbeck, C. L., & Terenzini, P. T. (2001). Developing performance indicators for assessing classroom teaching practices and student learning. Research in higher education, 42(3), 327-352.

Canning, E. A., Muenks, K., Green, D. J., & Murphy, M. C. (2019). STEM faculty who believe ability is fixed have larger racial achievement gaps and inspire less student motivation in their classes. Science advances, 5(2), eaau4734.

Casad, B. J., Oyler, D. L., Sullivan, E. T., McClellan, E. M., Tierney, D. N., Anderson, D. A., Greeley, P. A., Fague, M. A., & Flammang, B. J. (2018). Wise psychological interventions to improve gender and racial equality in STEM. *Group Processes & Intergroup Relations*, 21(5), 767-787.

Chang, M. J., Sharkness, J., Hurtado, S., & Newman, C. B. (2014). What matters in college for retaining aspiring scientists and engineers from underrepresented racial groups. *Journal of Research in Science Teaching*, 51(5), 555-580.

Fox, C. W., & Paine, C. T. (2019). Gender differences in peer review outcomes and manuscript impact at six journals of ecology and evolution. Ecology and Evolution, 9(6), 3599-3619.

Good, C., Aronson, J., & Inzlicht, M. (2003). Improving adolescents' standardized test performance: An intervention to reduce the effects of stereotype threat. Journal of Applied Developmental Psychology, 24(6), 645-662.

Griffith, A. L. (2010). Persistence of women and minorities in STEM field majors: Is it the school that matters?. Economics of Education Review, 29(6), 911-922.

Ladson-Billings, G. (1995). But that's just good teaching! The case for culturally relevant pedagogy. Theory into Practice, 34(3), 159–165.

Ogunyemi, D., Clare, C., Astudillo, Y. M., Marseille, M., Manu, E., & Kim, S. (2020). Microaggressions in the learning environment: A systematic review. *Journal of Diversity in Higher Education*, 13(2), 97.

Parson, L. (2016). Are STEM Syllabi Gendered? A Feminist Critical Discourse Analysis. Qualitative Report, 21(1).

Rath, K. A., Peterfreund, A. R., Xenos, S. P., Bayliss, F., & Carnal, N. (2007). Supplemental instruction in introductory biology I: Enhancing the performance and retention of underrepresented minority students. CBE—Life Sciences Education, 6(3), 203-216.

Sue, D. W., Capodilupo, C. M., Torino, G. C., Bucceri, J. M., Holder, A. M. B., Nadal, K. L., & Esquilin, M. (2007). Racial microaggressions in everyday life: Implications for clinical practice. *American Psychologist*, 62(4), 271-286.

Veri, M. J., Eliason, M., Hermoso, J. C. R., Bolter, N. D., & Van Olphen, J. E. (2019). The Social Justice Syllabus Design Tool: A First Step in Doing Social Justice Pedagogy.

Advocacy Organizations

Lachlan-Hache, L. & Castro, M. (2015). Proficiency or growth? An exploration of two approaches for writing student learning targets. *American Institutes for Research*.

Popular Press + Blogs

Bias. Psychology Today.

Koebler, J. (2012, April). **Experts: 'weed Out' Classes Are Killing STEM Achievement.** *U.S. News & World Report*.

Tungend, A. (2020, August). **Feel Like You're Going Out Of Your Mind? Consider Your Mindset.** *The New York Times*.

Washington, E. F., Birch, A. H., & Morgan, R. (2020, July). **When And How To Respond To Microaggressions**. *Harvard Business Review*.

Books

Cullen, M. (2008). 35 Dumb Things Well-Intended People Say: Surprising Things We Say That Widen the Diversity Gap. Wordclay.

Dweck, C. S. (2007). *Mindset: The New Psychology of Success*. Ballantine Books.

McKinnon, R. (2017). Allies behaving badly. In I. J. Kidd, J. Medina, G. Pohlhaus Jr. (Eds.), *The Routledge Handbook of Epistemic Injustice*. Routledge.

Other Resources

Murzi, H. & Woods Jr., J. (2020). **Culturally Responsive Teaching in Times of COVID-19**. ASEE Commission on Diversity, Equity, and Inclusion.

COMMUNITY

Create, Support, And Protect Safe Places And Community Spaces

IN THIS SECTION

- ☐ Get Involved With Student Groups
- ☐ Organize Inclusive Events
- ☐ Living Learning Communities
- ☐ Establish Norms
- ☐ Change Norms Not People

COMMUNITY

Create, Support, And Protect Safe Places And Community Spaces

Create time and space for members of minoritized communities to come together, support each other, and celebrate a love of science. These shared spaces can range from living-learning communities to research symposiums to campus organizations and student support centers and can have lasting benefits on student confidence and persistence in STEM.

Get Involved With Student Groups

Groups that combine undergraduates, graduates, post-docs, and faculty that co-identify as women or folks from minoritized groups contribute to higher achievement, retention, self-efficacy, and post-graduate advancement in the sciences for those that participate (Barlow and Villarejo, 2004; Ballard et al 2007, Szelenyi and Inkelas 2011). Most clubs and organizations require a faculty advisor to aid in the managing of its activities from year to year and serve as a stable source of influence as students frequently turnover. Become an advisor and make it known that you are a source of support for minoritized students on your campus.

Organize Inclusive Events

Take action to promote inclusivity, accessibility, and representation for campus events, research symposia, and other social or professional STEM events (Murphy et al. 2007). When planning an inclusive event be sure to consider the following: invite speakers who represent a variety of backgrounds, invite diverse stakeholders to plan portions of the event (and compensate them), ensure that access to the venue is handicap accessible, support the dietary needs of your participants, and provide closed captioning or interpreters for presentations. These are just some of the ways to ensure that everyone has a seat at the table.

Audrey Dussutour, subject of the Breakthrough film *The Slime Minder*

For biologist Audrey Dussutour, researching primitive slimes has led to surprising discoveries about the evolution of learning and collective behavior that she's been pondering her whole life.

Living Learning Communities

Advocate for and support STEM-focused campus living communities. Called "Living Learning Communities" or "STEM Residence Halls", these communities are places where women and/or students from minority groups can co-reside and share in programming, support, and recreation related to their STEM interests. These communities have been shown to dramatically improve retention in STEM fields (Ramsey et al 2016, Johnson 2011, Szelenyi and Inkelas 2011).

Establish Norms

Whether you're organizing an event or conference, establishing a new student organization, or running a research lab, norms are essential for creating an atmosphere where individuals feel safe, are held accountable, and can learn. Consider adopting the 14 recommendations put forth by Cooper and colleagues (2020) to create more inclusive environments. While these recommendations were put forth with LGBTQ+ individuals in Biology in mind, they lend themselves to be useful when thinking about what it looks like to create environments of meaningful engagement of folks from various underrepresented groups.

> *"Minoritized students do not actually need to become "gritty." Rather, minoritized students are running into what Sara Ahmed (2017) has called "brick walls" of institutional inertia and even retrenchment and the intransigence of inequity."*
>
> – STEWART (2020), TWISTED AT THE ROOTS: THE INTRANSIGENCE OF INEQUALITY IN U.S. HIGHER EDUCATION

Change Norms Not People

Allies, educators, and campus leaders should focus interventions on course, major, or campus norms rather than on individuals from underrepresented groups. Interventions that focused on adjusting campus or program norms rather than solely on interventions targeting women (Fox et al 2009) or the skills or behaviors or minoritized students (Cabrera, Colbeck, & Terenzini, 2001) are more effective at retaining those undergraduates in science majors.

CITATIONS + RESOURCES

Peer-reviewed publications

Ballard, J. W., Hathaway, R., Sharp, S., & Davis, C. S. (2007). The University Of Michigan's Women In Science And Engineering Residence Program: A Qualitative Analysis. Women in Engineering ProActive Network.

Barlow, A. E., & Villarejo, M. (2004). Making a difference for minorities: Evaluation of an educational enrichment program. Journal of research in science teaching, 41(9), 861-881.

Cabrera, A. F., Colbeck, C. L., & Terenzini, P. T. (2001). Developing performance indicators for assessing classroom teaching practices and student learning. Research in higher education, 42(3), 327-352.

Cooper, K. M., Auerbach, A. J. J., Bader, J. D., Beadles-Bohling, A. S., Brashears, J. A., Cline, E., ... & Heinz, H. M. (2020). Fourteen Recommendations to Create a More Inclusive Environment for LGBTQ+ Individuals in Academic Biology. CBE—Life Sciences Education, 19(3), es6.

Fox, M. F., Sonnert, G., & Nikiforova, I. (2009). Successful programs for undergraduate women in science and engineering: Adapting versus adopting the institutional environment. Research in Higher Education, 50(4), 333-353.

Johnson, D. R. (2011). Examining sense of belonging and campus racial diversity experiences among women of color in STEM living-learning programs. Journal of Women and Minorities in Science and Engineering, 17(3).

Murphy, M. C., Steele, C. M., & Gross, J. J. (2007). Signaling threat: How situational cues affect women in math, science, and engineering settings. Psychological science, 18(10), 879-885.

Ramsey, L. R., Betz, D. E., & Sekaquaptewa, D. (2013). The effects of an academic environment intervention on science identification among women in STEM. Social Psychology of Education, 16(3), 377-397.

Stewart, D-L. (2020). Twisted at the Roots: The Intransigence of Inequality in U.S. Higher Education, *Change: The Magazine of Higher Learning*, 52(2), 13-16, DOI: 10.1080/00091383.2020.1732753.

Szelényi, K., & Inkelas, K. K. (2011). The role of living–learning programs in women's plans to attend graduate school in STEM fields. Research in Higher Education, 52(4), 349-369.

Popular Press + Blogs

How To Organize A Conference That's Open To Everyone, Nature, July 24, 2019

MENTOR

How To Be A Better Mentor

IN THIS SECTION

- [ ] Ditch Bad Approaches To Mentoring Relationships
- [ ] Provide Well-Rounded Mentoring
- [ ] Build Around Shared Value
- [ ] Aid Student Support Programs

MENTOR

How To Be A Better Mentor

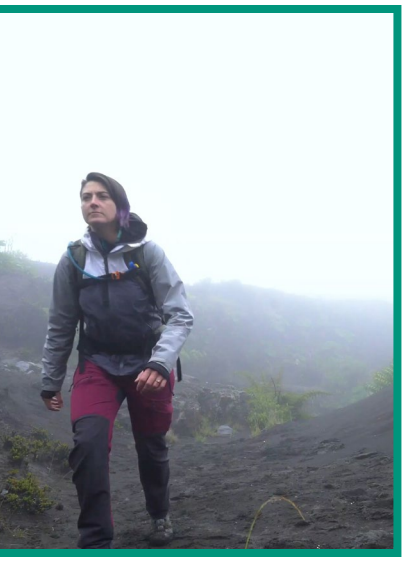
Effective mentorship is critical to supporting the path towards equity in STEM.

Ditch Bad Approaches To Mentoring Relationships

Some mentor-student relationships can reinforce stereotype threat and ultimately discourage students from continuing in STEM (reviewed in Hurtado 2009, Aikens et al 2017). For example, when mentors do not acknowledge the very real impacts that a mentee's race, gender, LGBTQ identity, ability status, and other identity factors can have on their experience, studies have shown that the mentor can have a more negative estimation of mentee's abilities and motivations (McCoy et al 2015). This "colorblind" approach even reduced the science identity of mentees (McCoy et al 2015). Mentors who believe STEM ability is a fixed trait instead of a learned one (e.g., fixed mindset vs. growth mindset) accentuate race and gender-biased performance gaps in their mentees (Canning et al 2019). We all have bias; it's important to identify and acknowledge them so that we can actively work to mitigate their potential negative impact. Acknowledge your mentees' full identity and help them navigate the very real challenges that they will likely face in STEM.

Provide Well-Rounded Mentoring

Effective mentorship can and should familiarize students with the dominant science cultural norms, invisible barriers, and important gateways to success while building social and cultural capital in the form of professional connections and references (Ovink & Veazey, 2011; Thiry and Laursen, 2011). High-quality mentors play a significant role in ensuring the academic success of mentees and can be critical for helping mentees increase self-efficacy and navigate the waters of biased structures and processes in STEM fields (Austria and Austria, 2010; Tsui, 2007). The key is to not force these relationships. Make yourself available as a resource to students and express willingness to aid students. If you are not the appropriate person to aid a student in this way, connect them with those who can.



Kayla Iacovino, subject of Breakthrough film *The Volcano Trekker*

Kayla Iacovino—part science fiction sleuth, part mountaineer—examines millenia-old cooled rocks and soils from volcanic eruptions to better understand the forces that created them.

Build Around Shared Value

STEM fields are often perceived as being solely technical pursuits, and "social" concerns, like the impacts that technology or project has on a community, are often pushed to the side. While individuals with STEM degrees have a huge ability to help their communities, the belief that STEM is only about the technical aspects can make individuals who want to help their communities and the broader society feel like they don't belong (Clark et al 2016). Get to know your mentee and understand what they value. Why did they pursue a STEM degree? If they are pursuing a STEM degree because they want to help their community, which is a common motivation among women and students of color, then help your mentee see the connection between what they're learning and how that knowledge can be used to help. Since the social and community impacts of STEM work are not often emphasized in the classroom, students may need your help to make these connections.

Aid Student Support Programs

Undergraduate research mentorship has been frequently associated with retention (e.g. Barlow and Villarejo 2004) and seems most beneficial when the gender and/or racial identity of the mentee matches that of their mentor. However, sometimes a lack of diversity among faculty makes it challenging to match students with a mentor of the same race and gender, and faculty from underrepresented groups should not be disproportionately tapped to be mentors. In these cases, studies have shown that a **trained** mentor can be as effective as a mentor that shares the students' gender and racial identities (Morales et al 2018, 2019). If your university has any type of support programs for students from underrepresented groups, there is likely an established mentoring program. Reach out to see if there are ways to get involved even beyond being a mentor (i.e., supporting summer and outreach programs). Literature also suggests that mentoring increases the chances of folks from underrepresented groups attaining graduate degrees in STEM and remaining in the industry (Lichtenstein, Chen, Smith, and Maldonado, 2014).

CITATIONS + RESOURCES

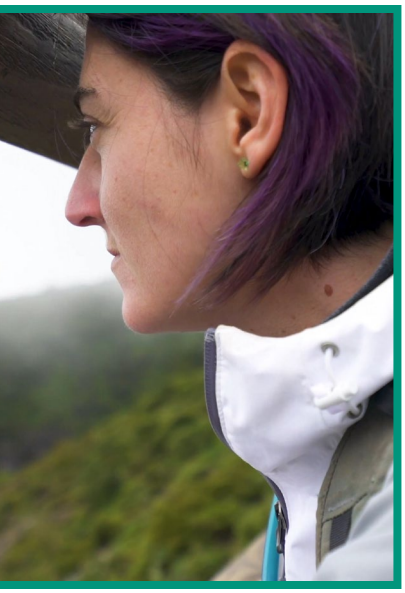
Peer-reviewed publications

Aikens, M. L., Robertson, M. M., Sadselia, S., Watkins, K., Evans, M., Runyon, C. R., ... & Dolan, E. L. (2017). Race and gender differences in undergraduate research mentoring structures and research outcomes. CBE—Life Sciences Education, 16(2), ar34.

Austria, A. M., & Austria, M. A. M. (2010). Enhancing Capabilities of Women and Ethinic Minorities. In

C. Rayburn, F. L. Denmark, M. E. Reuder & A. Austria, Miteria (Eds.), A Handbook for Women Mentors: Transcending Barriers of Stereotype, Race, and Ethnicity (pp. 129-196): ABC-CLIO.

Barlow, A. E., & Villarejo, M. (2004). Making a difference for minorities: Evaluation of an educational enrichment program. Journal of research in science teaching, 41(9), 861-881.



Clark, E. K., Fuesting, M. A., & Diekman, A. B. (2016). Enhancing interest in science: Exemplars as cues to communal affordances of science. Journal of Applied Social Psychology, 46(11), 641-654.

Hurtado, S., Cabrera, N. L., Lin, M. H., Arellano, L., & Espinosa, L. L. (2009). Diversifying science: Underrepresented student experiences in structured research programs. Research in Higher Education, 50(2), 189-214.

Lichtenstein, G., Chen, H. L., Smith, K. A., & Maldonado, T. A. (2014). **Retention and Persistence of Women and Minorities Along the Engineering Pathway in the United States**. Cambridge Handbook of Engineering Education Research (pp. 311–334). Cambridge, UK: Cambridge University Press.

McCoy, D. L., Winkle-Wagner, R., & Luedke, C. L. (2015). Colorblind mentoring? Exploring white faculty mentoring of students of color. Journal of Diversity in Higher Education, 8(4), 225.

Morales, D. X., Grineski, S. E., & Collins, T. W. (2018). Effects of gender concordance in mentoring relationships on summer research experience outcomes for undergraduate students. Science Education, 102(5), 1029-1050.

Morales, D. X., Grineski, S. E., & Collins, T. W. (2019). Effects of mentoring relationship heterogeneity on student outcomes in summer undergraduate research. Studies in Higher Education, 1-14.

Ovink, S. M., & Veazey, B. D. (2011). More than "getting us through:" A case study in cultural capital enrichment of underrepresented minority undergraduates. Research in higher education, 52(4), 370-394.

Thiry, H., & Laursen, S. L. (2011). The role of student-advisor interactions in apprenticing undergraduate researchers into a scientific community of practice. Journal of Science Education and Technology, 20(6), 771-784.

Tsui, L. (2007). Effective strategies to increase diversity in STEM fields: A review of the research literature. The Journal of Negro Education, 555-581.

Popular Press + Blogs

A Message For Mentors From Dissatisfied Graduate Students, Nature, November 20, 2019

Us Academic-science Mentoring Falls Short Of Best Practices, Say National Academies, Nature, November 20, 2019

Books

Critical Mentoring: A Practical Guide by Torie Weiston-Serdan

IN THIS SECTION

- ☐ Mitigate Stereotype Threat
- ☐ Build A Peer Support Network
- ☐ Identify Role Models
- ☐ Take Credit
- ☐ Ask Peers For Advice On Classes And Instructors
- ☐ Practice Affirmations
- ☐ Practice A Growth Mindset

For Students Underrepresented In STEM

Hey students. Do you identify as someone from a group that is historically underrepresented in STEM? If yes, and you're thinking about pursuing a degree in STEM or are already in the process, this section is for you. The culture of STEM and the challenges you will face (or are facing) are a result of a biased and broken system. It's not your job to change yourself, nor is it your job to fix the system. What we offer here are a handful of strategies to help you get through your degree. To persist, while we collectively work to change the culture of STEM, to improve access, and to make your experience better continues. As you read these strategies we want you to know that the culture of STEM and the challenges you will face (or are facing) are a result of a biased and broken system. It's not your job to change yourself, nor is it your job to fix the system. None of these strategies will make all of your struggles go away, but we offer these strategies because they have been useful for some students who come from groups that are historically underrepresented in STEM.

Mitigate Stereotype Threat

Soak yourself in stories of people like yourself succeeding. Being surrounded by narratives that reinforce negative stereotypes about some part of your identity can become an added challenge to overcome known as "stereotype threat" (Steele and Aronson 1995; Fischer 2010; Casadet al 2019). There is evidence that stereotype threat can be made less damaging by surrounding yourself with positive role models and stories that negate the stereotype (Steele 1997; Good et al 2003). For example, one study of undergraduate women found that reading about other women's successes, even in unrelated fields, improved their performance on a series of math exams shortly after (McIntyre et al 2003). Additionally, try focusing on other unthreatened aspects of your identity. It's useful to remind yourself that you are a whole person with many facets. Try not to let "minority in STEM" become your sole identity if that's not how you see yourself, even if that is the limited view others have of you.

Build A Peer Support Network

STEM is a team sport. Having a network of peers to study with and interact with can be a lifesaver in a difficult STEM degree program. When considering schools, be sure to inquire about retention and completion rates for students who look like you. Knowing that there are other students who look like you can be important for your own journey and for ensuring there is a peer network for you to connect with. Seek out these peers in your major or field of study, and surround yourself with those peer role models. Even short, regular interactions with peers you identify with can improve your confidence in STEM and minimize stereotype threat (Ramsey et al 2013). One way to do this is to start or join a club, group, or society for you and your peers that share a common STEM identity like Out in Science, Technology, Engineering, and Mathematics (oSTEM), Society of Women in Engineering (SWE), National Society of Black Engineers (NSBE).

In addition to connecting with fellow students, think about asking your club or group to invite speakers who share your identity, particularly from different career stages. Participation in groups that combine undergraduates, graduates, post-docs, and faculty that co-identify as women or folks from minoritized groups contribute to higher achievement, retention, self-efficacy, and post-graduate advancement in the sciences (Barlow and Villarejo, 2004; Ballard et al 2007, Szelenyi and Inkelas 2011). Similarly, pay attention to any peer relationships that negatively influence your confidence, convey that you're not a good fit for STEM, or underestimate you–they can do damage to your how you perceive your abilities (Casad et al 2019).

> *"The problem is that the pressure to disprove a stereotype... gives you an additional task. In addition to learning new skills, knowledge, and ways of thinking in a schooling situation, you are also trying to slay a ghost in the room, the negative stereotype and its allegation about you and your group. You are multitasking, and because the stakes involved are high–survival and success versus failure in an area that is important to you–this multitasking is stressful and distracting."*
>
> –CLAUDE M. STEELE, WHISTLING VILVALDI: AND OTHER CLUES TO HOW STEREOTYPES AFFECT US

Identify Role Models

Find role models in STEM who share your identities - this could be faculty, professionals, or even your peers. Use popular hashtags (#BlackInStem, #WomenInSTEM, #OutInSTEM [there's probably some new ones out now?) on social media to help locate inspiring folks in STEM and stay up to date on events and resources. Don't be afraid to reach out and make the connection! Studies have shown that having role models that look like you can help mitigate the negative psychological effects of stereotype threat, attribution bias, and microaggressions in STEM work and academic settings.

Remember that peers are role models too! Undergrad women who experienced a 2-minute encounter with a peer who exemplified stereotypes of computer science majors reported an immediate and lasting decrease in their interest in pursuing computer science as a major compared to those who encountered a peer who did not exemplify computer science stereotypes (Cheryan, Drury, Vichayapa 2013).

Take Credit

Take credit for your successes! If you notice yourself attributing your successes to external factors like help you received or "luck," while attributing the success of others to their innate abilities, consider embracing a growth mindset and owning your successes. This bias, called "attribution bias" is especially likely to occur in contexts where you feel different from your peers and role models (i.e. where stereotype threat occurs, Lacosse et al 2016). Pay attention if you are more likely to attribute failures to yourself, and successes to someone or something else that fits a stereotypical expectation for what "good at STEM" looks like–that's a hallmark of stereotype attribution bias.

> *"I wasn't sure I could do astronomy as a job because I didn't see role models around me."*
>
> –BURÇIN MUTLU-PAKDIL, THE GALAXY HUNTER

Ask Peers For Advice On Classes And Instructors

Ask your peers for advice on which courses and instructors to sign up for. Look out for courses with the reputation of a "weed out" course, typically meaning that the class is particularly hard and/or that a certain percentage of the students fail each term. If you are not able to avoid a "weed out" course, ask your peers for advice on which instructors provide the most support to students and identify peer and academic support for that course early. Form homework and study groups, if allowed, and attend office and tutoring hours frequently. Finally, getting to know the instructor (i.e., showing up to office hours, introducing yourself, asking follow-up questions after class) is another strategy that can help you navigate particularly challenging courses.

Practice Affirmations

When times get tough, remind yourself why you chose to pursue a degree in STEM. Maybe you love math and science. Maybe you were encouraged by someone who believed in you. Maybe you have goals to become a scientist or engineer who will change the world. You're the bomb, you're great at science and math, and you're an honest friend and reliable colleague. Positive messages that reaffirm our abilities, values, and good habits can improve self-perception and ultimately achievement in STEM courses and tasks (reviewed by Casad et al 2018). In a study of undergraduate men and women who

were asked to write about their most important values in a college-level introductory physics course, the women who affirmed their values scored on average a full letter grade higher than those who did not (Miyake et al 2010).

> *"I arrive in professional spaces FULLY AFFIRMED! This allows me to engage in my work "from affirmation" or in pursuit of joy or fulfillment, rather than "for affirmation" which can often lead to operating from fear of being judged inadequate or unworthy."*
>
> - **BERONDA MONTGOMERY,** HOW I WORK AND THRIVE IN ACADEMIA –FROM AFFIRMATION, NOT FOR AFFIRMATION,

Practice A Growth Mindset

Do you think that you can sing like your favorite artist? If you answered no, this would be called having a fixed mindset as opposed to the preferred growth mindset. A fixed mindset believes that our abilities are fixed; we either have what it takes to be a star, or succeed in STEM, or we don't. A growth mindset believes that our abilities can be developed; we can find success in STEM through dedication and hard work. Practicing a growth mindset is one tool that can help you get through a challenging STEM degree program. (Caveat—It's not your fault that the system was not created with you in mind and if you decide your time and energy is better spent elsewhere, that's ok too. Ultimately, do what's best for you!.)

> *"In a growth mindset, people believe that their most basic abilities can be developed through dedication and hard work–brains and talent are just the starting point. This view creates a love of learning and a resilience that is essential for great accomplishment."*
>
> –CAROL S. DWECK, MINDSET: THE NEW PSYCHOLOGY OF SUCCESS

CITATIONS + RESOURCES

Peer-reviewed publications

Brown, N., & Leigh, J. (2018). Ableism in academia: where are the disabled and ill academics?. Disability & Society, 33(6), 985-989.

Casad, B. J., Oyler, D. L., Sullivan, E. T., McClellan, E. M., Tierney, D. N., Anderson, D. A., ... & Flammang, B. J. (2018). Wise psychological interventions to improve gender and racial equality in STEM. Group Processes & Intergroup Relations, 21(5), 767-787.

Casad, B. J., Petzel, Z. W., & Ingalls, E. A. (2019). A model of threatening academic environments predicts women STEM majors' self-esteem and engagement in STEM. Sex Roles, 80(7-8), 469-488.

Cheryan, S., Drury, B. J., & Vichayapai, M. (2012). **Enduring influence of stereotypical computer science role models on women's academic aspirations**. *Psychology of Women Quarterly*, 37(1), 72-79.

Good, C., Aronson, J., & Inzlicht, M. (2003). Improving adolescents' standardized test performance: An intervention to reduce the effects of stereotype threat. Journal of Applied Developmental Psychology, 24(6), 645-662.

Fischer, M. J. (2010). A longitudinal examination of the role of stereotype threat and racial climate on college outcomes for minorities at elite institutions. Social Psychology of Education, 13(1), 19-40.

LaCosse, J., Sekaquaptewa, D., & Bennett, J. (2016). STEM stereotypic attribution bias among women in an unwelcoming science setting. *Psychology of Women Quarterly*, 40(3), 378-397.

McIntyre, R. B., Paulson, R. M., & Lord, C. G. (2003). Alleviating women's mathematics stereotype threat through salience of group achievements. Journal of Experimental Social Psychology, 39(1), 83-90.

Miyake, Akira, et al. "Reducing the gender achievement gap in college science: A classroom study of values affirmation." Science 330.6008 (2010): 1234-1237.

Ramsey, L. R., Betz, D. E., & Sekaquaptewa, D. (2013). The effects of an academic environment intervention on science identification among women in STEM. Social Psychology of Education, 16(3), 377-397.

Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. Journal of personality and social psychology, 69(5), 797.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. American psychologist, 52(6), 613.

Advocacy Organizations

If/Then Initiative.

TechBridge Girls.

Books

Steele, C. (2010). *Whistling Vivaldi: And Other Clues to How Stereotypes Affect Us (Issues of Our Time)*. W. W. Norton & Company.

Dweck, C. S. (2007). *Mindset: The New Psychology of Success*. Ballantine Books.