

Mentorship Builds Inclusivity and Belonging in the Geosciences

Four evidence-based approaches implemented through an innovative mentoring program have succeeded at improving retention rates of undergraduate women in the geosciences.

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26 January 2023



A panelist speaks with student participants during a workshop in Atlanta organized by the PROGRESS (Promoting Geoscience Research, Education and Success) program.
Credit: Ivan Schustak

People from marginalized communities pursuing degrees in science, technology, engineering, or mathematics (STEM) disciplines [face obstacles](#) such as hostile environments (e.g., sexual harassment), lack of representation, and poor mentorship that challenge their

sense of belonging [e.g., [Berhe et al.](#), 2022]. This is true for Black, Indigenous, and Latinx/e people, as well as for other people of color, LGBTQIA+ people, white women, and people with disabilities. Efforts to diversify the STEM community and workforce have focused largely on recruitment while neglecting the work needed to retain individuals and ensure their sense of belonging [[Allen-Ramdial and Campbell](#), 2014].

The geosciences continue to be one of the least diverse fields within STEM, including a [lack of gender parity](#). This underrepresentation of women, especially those from racially and ethnically excluded groups, is a pattern that emerges at the undergraduate level in the geosciences.

In 2015, we created [PROGRESS](#) (Promoting Geoscience Research, Education and Success) as an

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Our project recruits STEM (science, technology, engineering, or mathematics) undergraduates who identify as women in their first or second year of college with the goal of nurturing their interest in the geosciences.

through mentoring, introduction to role models, professional development opportunities, and online and in-person discussions and resources. Workshops are designed on the basis of published research and demonstrated approaches and are a core component of PROGRESS. These workshops connect undergraduate women to more senior mentors in the geosciences, establish connections among students on individual campuses and regionally, and expand students' ecosystems of support to help them gain technical and professional skills.

As documented in several studies, PROGRESS has raised awareness and improved retention of undergraduate women in the field. Given this success, and the broadening acknowledgment within our field of the many barriers to inclusion within the geosciences, we offer results and strategies of this program as a valuable model for other efforts aimed at diversifying and retaining women in STEM. Below we summarize four critical elements for meaningfully supporting

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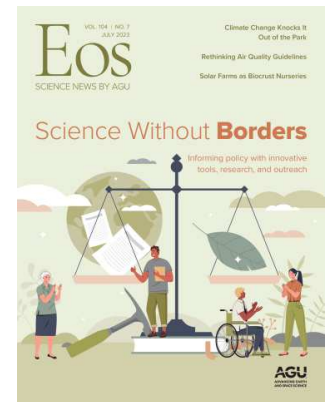
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The Vanishing Scholar: Indigenous Erasure in Funding Data

The Policy of Science

experimental program serving 11 institutions in the Colorado-Wyoming Front Range and the Carolinas region to develop, test, iterate, and scale strategies to support women's persistence in the geosciences. Since then, PROGRESS has expanded to three additional regions (Atlanta; El Paso, Texas; and College Station, Texas) and 12 more institutions, including community colleges, undergraduate-only institutions, and larger research (i.e., R1) schools.

Our project recruits STEM undergraduates who identify as women in their first or second year of college with the goal of [nurturing their interest in the geosciences](#)



undergraduate women. These practices are not comprehensive. Rather, they are examples of ways to nurture and build a geosciences community that is [supportive, inclusive, and equitable](#), and one that ultimately offers the opportunity for students to feel a [greater sense of belonging](#).

Representation and Science Identity

Studies have found that undergraduate students who identify with science or as a “science person” are more likely to persist to graduation and perform well in science fields [[Chen et al.](#), 2021]. Introducing undergraduate women to professionals with a variety of perspectives, backgrounds, and life paths provides students with opportunities to observe people like themselves succeeding. This exposure to role models helps to increase students’ science identity, break down stereotypes of what scientists *look like*, and increase their sense of belonging [e.g., [Good et al.](#), 2012].

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Consistent with others’ recommendations to highlight the relevance of scientific work and [varied paths to success](#) in science careers, PROGRESS engages participants with an empowering 1-day workshop, where they are introduced to professionally and ethnically diverse women geoscientists through a series of panels. Panelists describe their individual career experiences, which emphasizes to the students the variety of entry points into the field and the multifaceted professional and personal pathways taken by successful geoscientists.

In a study conducted of PROGRESS participants, students reported being inspired by relevant role models who had shared their pathways to achieving success. Those introductions to role models led to higher rates of persistence in geoscience fields among PROGRESS participants compared with students who did not participate in the program [[Hernandez et al.](#), 2018]. In fact, on average, the likelihood of a PROGRESS student staying in the geosciences doubled with each additional same-gender role model they identified.

Early Engagement and Access to Resources

Many students have limited precollege exposure to geoscience education but are attracted to these fields as undergraduates because of a love of the outdoors, fond memories of familial experiences, or positive experiences in elective geoscience courses [[Holmes and O’Connell](#), 2003]. Early engagement in STEM has been shown to increase student persistence and retention in these disciplines, particularly among historically excluded groups. Early engagement with students by geoscientists is thus important to increasing their awareness of, and retention within, the field.

In PROGRESS, students have reported, and program leaders have anecdotally observed, many benefits of early engagement with our programmatic activities. These benefits include increasing students' knowledge of and access to opportunities in the geosciences (e.g., undergraduate research experiences and tips for applying to them), helping them establish and broaden a support system in the field (e.g., through peer and local mentoring), and allowing them to explore and develop individual skills that are useful in the geosciences (e.g., strategies on how to navigate obstacles).

The Societal Relevance of the Geosciences

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Geoscience topics, knowledge, and expertise are central to many of the most challenging problems facing society today—from climate change and water security to air pollution and natural hazards—as well as to potential solutions to these challenges. Therefore, we need future scientists to be well versed in Earth system processes and interdisciplinary approaches. Studies have suggested, however, that many people perceive a lack of communal goals (i.e., goals oriented toward working with or helping others) within STEM disciplines and have pointed to this as one reason for the large gender disparities [e.g., [Diekman et al.](#), 2017].

In PROGRESS workshops, we aim to dispel this myth by helping participants understand the societal relevance and collaborative nature of the geosciences. For example, we introduce various geoscience fields paired with global challenges that scientists in these fields are helping to address, such as atmospheric scientists and air pollution, seismologists and natural disasters, and hydrologists and water quality. These approaches help defuse conflicts that students may experience between their personal and professional goals. They also promote stronger intentions to continue in the field, as we documented in a recent study [[Henderson et al.](#), 2022].

Communities of Support

Students are often under the impression that they need only *one* mentor, not recognizing the many benefits of having multiple mentors. As several studies have illustrated, a multitiered, multimentor approach is more beneficial to mentees, not only providing them with multiple perspectives but also helping build their networks and increase their sense of belonging [e.g., [Pandya et al.](#), 2007].



A student maps out a plan for developing a mentoring network, or ecosystem of support, at a PROGRESS workshop. Credit: Ivan Schustak

The PROGRESS program stresses the importance of developing an ecosystem of support that can provide a mentee with intellectual, career, and wellness support. Specifically, we emphasize that no one person can provide another individual with all the support they need. We are more than our science and therefore need mentors in other parts of our lives. We work with all participants to build individualized mentor maps, helping them identify the many members of their community who already provide support, as well as areas where they may be missing someone. We then collectively brainstorm how to fill the gaps strategically and work with participants on how to approach potential new mentors.

This approach recognizes the benefits of multiple mentors and conveys why it's best not to rely on a single mentor for all needs. It also provides opportunities to discuss what mentorship is and who can serve as mentors. Broadening one's network can increase a student's sense of belonging and their intention to stay in the field [[Estrada et al., 2018](#)]. It can also help reduce racial isolation and positively affect students' persistence in STEM [[Gasiewski et al., 2010](#)].

We found that the greatest gains in scientific identity and reported interest in staying in the field by PROGRESS participants were experienced by those who not only were taught the value of mentorship during a PROGRESS workshop but also were paired with a local, same-gender mentor [[Hernandez et al., 2020](#)]. In some cases, though, we have found it challenging to recruit enough same-gender mentors for all participants. Anecdotally, this difficulty has arisen not because of a lack of interest by prospective mentors but, rather, because of the amount of service in which

these individuals were already engaged. This result points to an often discussed but unaddressed challenge in STEM: Women, especially women of color, often do far more of the unpaid labor of mentoring than their colleagues [[Hirshfield and Joseph](#), 2012].

Furthermore, not everyone in the STEM community is prepared to be an effective mentor, in part because the work of mentoring in science is undervalued. It is critical that we collectively increase our community's valuation of and capacity for mentorship. To that end, the PROGRESS team also provides 1-hour mentor training to faculty, graduate students, and professionals. Beyond the efforts of PROGRESS, we suggest that the community can more appropriately value those who develop the skills (including learning to shoulder the emotional toll) and take the time to mentor the next generation of scientists by ensuring that these activities are recognized and accounted for in workload distributions and considerations of recognition and career advancement.

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Forward PROGRESS

Systematically improving mentoring will be a critical part of retaining undergraduate students in the geosciences and overcoming the field's persistent diversity challenges. The development, iteration, and testing of PROGRESS have indicated that all mentoring efforts should encourage broad representation to help students build their science identity; provide early engagement and access to resources; explain the societal relevance of the geosciences; and intentionally establish communities of support.

We will continue to grow the number of regions and institutions involved in PROGRESS and update the community as we identify additional critical and transferable attributes of the program. We welcome new partnerships with those interested in working together to further transform the way we welcome the next generation of scientists.

Acknowledgments

Support was provided by the National Science Foundation's Improving Undergraduate STEM Education program through awards DUE-1431795, DUE-1431823, DUE-1460229, DUE-2013318, DUE-2013333, DUE-2013323, DUE-2013312, and DUE-2013326. We thank all of our incredible volunteer mentors.

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Citation: Burt, M. A., R. T. Barnes, S. Schanz, S. Clinton, and E. V. Fischer (2023), Mentorship builds inclusivity and belonging in the geosciences, *Eos*, 104, <https://doi.org/10.1029/2023EO230020>. Published on 26 January 2023.

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