

Scientists from historically excluded groups face a hostile obstacle course

Inclusive and equitable geoscience requires identification and removal of structural barriers to participation. Replacing the leaky pipeline metaphor with that of a hostile obstacle course demands that those with power take the lead.

Asmeret Asefaw Berhe, Rebecca T. Barnes, Meredith G. Hastings, Allison Mattheis, Blair Schneider, Billy M. Williams and Erika Marín-Spiotta

Geoscience remains one of the least diverse disciplines in Science, Technology, Engineering, Mathematics and Medicine (STEMM), with persistent underrepresentation of Black, Indigenous and other people of colour (BIPOC) and other minoritized groups, in the United States and other countries^{1–4}. The exclusion and limited recruitment, retention and success of some racial and ethnic groups and other minoritized communities in the geosciences is often discussed using the metaphor of a leaky pipeline. However, as many have argued, this passive imagery betrays the fact that, in many ways, the experience for minoritized scholars is more like a vicious or hostile obstacle course^{5–10} with barriers that have been put in place to slow down or exclude certain groups. To address the lack of inclusion within the workforce, this exclusionary obstacle course should be placed in the context of scientific racism, colonial legacies and systemic biases that permeate our disciplines and institutions^{11–13}. We argue that in the geosciences and beyond, we must first acknowledge the cultural and structural barriers that this hostile obstacle course presents before we can dismantle them.

Problems with the leaky pipeline

The metaphorical educational and development pipeline that funnels researchers from their student days towards graduation and careers in STEMM has been known to leak for some time. Often used to describe the limited retention of women in academia¹⁴, the leaky pipeline implies that the attrition of white women, BIPOC and members of other minoritized communities is a passive process: nothing more than a ‘drip, drip’ from holes within an otherwise robust system. In reality, we (and others^{15,16}) argue that the imagery of a leaky pipeline fails to represent the exclusionary experiences of many.

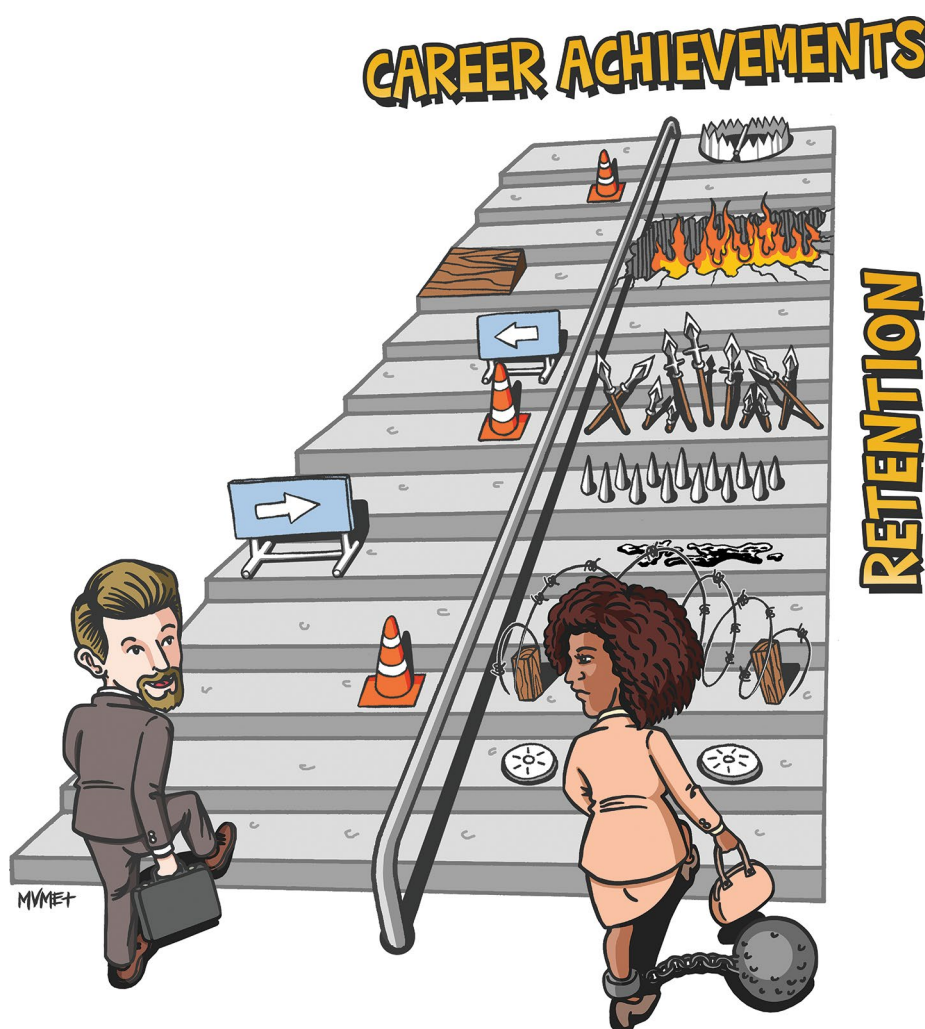


Fig. 1 | The hostile obstacle course that women and BIPOC researchers have to endure in STEMM. Illustration inspired (with permission) by Emanu's Equality hurdles³⁸. Credit: Mvmet.

Batchelor and colleagues¹⁵ suggest that, with only one entry point and one route through, the pipeline no longer captures the reality or breadth of scientific career trajectories. Instead, they suggest that a braided river metaphor is better able to

reflect and inform the many different career paths that are — and should be — available to researchers in the geosciences and STEMM more generally.

Furthermore, focusing on the leaking pipe ensures that efforts to patch up the

holes — for example, by promoting career development, mentoring and recommending historically excluded groups for awards or refereeing opportunities¹⁴ — distract from the structural problems in our scientific institutions. Widely documented bias, harassment, discrimination and other exclusionary behaviours create especially hostile climates for BIPOC people in STEM^{4,11–13,17–22}. Our scientific communities' reluctance to effectively deal with these obstacles actively contributes to persistent inequities in recruitment and retention in the academic workforce^{8,23,24}. Ultimately, the systemic problems contributing to continued discrimination and harassment of minoritized scholars in academia will not be solved by patching over the cracks in a leaky pipeline.

The hostile obstacle course

We suggest that an unequal, vicious or hostile obstacle course⁵ (Fig. 1) better reflects the experiences of minoritized and marginalized scholars in the geosciences. A growing body of research documents hostile work environments for many scholars, including but not limited to: BIPOC, white women, those who identify as transgender, genderqueer or non-conforming, religious minorities, academics with disabilities, and foreign-born or international scholars^{8,25–29}. The obstacle course metaphor allows us to recognize that the cultural and structural barriers to participation are not experienced equally; everyone is on their own unique track. Unlike a leaking pipe, the obstacles are not the inevitable consequence of poorly maintained infrastructure; instead, they are barriers that have often been deliberately — or at the very least unconsciously — put in place and sustained. The obstacles selectively slow down scholars from historically excluded groups, increasing the time and energy necessary to progress, and meaning that they have to be that much better than their peers to be viewed as performing 'equally'^{30,31}.

BIPOC scientists face additional hurdles. Their path through the academy's obstacle course is harder because of racial discrimination that may manifest itself as dismissiveness, harassment, or exclusion from formal and informal professional opportunities, affecting long-term professional success as well as health and well-being^{31,32}. At the very minimum, experiencing these behaviours slows advancement; at worst, these traumatic experiences derail careers, pushing BIPOC scholars out of education and research institutions and further contributing to their persistent underrepresentation in academic workplaces³³.

The obstacle course is even more difficult for people who belong to more than one oppressed group. For example, women of colour report feeling unsafe at work because of both their gender and their race³¹. The gender and racial homogeneity of STEM environments contributes to the professional isolation of BIPOC researchers and white women, who experience increased vulnerability due to discriminatory and hostile behaviours, including racism and sexual harassment. Although these behaviours can affect anybody, overt and subtle forms of gender and racial discrimination play critical roles in the decisions of women overall, and women of colour specifically, to leave science and the academy^{8,12,13}.

Compared with the leaky pipeline, a hostile obstacle course better reflects a number of the variables that cause the persistent lack of diversity in the geosciences as documented in the United States and other countries^{1–4}. Starting early in their training, minoritized scholars often face increased resistance and are held back by a lack of resources and by gatekeeping, which prevents many from even reaching the start line.

Within their careers, minoritized scholars frequently lack role models, mentors and sponsors. This can be easily seen in the guidance and direction given to members of the majority but not offered to the marginalized. Inherent knowledge of the unwritten rules of academia is rarely available for minoritized scholars, and efforts must be made to both challenge and illuminate the hidden curriculum and cultural norms of academia³³.

Hidden landmines represent the repeated discrimination that lies below the surface, waiting to be activated when minoritized scholars step on a specific path. They come in many different forms such as micro- and macro-aggressions; bullying and career isolation; and biases in the way applications are evaluated for admission to graduate programmes, research opportunities, job recruitments, funding and awards, as well as biases in the peer-review process; and they can cause real injury and harm. As the landmines are not visible, the need for constant vigilance to avoid their harm is exhausting, and people with power need to actively remove them from the path of others in order to ease the burden. If discrimination is allowed to remain, it will affect multiple cohorts of scholars, with ramifications for overall workplace health.

Those who survive the obstacle course often do so with bruises and burns, and they carry the scars for the rest of their lives. Their survival does not bring immunity to

bias^{8,13}; no matter their position, survivors are not free from the stereotypes that underlie the belief that BIPOC scientists are not smart enough or capable enough; do not have the demeanour expected of a scholar; and were only able to reach the heights of scholarly accomplishments because of their identity as a member of a minoritized group.

Importantly, imagery of an obstacle course also accounts for the burnout experienced by scholars who work not only to succeed in the system but also to change it. Unfortunately, the weakened state caused by exhaustion, trauma and burnout all too often mean that further challenges in day-to-day life can quickly escalate to a downhill departure from their career track or even involuntary exit from STEM entirely.

Moving forward

Reframing the challenges of BIPOC scholars, especially women of colour, as a hostile obstacle course provides a more accurate visual representation of the inequitable experiences within academia and the systemic barriers that exist. By considering macro- and micro-aggressions and exclusionary behaviours as obstacles, the emphasis and responsibility falls to those with power to actively remove the barrier. We therefore believe that the image of a hostile obstacle course is required in the construction of a more equitable STEM enterprise, as it aids the identification of barriers to participation and necessitates their removal.

It is critical that we take action now, because diversity of thought is needed to address the problems³⁴ of climate change, energy production, food security and safe water supply. In the context of climate crisis, voices of BIPOC people from the global south, people of lower socioeconomic status, and people who inhabit regions that are expected to be the hardest hit by climate impacts are underrepresented in some of the most important conversations³⁴. In addition, regardless of identity, all people deserve the right to explore their interests and the opportunity to contribute to science; to achieve this, we need to value the whole scientist, acknowledging that our differing life experiences inform our interests, questions and approaches.

Discussions around the causes and consequences of minoritization of scholars in the geosciences and STEM should start by updating old and inadequate metaphors. Beyond platitudes and statements of concern, actions must be taken to redefine who is, should be and can be a geoscientist³⁵. Although scientific societies such as the American Geophysical

Union³⁶ have taken the lead to address some exclusionary behaviours, they — and all of us — must do more to address racism³⁷. Only by recognizing that the academic path is littered with actively designed and sustained discriminatory hazards can we hope to foster an equitable, inclusive, diverse and thriving geoscience workforce. If we make no efforts to transform the culture of geoscience, we are forcing marginalized individuals to endure more and more harm if they stay in STEM. ■

Asmeret Asefaw Berhe¹✉, Rebecca T. Barnes², Meredith G. Hastings³, Allison Mattheis⁴, Blair Schneider⁵, Billy M. Williams⁶ and Erika Marín-Spiotta⁷

¹Department of Life and Environmental Sciences, University of California, Merced, CA, USA.

²Environmental Studies Program, Colorado College, Colorado Springs, CO, USA. ³Department of

Earth, Environmental and Planetary Sciences and Institute at Brown for Environment and Society, Brown University, Providence, RI, USA. ⁴Applied and Advanced Studies in Education, California State University Los Angeles, Los Angeles, CA, USA.

⁵Kansas Geological Survey, Lawrence, KS, USA.

⁶American Geophysical Union, Washington, DC, USA.

⁷Department of Geography, University of Wisconsin-Madison, Madison, WI, USA.

✉e-mail: aaberhe@ucmerced.edu

Published online: 23 December 2021

<https://doi.org/10.1038/s41561-021-00868-0>

References

- Berhe, A. A. & Ghezzehei, T. A. *Eur. J. Soil Sci.* **72**, 1292–1297 (2020).
- Bernard, R. E. & Cooperdock, E. H. G. *Nat. Geosci.* **11**, 292–295 (2018).
- Dowey, N. et al. *Nat. Geosci.* **14**, 256–259 (2021).
- Dutt, K. *Nat. Geosci.* **13**, 2–3 (2020).
- Ramirez, A. @ainissaramirez. When I graduated there were 8 other black engineering PhDs that did too — in the country. It isn't a leaky pipeline. It is a vicious obstacle course. *Twitter* (2019); <https://twitter.com/ainissaramirez/status/1121042881878294528?s=20>
- Adams, M. V. *Psychoanal. Psychol.* **19**, 182 (2002).
- De Welde, K. & Laursen, S. *Int. J. Gender Sci. Technol.* **3**, 571–595 (2011).
- Davis, M. E., Vakilahi, H. F. O. & Scales, R. in *Disrupting the Culture of Silence: Confronting Gender Inequality and Making Change in Higher Education* (eds De Welde, K. & Stepnick, A.) 265–277 (Stylus, 2015).
- Hoch, P. in *White Hero, Black Beast: Racism, Sexism and the Mask of Masculinity*, 93–107 (Pluto, 2004).
- Rockhill, K. & Tomic, P. *Can. Women's Stud.* **14**, <https://cws.journals.yorku.ca/index.php/cws/article/view/9970> (1994).
- Mattheis, A., Murphy, M. & Marín-Spiotta, E. *J. Geosci. Educ.* **67**, 505–517 (2019).
- Berhe, A. A., Hastings, M., Schneider, B. & Marín-Spiotta, E. in *Addressing Gender Bias in Science and Technology* 109–125 (ACS, 2020).
- Marín-Spiotta, E. et al. *Adv. Geosci.* **53**, 117–127 (2020).
- Grogan, K. E. *Nat. Ecol. Evol.* **3**, 3–6 (2019).
- Batchelor, R. et al. *Eos* **102**, <https://eos.org/opinions/reimagining-stem-workforce-development-as-a-braided-river> (2021)
- Tajmel, T. *Cult. Stud. Sci. Educ.* **14**, 1105–1113 (2019).
- Atchison, C. & Martinez-Frias, J. *Nat. Geosci.* **5**, 366 (2012).
- Stokes, A., Feig, A. D., Atchison, C. L. & Gilley, B. *Geosphere* **15**, 1809–1825 (2019).
- Baber, L. D., Pifer, M. J., Colbeck, C. & Furman, T. *J. Geosci. Educ.* **58**, 32–42 (2010).
- Huntoon, J. E. & Lane, M. J. *J. Geosci. Educ.* **55**, 447–457 (2007).
- Miller, K. C. et al. *J. Geosci. Educ.* **55**, 596–603 (2007).
- Wechsler, S. P. et al. *J. Geog.* **104**, 141–149 (2005).
- Cortina, L. M., Kabat-Farr, D., Leskinen, E. A., Huerta, M. & Magley, V. J. *J. Manage.* **39**, 1579–1605 (2011).
- National Academies of Sciences Engineering and Medicine. *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine* (National Academies Press, 2018).
- Atherton, T. J. et al. *LGBT Climate in Physics: Building an Inclusive Community* (College Park, 2016).
- Bonistall Postel, E. J. *International Graduate Students' Risk and Vulnerability to Sexual Violence and Victimization*. PhD thesis, Univ. Delaware (2015).
- Niemann, Y. F. in *Presumed Incompetent: The Intersections of Race and Class for Women in Academia* 446–499 (2012).
- Sian, K. *Pap. CEIC* **2**, <https://doi.org/10.1387/pceic.17625> (2017).
- Camacho, M. M. & Lord, S. M. in *2011 Frontiers in Education Conference (FIE)* S3H-1–S3H-6 (IEEE, 2011).
- Settles, I. H., Buchanan, N. T. & Dotson, K. J. *Vocat. Behav.* **113**, 62–74 (2019).
- Rolle, T. et al. *Pathog. Dis.* **79**, ftab041 (2021).
- O'Brien, R. *Signs* **30**, 1529–1554 (2005).
- Blackstock, U. *Stat News* <https://www.statnews.com/2020/01/16/black-doctors-leaving-faculty-positions-academic-medical-center/> (16 January 2020).
- Berhe, A. A. *Time* <https://time.com/5864693/climate-change-racism/> (20 July 2020).
- Wood, S. et al. *Proc. R. Soc. B* **287**, 20200877 (2020).
- AGU Scientific Integrity and Professional Ethics (American Geophysical Union, 2017); https://www.agu.org/-/media/Files/Learn-About-AGU/AGU_Scientific_Integrity_and_Professional_Ethics_Policy_document.pdf
- Ali, H. N. et al. *Nat. Commun.* **12**, 3794 (2021).
- Emanu. Equality hurdles. <https://www.emanu.se/illustration> (2016).

Competing interests

The authors declare no competing interests.