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**Counteracting Systemic Bias in the Lab, Field, and Classroom**

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## 1                    **Counteracting Systemic Bias in the Lab, Field, and Classroom**

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9  
10   Keywords: diversity, inclusion, equity, principle investigator, systemic bias

### 11   **Highlights:**

- 12        • Scientists in leadership roles can immediately address systemic bias in their spheres of
- 13        influence.
- 14        • We present actions that can reduce harm and increase inclusion in the lab, the field, and
- 15        the classroom.
- 16        • We call on all scientists to personally engage with research on anti-oppressive practices
- 17        and translate it into sustained action.
- 18
- 19

20 **Abstract**

21 Grappling with systemic discrimination and bias in geosciences can be overwhelming to the  
22 point that one may feel powerless to fix them. Despite the sweeping nature of this challenge,  
23 faculty, principal investigators, and other scientists with leadership roles have unparalleled  
24 power to mitigate harm in environments they oversee. Here, we identify ways that scientists in  
25 these roles can immediately address bias in three common spaces — the lab, field, and  
26 classroom. We highlight key actions that can be taken to improve the quality of life of  
27 marginalized students and other trainees quickly, while important but comparatively slow  
28 institutional changes proceed.

29

30 **1 Introduction**

31 Events in 2020, including the killings of George Floyd, Breonna Taylor, and others, ignited a  
32 global conversation across all sectors of society about racism, white supremacy, and other  
33 systems of oppression experienced by marginalized groups. The geoscience community has  
34 responded with statements, reading groups, and committees addressing the overall lack of  
35 diversity, equity, and inclusion within our field. The sad truth is that our community has  
36 discussed its lack of diversity, particularly related to race and gender, for decades with few  
37 measurable improvements (Bromery et al., 1972; Bernard and Cooperdock, 2018). This lack of  
38 diversity, which spans race, gender, able-bodiedness, sexuality and other social categories,  
39 contributes directly to the lack of inclusion and equity experienced by people from marginalized  
40 groups (Dutt, 2020).

41 Recent efforts have focused on systemic bias — the ways in which institutional culture, norms,  
42 and procedures exclude people based on their social identity and/or background, in both  
43 intentional and unintentional ways. Several calls have been made to address this at the  
44 institutional and federal agency level (e.g., notimeforsilence.org), and many professional  
45 societies responded by updating codes of conduct and retooling other functions with a diversity  
46 lens. At the same time, faculty, principal investigators (PIs), and other scientists that manage  
47 labs, lead fieldwork, or teach students also have an important role to play. As authoritative  
48 figures of environments that people navigate on a near-daily basis, these individuals have  
49 outsized influence over the spaces where students and trainees most keenly feel the adverse  
50 impacts of systemic bias. This power to alter career trajectories is most apparent with reference  
51 letters, grades, and providing access to resources and opportunities (“gatekeeping”), but it also  
52 manifests subtly in day-to-day interactions and norms that can either support or undermine  
53 people’s sense of belonging, fulfillment, and confidence.

54 Here, we highlight actions for scientists supervising labs, fieldwork, and classrooms to address  
55 systemic biases that impact students and trainees, our next generation of geoscientists. While  
56 faculty and PIs are the target of this article, these ideas are relevant to any individual in a  
57 position of authority (e.g., lab managers, teaching assistants, fieldwork organizers). We focus on  
58 tractable actions that can have immediate positive impacts for marginalized community  
59 members, mitigating harm while critical but protracted progress continues at higher  
60 organizational levels (Keisling et al., 2020; Oviemhada et al., 2020). We call on all scientists in  
61 leadership roles to personally reflect and engage with research on anti-oppressive practices

62 published by historians, social scientists, and education scholars, and to translate this learning  
 63 into sustained, life-long action.

## 64 **2 The Lab**

65 For many, “the lab” is both the physical space and the group of people with whom we work to  
 66 accomplish our scientific objectives. Lab work is central to geoscience research, education, and  
 67 professional development, but bias and harassment can make laboratories exceptionally hostile  
 68 spaces for under-represented groups. Hostile work environments are a primary driver for the lack  
 69 of diversity in all STEM fields (Marín-Spiotta et al., 2020).

70 Generally, no PI intends to create a toxic lab culture. However, most receive no formal training  
 71 in mentoring, group management, or on how to create spaces where people of all backgrounds  
 72 and identities can succeed. Consequently, most default to familiar practices, universalizing their  
 73 own experiences by mentoring and managing in ways that worked for themselves. Due to power  
 74 imbalances, PIs can remain oblivious to problems with their lab culture, leading to a cycle in  
 75 which labs are most hospitable to those most similar to current leadership (i.e., “affinity bias”;  
 76 Dutt, 2020). This perpetuates a lack of diversity and propagates harmful supervisory practices  
 77 (Hund et al., 2018).

78 To counteract this, PIs must come to terms with their own positionality, which is the way that  
 79 one’s identity and background shape one’s social standing, power, and experience in an  
 80 inequitable world. Part of this work involves familiarizing oneself with the barriers and dangers  
 81 faced by others (e.g., Marín-Spiotta et al., 2020). For example, most white scientists probably  
 82 have minimal anxiety interacting with campus security; men likely never think twice about  
 83 working isolated in a room with a stranger or acquaintance; and able-bodied scientists rarely  
 84 worry about the arrangement of microscopes, work benches, or walkways. Due to power  
 85 imbalances, PIs can remain oblivious to problems occurring in their own labs. Without this self-  
 86 work, allyship efforts risk being ineffective or even harmful, hampered by a lack of attention to  
 87 power dynamics, and catering to personal comfort levels.

88 Armed with sufficient understanding of one’s positionality, PIs should cultivate skills that will  
 89 support the marginalized community members around them (e.g., bystander intervention and  
 90 conflict management). To establish an inclusive lab culture, PIs can adopt anti-oppressive lab  
 91 guidelines and procedures, following recommendations by leaders in these efforts (Chaudhary  
 92 and Berhe, 2020; Sloan and Haacker, 2001). In mentorship, PIs must recognize that identities  
 93 and sociodemographic backgrounds matter, and that embracing different modes of work and  
 94 models of success promotes an environment where everyone can bring their whole selves to their  
 95 research. Recruitment of underrepresented scholars is essential, but must be coupled with efforts  
 96 to improve inclusion, with the latter prioritized to avoid inflicting further harm (Table 1).

## 97 **3 The Field**

98 Field trips and fieldwork are common components of geoscience training and practice. The  
 99 chance to experience new geographic settings, bond with a research team, and apply knowledge  
 100 first hand are aspects of the field that attract many to the discipline. However, a long history of  
 101 exclusion tarnishes this space: the idea of “the field” as the domain of rugged straight white men

102 persists, and its endurance reflects the shameful reality that many who do not fit this archetype  
 103 must contend with hostile environments involving alienation, unsafe conditions, harassment, and  
 104 assault.

105 Certain field requirements and harmful field experiences can stifle diversity (Giles, 2020). For  
 106 example, field gear costs disproportionately affect low-income students and sharing tents or  
 107 bunkhouses can be exclusionary or dangerous, especially for transgender students or those with  
 108 past trauma. The physical requirements associated with hiking and camping can be unsafe for  
 109 those without experience and infeasible for those with disabilities. The goal here is not to remove  
 110 field experiences, but to identify barriers to participation and adapt accordingly (Table 1, Gilley  
 111 et al., 2015).

112 Fieldwork can also be a life or death situation for some, not only due to weather or terrain, but  
 113 based on an individual's gender, race, and sexuality. Over 64% of surveyed women report  
 114 experiencing sexual harassment and 20% experiencing sexual assault while doing fieldwork  
 115 (Clancy et al., 2014). In the United States, Black people face threats of violence and even death  
 116 in the outdoors and other predominantly white spaces (Lanham, 2016; Anadu et al., 2020).  
 117 LGBTQ+ scientists must also contend with violence and even criminalization in many countries  
 118 (Olcott and Downen, 2020). Although we cannot control societal biases, it is our responsibility to  
 119 ensure the safety of every member of our group. This starts with selecting safe destinations,  
 120 developing safety protocol plans based on participants' identities before travel, and ensuring  
 121 safety structures are in place once there (Viglione, 2020).

122 Lastly, fieldwork can become more inclusive by avoiding practices like "parachute science," in  
 123 which Western scientists gather data in other countries and then leave without collaborating with  
 124 or investing in those communities. Researchers should meaningfully involve Indigenous and  
 125 other local communities and collaborators to incorporate non-Western knowledge systems and  
 126 avoid exacerbating inequalities (e.g., Maldonado et al., 2016; North et al., 2020).

#### 127 **4 The Classroom**

128 Diversity in STEM decreases with every stage of professional advancement, from undergraduate  
 129 through graduate programs, postdocs, and faculty. Geoscience has the most room for  
 130 improvement, with the lowest ethnic and racial representation of all STEM fields at all levels  
 131 (Riggs et al., 2018). Educators must acknowledge that while classrooms can be places of positive  
 132 transformation, they can also be spaces of emotional toil and attrition, especially for students of  
 133 color (hooks, 1994; Hurtado et al., 2011).

134 One way geoscience educators can promote positive experiences is through intentional anti-  
 135 oppressive, intersectional course design, recognizing the interrelated ways that multiple social  
 136 identities can impact opportunities (Núñez et al., 2020). For instance, instead of relying on  
 137 textbook portrayals of white male geoscientists (Bush and Mattox, 2019), teachers can highlight  
 138 contributions by scientists from marginalized backgrounds (Table 1). Exposing students to  
 139 relatable role models inspires a sense of belonging, increasing recruitment and retention of  
 140 underrepresented minorities (Hernandez et al., 2018). Designing course syllabi that contain  
 141 statements on diversity and inclusion, preferred pronouns, and land acknowledgments can  
 142 establish a classroom culture of inclusivity (Fuentes et al., 2020). Carefully considered

143 implementation of in-class community building exercises and active learning techniques  
 144 designed to increase inclusivity (Cooper et al., 2021) can combat imposter syndrome,  
 145 particularly for first-generation college students and those from underrepresented groups  
 146 (Theobald et al., 2020). Instructors should explicitly acknowledge the exclusionary history of  
 147 geology as a discipline, and incorporate complementary Indigenous perspectives on Earth  
 148 processes in their teaching (Reano and Ridgway, 2015; Gibson and Puniwai, 2006).

149 Another way to advance equity in the classroom is to adopt principles of Universal Design. For  
 150 example, recorded and closed captioned lectures allow non-native English speakers and learning-  
 151 disabled students to review course content at their own pace. Incorporating scientific research  
 152 projects within class assignments provides working students with an essential experience that  
 153 they might not have otherwise. Developing multiple avenues to experience the field rather than  
 154 creating alternative assignments for those unable to participate promotes inclusion and avoids  
 155 further marginalization (e.g., Carabajal and Atchison, 2020). The COVID-19 pandemic has  
 156 hastened the advent of hybrid and online courses, including virtual field trips that can achieve the  
 157 same learning outcomes as in-person field trips, while improving equity in the classroom (Sima,  
 158 2020; Whitmeyer and Dordevic, 2020).

159 Ultimately, classroom structures that empower students of all identities to engage in their own  
 160 learning should be adopted. In support of these efforts, institutions should provide and  
 161 incentivize formal pedagogical training in student-centered, inclusive teaching methods.

## 162 **5 Closing Thoughts**

163 History repeatedly shows us that the core values and traditions of scientific disciplines are set by  
 164 the individuals who practice it. We, as a community, must acknowledge the historical roots of  
 165 systemic bias in our field: shaped by early Western naturalists, the original practice of  
 166 geoscience was exclusive by design. In the 1800s, Western geoscientists dismissed knowledge  
 167 generated by non-white groups in violent ways, promoting ideas about the racial inferiority of  
 168 Black and Indigenous people (e.g., Pico, 2019) while also being complicit in the transatlantic  
 169 slave trade, e.g., “hitch[ing] rides on slave ships” for so-called discovery (St. Onge, 2018; Wynn-  
 170 Grant, 2019). Despite social progress in the following century, the exclusion of certain groups  
 171 continued in the form of segregated laboratories and classrooms (e.g., Felt, 2017).

172 Today, marginalization and devaluation of contributions remain, not as distant history but as the  
 173 continued lived experience of many scientists (Makgoba, 2020). Uprooting the systems that have  
 174 prevented the full and broad participation of marginalized groups in our field is arguably the  
 175 most pressing task we must confront, now and into the future (Dutt, 2021). Academic and  
 176 professional reward structures must help, rather than hinder those doing the “invisible work” to  
 177 implement the actions we suggest, which often falls on colleagues who belong to  
 178 underrepresented groups (Jimenez et al., 2019).

179 No individual action we take will eradicate systemic bias overnight, but each of us bears  
 180 responsibility to help transform geoscience into a safe, diverse, and accessible discipline.  
 181 Analogous to the concept of anti-racism, there is no neutral position: one is either working to  
 182 make spaces more inclusive and less hostile, or maintaining systems that reward privilege at the  
 183 expense of marginalized communities. The suggested actions highlighted here represent only a  
 184 fraction of the work needed to counteract the systemic bias built into our discipline. A safe,

185 accessible, and diverse geosciences for all will only be realized when historical injustices are  
186 reckoned with and institutional structures and policies are redesigned with equity, inclusion, and  
187 justice prioritized.

188 **Author contributions**

189 EHGC initiated the article. All authors contributed to each section.

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196 **References**

- 197 Anadu J., Ali H., & Jackson C. (2020). Ten Steps to Protect BIPOC Scholars in the Field. *Eos*,  
 198 101. <https://doi.org/10.1029/2020EO150525>.  
 199
- 200 Berhe A. A. & Kim S. (2019). Avoiding racial bias in letter reference writing. Retrieved from  
 201 <https://tinyurl.com/y8vub7nd>  
 202
- 203 Bernard R. E. & Cooperdock E. H. G. (2018). No progress on diversity in 40 years. *Nature*  
 204 *Geoscience*, 11: 292-295. <https://doi.org/10.1038/s41561-018-0116-6>.  
 205
- 206 Bromery R.W. (1972). Minorities in the geosciences. American Geological Institute, *Geotimes*,  
 207 17(2): 23–24.  
 208
- 209 Bush P., & Mattox S. (2019). Decadal Review: How Gender and Race of Geoscientists Are  
 210 Portrayed in Physical Geology Textbooks. *Journal of Geoscience Education*, 68(1): 2–7.  
 211 <https://doi.org/10.5408/1089-9995-56.2.156>.  
 212
- 213 Carabajal I. G., & Atchison C. L. (2020). An investigation of accessible and inclusive  
 214 instructional field practices in US geoscience departments. *Adv. Geosci.*, 53: 53–63.  
 215 <https://doi.org/10.5194/adgeo-53-53-2020>.  
 216
- 217 Chaudhary V. B., & Berhe A. A. (2020). Ten simple rules for building an antiracist lab. *PLoS*  
 218 *Comput Biol*, 16(10): e1008210. <https://doi.org/10.1371/journal.pcbi.1008210>.  
 219
- 220 Clancy K. B. H., Nelson R. G., Rutherford J. N., & Hinde K. (2014). Survey of Academic Field  
 221 Experiences (SAFE): Trainees Report Harassment and Assault. *PLoS ONE*, 9(7): e102172.  
 222 <https://doi.org/10.1371/journal.pone.0102172>.  
 223
- 224 Cooper, K. M., Schinske, J. N., & Tanner, K. D. (2021). Reconsidering the Share of a Think–  
 225 Pair–Share: Emerging Limitations, Alternatives, and Opportunities for Research. *LSE*, 20, fe1.  
 226 <https://doi.org/10.1187/cbe.20-08-0200>.  
 227
- 228 Dutt, K. (2020). Race and racism in the geosciences. *Nature Geoscience*, 13: 2–3.  
 229 <https://doi.org/10.1038/s41561-019-0519-z>.  
 230

- 231 Dutt, K. (2021). Addressing racism through ownership. *Nature Geoscience*, 14: 58.  
 232 <https://doi.org/10.1038/s41561-021-00688-2>.  
 233
- 234 Dutt, K., Pfaff, D., Bernstein, A., Dillard, J. S., & Block, C. J. (2016). Gender differences in  
 235 recommendation letters for postdoctoral fellowships in geoscience. *Nature Geoscience*, 9, 805–  
 236 808. <https://doi.org/10.1038/ngeo2819>.  
 237
- 238 Felt, H. (2017). Marie Tharp — Plate Tectonics Pioneer. *GSA Today*, Retrieved from  
 239 <https://www.geosociety.org/gsatoday/archive/27/6/pdf/i1052-5173-27-6-32.pdf>.  
 240
- 241 Fuentes, M. A., Zelaya, D. G., & Madsen, J. W. (2020). Rethinking the Course Syllabus:  
 242 Considerations for Promoting Equity, Diversity, and Inclusion. *Teaching of Psychology*, 48, 69–  
 243 79. <https://doi.org/10.1177/0098628320959979>.  
 244
- 245 Gibson, B.A., & Puniwai, N. (2006). Developing an archetype for integrating Native Hawaiian  
 246 traditional knowledge with earth system science education. *Journal of Geoscience Education*, 54  
 247 (3), 287–294. <https://doi.org/10.5408/1089-9995-54.3.287>.  
 248
- 249 Giles S., Jackson C., & Stephen N. (2020). Barriers to fieldwork in undergraduate geoscience  
 250 degrees. *Nat. Rev. Earth Environ*, 1: 77–78. <https://doi.org/10.1038/s43017-020-0022-5>.  
 251
- 252 Gilley, B., Atchison, C., Feig, A., Stokes, A. (2015). Impact of inclusive field trips. *Nature*  
 253 *Geoscience*, 8, 579–580. <https://doi.org/10.1038/ngeo2500>.  
 254
- 255 Hernandez P. R., Bloodhart B., Adams A. S., Barnes R. T., Burt M., Clinton S. M., & Du, W.  
 256 (2018). Role Modeling Is a Viable Retention Strategy for Undergraduate Women in the  
 257 Geosciences. *Geosphere*, 14(6): 2585–93. <https://doi.org/10.1130/GES01659.1>.  
 258
- 259 Hurtado, S., Cuellar, M., & Guillermo-Wann, C. (2011). Quantitative measures of students’  
 260 sense of validation: Advancing the study of diverse learning environments. *Enrollment*  
 261 *Management Journal*, 53-71. <http://hdl.handle.net/10919/83068>.  
 262
- 263 hooks, b. (1994). *Teaching to Transgress: Education as the Practice of Freedom*. Routledge, 216  
 264 p.  
 265
- 266 Hund, A. K., Churchill, A. C., Faist, A.M., Havrilla, C. A., Love Stowell, S. M., McCreery, H.  
 267 F., Ng, J., Pinzone, C. A., & Sordato, E. S. C. (2018). Transforming mentorship in STEM by  
 268 training scientists to be better leaders. *Eco. Evo.*, 8(20): 9962–9974.  
 269 <https://doi.org/10.1038/s41559-019-0911-5>.  
 270
- 271 Jimenez, M. F., Laverty, T. M., Bombaci, S. P., Wilkins, K., Bennett, D. E., & Pejchar, L.  
 272 (2019). Underrepresented faculty play a disproportionate role in advancing diversity and  
 273 inclusion. *Nature Ecology & Evolution*, 3: 1030–1033.  
 274

- 275 Keisling, B., Bryant, R., Golden, N., Stevens, L. A., & Alexander, E. (2020). Does Our Vision of  
276 Diversity Reduce Harm and Promote Justice?. *GSA Today*, (30).  
277 <https://doi.org/10.1130/GSATG429GW.1>.  
278
- 279 Lanham, J. D. (2016). Birding While Black. Lit Hub. Retrieved from <https://lithub.com/birding-while-black/>.  
280  
281
- 282 Makgoba, M. W. (2020). Black scientists matter. *Science*, 884. DOI: 10.1126/science.abe3234.  
283
- 284 Maldonado, J., Lazarus, H., Gough, B., Bennett, S., Chief, K., Kruger, K., Morissette, J., Petrovic,  
285 S., & Whyte, K. P. (2016). *The Story of Rising Voices: Facilitating Collaboration between*  
286 *Indigenous and Western Ways of Knowing*. In *Understanding Vulnerability, Building Resilience:*  
287 *Responses to Disasters and Climate Change*. CR Press.  
288
- 289 Marín-Spiotta, E., Barnes, R. T., Berhe, A. A., Hastings, M. G., Mattheis, A., Schneider, B., &  
290 Williams, B. M. (2020). Hostile Climates Are Barriers to Diversifying the Geosciences. *Adv.*  
291 *Geosci.*, 53: 117–27. <https://doi.org/10.5194/adgeo-53-117-2020>.  
292
- 293 North, M. A., Hastie, W. W., & Hoyer, L. (2020). Out of Africa: The underrepresentation of  
294 African authors in high-impact geoscience literature. *Earth-Sci Reviews*, 208: 13262.  
295 <https://doi.org/10.1016/j.earscirev.2020.103262>.  
296
- 297 Nelson, R. G., Rutherford, J. H., Hinde, K., & Clancy, K. B. H. (2017). Signaling Safety:  
298 Characterizing Fieldwork Experiences and Their Implications for Career Trajectories. *American*  
299 *Anthropologist*, 119(4): 710–722. <https://doi.org/10.1111/aman.12929>.  
300
- 301 Núñez, A. M., Rivera, J., & Hallmark, T. (2020). Applying an Intersectionality Lens to Expand  
302 Equity in the Geosciences. *Journal of Geoscience Education*, 68(2): 97–114.  
303 <https://doi.org/10.1080/10899995.2019.1675131>.  
304
- 305 Sloan, V. and R. Haacker (Eds). (2020). *GEO REU Handbook: A Guide for Running Inclusive*  
306 *and Engaging Geoscience Research Internship Programs* (1st ed.). National Center for  
307 Atmospheric Research, Boulder, CO. doi: <http://dx.doi.org/10.5065/ycba-qw42>.  
308
- 309 Olcott, A.N., & Downen, M. R., (2020). The Challenges of Fieldwork for LGBTQ+  
310 Geoscientists. *EOS*, 101. <https://doi.org/10.1029/2020EO148200>.  
311
- 312 Oviemhada, U., Lepe, B., & Carter, J.-K. (2020). Stop telling URM to wait for change. The  
313 Tech. Retrieved from <https://thetech.com/2020/10/08/dei-cant-wait>.  
314
- 315 Pico, T. (2019). The Darker Side of John Wesley Powell. *Scientific American*, Retrieved from  
316 <https://blogs.scientificamerican.com/voices/the-darker-side-of-john-wesley-powell/>.  
317
- 318 Reano, D., & Ridgway, K. D. (2015). Connecting geology and Native American culture on the  
319 reservation of Acoma Pueblo, New Mexico, USA. *GSA Today*, 25 (8) 26-28.  
320

- 321 Riggs, E. M., Callahan, C., & Brey, J. (2018). Research on Access and Success of Under-  
322 Represented Groups in the Geosciences. In St. John, K. (Ed.). *Community Framework for*  
323 *Geoscience Education Research*. National Association of Geoscience Teachers. Retrieved from  
324 DOI [https://doi.org/10.25885/ger\\_framework/6](https://doi.org/10.25885/ger_framework/6).
- 325  
326 Sima, R. J. (2020). Accessibility and fieldwork in the time of coronavirus. *Eos*, 101,  
327 <https://doi.org/10.1029/2020EO147056>.
- 328  
329 St. Onge, T. (2018). Scientist of the Seas: The Legacy of Matthew Fontaine Maury. Library of  
330 Congress. Retrieved from [https://blogs.loc.gov/maps/2018/07/scientist-of-the-seas-the-legacy-of-](https://blogs.loc.gov/maps/2018/07/scientist-of-the-seas-the-legacy-of-matthew-fontaine-maury/)  
331 [matthew-fontaine-maury/](https://blogs.loc.gov/maps/2018/07/scientist-of-the-seas-the-legacy-of-matthew-fontaine-maury/).
- 332  
333 Theobald, E. J., et al. (2020). Active learning narrows achievement gaps for underrepresented  
334 students in undergraduate science, technology, engineering, and math. *PNAS*, 117 (12): 6476-  
335 6483. <https://doi.org/10.1073/pnas.1916903117>.
- 336  
337 University of Arizona Commission on the Status of Women, (2016). Avoiding gender bias in  
338 reference writing. Retrieved from  
339 [https://csw.arizona.edu/sites/default/files/avoiding\\_gender\\_bias\\_in\\_letter\\_of\\_reference\\_writing.p](https://csw.arizona.edu/sites/default/files/avoiding_gender_bias_in_letter_of_reference_writing.pdf)  
340 [df](https://csw.arizona.edu/sites/default/files/avoiding_gender_bias_in_letter_of_reference_writing.pdf).
- 341  
342 Viglione, G. (2020). Racism and harassment are common in field research. *Nature*, 585: 15–16.  
343 DOI: [10.1038/d41586-020-02328-y](https://doi.org/10.1038/d41586-020-02328-y).
- 344  
345 Whitmeyer, S. J., Dordevic, M. (2020). Creating virtual geologic mapping exercises in a  
346 changing world. *Geosphere*, 17 (1): 226–243. doi: <https://doi.org/10.1130/GES02308.1>.
- 347  
348 Wynn-Grant, R. (2019). On reporting scientific and racial history. *Science*, 365: 1256–1257.  
349 DOI: [10.1126/science.aay2459](https://doi.org/10.1126/science.aay2459).

**Table 1.** Some suggested actions that can be readily adopted to make the lab, field, and classroom more inclusive.

<b>The Lab</b>	<b>The Field</b>	<b>The Classroom</b>
<p>Normalize the discussion of diversity, equity, and inclusion (DEI) and commit resources (time, money, and personnel) to DEI efforts.</p>	<p>Adopt and enforce codes of conduct (Nelson et al. 2017).</p>	<p>Show examples of diverse geoscientists (e.g., Instagram/Twitter: @diversegeologists, @geolatinas, @blackingeoscience).</p>
<p>Create written lab guidelines and expectations that ensures equal opportunity to information and fosters inclusivity (e.g., Chaudhary &amp; Berhe 2020).</p>	<p>Create safety plans that consider those who are non-white, LGBTQ+, disabled, women, etc.; avoid work in intolerant areas (e.g., ADVANCEGeo Partnership: <a href="https://serc.carleton.edu/advancegeo/resources/field_work.html">https://serc.carleton.edu/advancegeo/resources/field_work.html</a>).</p>	<p>Plan universally accessible field trips and classroom activities; provide multiple ways to experience the field, using virtual options or other technology (<a href="http://www.theiagd.org">www.theiagd.org</a>).</p>
<p><u>PIs should receive formal training in skills that help promote inclusivity and justice, such as conflict management and bystander intervention.</u></p>	<p>Provide financial and material assistance for equipment and other expenditures.</p>	<p>Apply inclusive learning techniques that empower students to engage (hooks, 1994); include a diversity and inclusion commitment statement in the syllabus.</p>
<p>Apply best practices in letter reference writing to avoid racial and gender bias (e.g., Dutt et al., 2016; Berhe and Kim, 2019; University of Arizona Commission on the Status of Women 2016).</p>	<p>Collaborate with and recognize as co-authors local researchers (e.g., North et al., 2020).</p>	<p>Provide opportunities and reward trainees for learning experiential and inclusive teaching and mentoring techniques.</p>