

Journal of Geoscience Education

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/ujge20

Making departments diverse, equitable, and inclusive: Engaging colleagues in departmental transformation through discussion groups committed to action

Carol J. Ormand, R. Heather Macdonald, Janet Hodder, Debra D. Bragg, Eric M. D. Baer & Pamela Eddy

To cite this article: Carol J. Ormand, R. Heather Macdonald, Janet Hodder, Debra D. Bragg, Eric M. D. Baer & Pamela Eddy (2022) Making departments diverse, equitable, and inclusive: Engaging colleagues in departmental transformation through discussion groups committed to action, Journal of Geoscience Education, 70:3, 280-291, DOI: 10.1080/10899995.2021.1989980

To link to this article: https://doi.org/10.1080/10899995.2021.1989980

© 2021 The Author(s). Published with license by Taylor and Francis Group, LLC

Published online: 20 Oct 2021.

Submit your article to this journal

Article views: 2678

View related articles

View Crossmark data

Citing articles: 1 View citing articles

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=ujge20

JOURNAL OF GEOSCIENCE EDUCATION
2022, VOL. 70, NO. 3, 280–291
https://doi.org/10.1080/10899995.2021.1989980

Routledge
Taylor & Francis Group

OPEN ACCESS Check for updates

Making departments diverse, equitable, and inclusive: Engaging colleagues in departmental transformation through discussion groups committed to action

Carol J. Ormand[a], R. Heather Macdonald[b], Janet Hodder[c], Debra D. Bragg[d], Eric M. D. Baer[e] and Pamela Eddy[f]

[a]Science Education Resource Center, Carleton College, Northfield, Minnesota, USA; [b]Department of Geology, William & Mary, Williamsburg, Virginia, USA; [c]Oregon Institute of Marine Biology, University of Oregon, Charleston, Oregon; USA; [d]Bragg & Associates, Chicago, Illinois, USA; [e]Geology Program, Highline College, Des Moines, Washington, USA; [f]School of Education, William & Mary, Williamsburg, Virginia, USA

ABSTRACT

The geosciences have a pervasive, persistent, and deeply troubling lack of diversity, despite the availability of a suite of well-documented, research-based strategies for broadening participation in STEM (Science, Technology, Engineering, and Mathematics). The pervasiveness, persistence, and depth of the problem indicate that the lack of diversity is systemic, and is embedded in the culture of our discipline, including in the academic departments where future geoscientists are educated. Shifting the demographics of our community will therefore require changing the culture of geoscience, including within our departments. Departmental change is possible and can be accelerated intentionally. Levers for cultural change include using data to illuminate the need; incentivizing the work that closes equity gaps and builds inclusive environments; and developing a departmental community of practice committed to just, equitable outcomes. Departmental discussion groups can facilitate and support both the development of a community of practice and the ongoing work of the community, including identifying context-appropriate solutions from the research literature. The SAGE 2YC project (Supporting and Advancing Geoscience Education at Two-Year Colleges) has used discussion groups to raise awareness and understanding of the factors leading to homogeneity in the geoscience community and of the strategies for achieving equity and inclusion. SAGE 2YC participants have successfully closed or narrowed equity gaps. As scientists, we have the skills necessary to gather, analyze, and interpret relevant data and to evaluate the efficacy of strategies we implement. As humans, we have the moral and ethical responsibility to do this work to improve equity and inclusion in STEM.

ARTICLE HISTORY
Received 19 January 2021
Revised 04 October 2021
Accepted 04 October 2021

KEYWORDS
Diversity; Equity; and Inclusion; community of practice; faculty learning communities; equity-mindedness

Introduction

With respect to race, ethnicity, gender, disability status, and LGBTQ+ (lesbian, gay, bisexual, transgender, and queer) identities, the STEM disciplines are persistently and significantly less diverse than the general population, and the geosciences remain persistently and significantly among the least diverse of the STEM disciplines (e.g., Bernard & Cooperdock, 2018; Carabajal et al., 2017; Dutt, 2020; Gonzales, 2019; Gonzales & Keane, 2020; Hill et al., 2010; Holmes & O'Connell, 2004; Hughes, 2018; Huntoon & Lane, 2007; Marín-Spiotta et al., 2020; National Center for Science and Engineering Statistics (NCSES), 2019; Sidder, 2017; Wilson, 2019). This is true despite the *over-representation* of racial and ethnic minorities in the population of students who express an interest in STEM majors when they arrive at college (e.g., Asai, 2020; O'Brien et al., 2015; Tsui, 2007); despite women earning more than 40% of both undergraduate and graduate degrees in the geosciences since 2005 (Gonzales & Keane, 2020); and despite LGBQ students being more likely to participate in undergraduate research (Hughes, 2018), one of the most effective high-impact practices for attracting students into STEM (e.g., Kuh, 2008). Moreover, the intersectionality of multiple identities is an important aspect of diversity and inclusion (e.g., Bernard & Cooperdock, 2018; Núñez et al., 2020; O'Brien et al., 2015; Williams et al., 2014). For instance, women of color are *disproportionately* underrepresented in geosciences, and appallingly so (Bernard & Cooperdock, 2018). This lack of diversity, despite the demographics of arriving college students who express interest in STEM majors, indicates that the *STEM disciplines, including the geosciences, are driving interested students away*. This is detrimental to the geosciences (e.g., Hofstra et al., 2020; Hong & Page, 2004; Medin

CONTACT Carol J. Ormand cormand@carleton.edu Science Education Resource Center, Carleton College, Northfield, MN 55057, USA
© 2021 The Author(s). Published with license by Taylor and Francis Group, LLC
This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (http://creativecommons.org/licenses/by-nc-nd/4.0/), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.

& Lee, 2012) and to individuals (Cleveland et al., 2018; Gewin, 2020; Quaye et al., 2019).

There is a growing awareness and acknowledgment of the urgent need to undertake the crucial work of fostering an inclusive and equitable environment in the geosciences (e.g., Ali et al., 2020; Ali et al., 2021; Asai, 2020; Beane et al., 2021; Bell & Lozier, 2020; Dutt, 2020; Egger, 2020; Marín-Spiotta et al., 2020; Morales et al., 2021; Morris et al., 2020; Posselt et al., 2019; Quardokus Fisher et al., 2019; Walker & Dutrow, 2020). We challenge every reader, if it is safe for you to do so, to engage your colleagues in meaningful discussions of what your department can do to work toward equity and inclusion in the geosciences, with the ultimate goal of having an anti-racist geoscience community: one that mirrors the demographics of the nation and that welcomes and supports all of its members. In doing so, we acknowledge that we are a team of all-White authors. While this article is based on observed successes, we acknowledge that our understanding of racism in the geosciences is limited by our lived experiences. Further, we know that not everyone is in a situation where it is safe to take on this work. We particularly call on our tenured White colleagues to provide support in efforts to lead your departments toward an anti-racist future and to become an ally for all of your colleagues whose identities and experiences have been marginalized. We offer concrete examples and resources from the SAGE 2YC project to support your discussions and the work arising from them.

SAGE 2YC: Faculty as change agents

SAGE 2YC is a national network of 2YC geoscience and other STEM faculty Change Agents who use evidence-based strategies to support students' academic success, broaden participation in STEM, and facilitate students' professional pathways into the STEM workforce. This NSF-funded project (https://serc.carleton.edu/sage2yc/index.html) provides a successful model for a data-driven approach to working toward equity, as well as for the design of effective discussion groups, where discussion leads to implementation of new practices. To date, there have been a total of 84 SAGE 2YC faculty participants in three cohorts. Professional development for project participants has been a blend of workshops – some face-to-face and some online – and faculty discussion series (all online, with both synchronous and asynchronous components). All of the workshops and discussion series have incorporated action planning, as the project expects participants to implement some of the strategies they learn about. An overarching goal of the professional development activities is to spark changes in practice through deep engagement with evidence-based practices for teaching and learning. Each team has worked for change within their own courses, their departments/programs, and their institutions. Teams have also shared what they've learned with colleagues in their region and on their campuses (e.g., Eddy et al., 2019; Iverson et al., 2020; Macdonald et al., 2019), as well as at national meetings (e.g., Anders & Boryta, 2019; Bair, 2019; James, 2019; Layou, 2019; Leinbach et al., 2019; Mrofka & Walker, 2019; Resnick et al., 2019; Tvelia, 2019; Voorhees, 2018; Walker & Mrofka, 2017; Woodall & Braley, 2019). Figure 1 illustrates key elements of the SAGE 2YC professional development program supporting the change process: gathering data and interrogating it to identify needs; exploring strategies that address those needs through the educational research literature; developing a plan with measurable outcomes; and implementing the plan, using data to measure progress.

The SAGE 2YC final evaluation report (2020) quantifies remarkable progress toward closing equity gaps in student academic success: "For cohort 1 from year 2 to year 4, the course success rate rose 7% for females, 12% for racially minoritized students, 9% for nontraditional age students, and 8% for Pell-eligible students. For all groups except the racially minoritized group, the average course success rate approximated or exceeded the overall course completion rate by year 4 of the grant. For the racially minoritized group, the course success rate closed to a gap of 7% by year 4 (64% for the racially minoritized group in year 4 compared to 71% for overall success)" (Bragg et al., 2020, p. vi).

Working for change: Process model

Incentivize change

Involvement in the SAGE 2YC project is voluntary and participants earned modest stipends for their work. As a result, we were able to proceed with the work of the project knowing that everyone was invested in the project goals, including broadening participation in STEM. Furthermore, SAGE 2YC participants needed the support of an institutional administrator, generally at the rank of Dean or higher, to participate in the project. If your department is not yet fully invested in working for diversity, equity, and inclusion (DEI), you may need to start by finding ways to incentivize this work. Consider enlisting your department chair, a Dean, or another administrator in developing standards to recognize and reward both efforts and results in this area. For example, cultural competency can be incorporated into annual performance reviews, tenure, and promotion criteria (McGee, 2020, p. 136). Grassroots leadership by faculty members is enhanced when faculty are knowledgeable about the role they play as leaders on campus (Kezar & Lester, 2020).

Identify departmental equity and diversity gaps: Gather data and interrogate it

As in geoscience research, the first step in solving an educational problem is identifying a question or questions and gathering relevant data. The lack of diversity in STEM, and in the geosciences, is well-documented, but it can be worth reviewing national data as a department simply to make sure that everyone is equally informed about the historical and current state of affairs, as well as about the uneven and grossly inadequate progress in our lifetimes. In addition, we have found it is illuminating and highly motivating to understand how national trends play out in one's own department (e.g., Bair, 2019). Moreover, we are not alone in using this

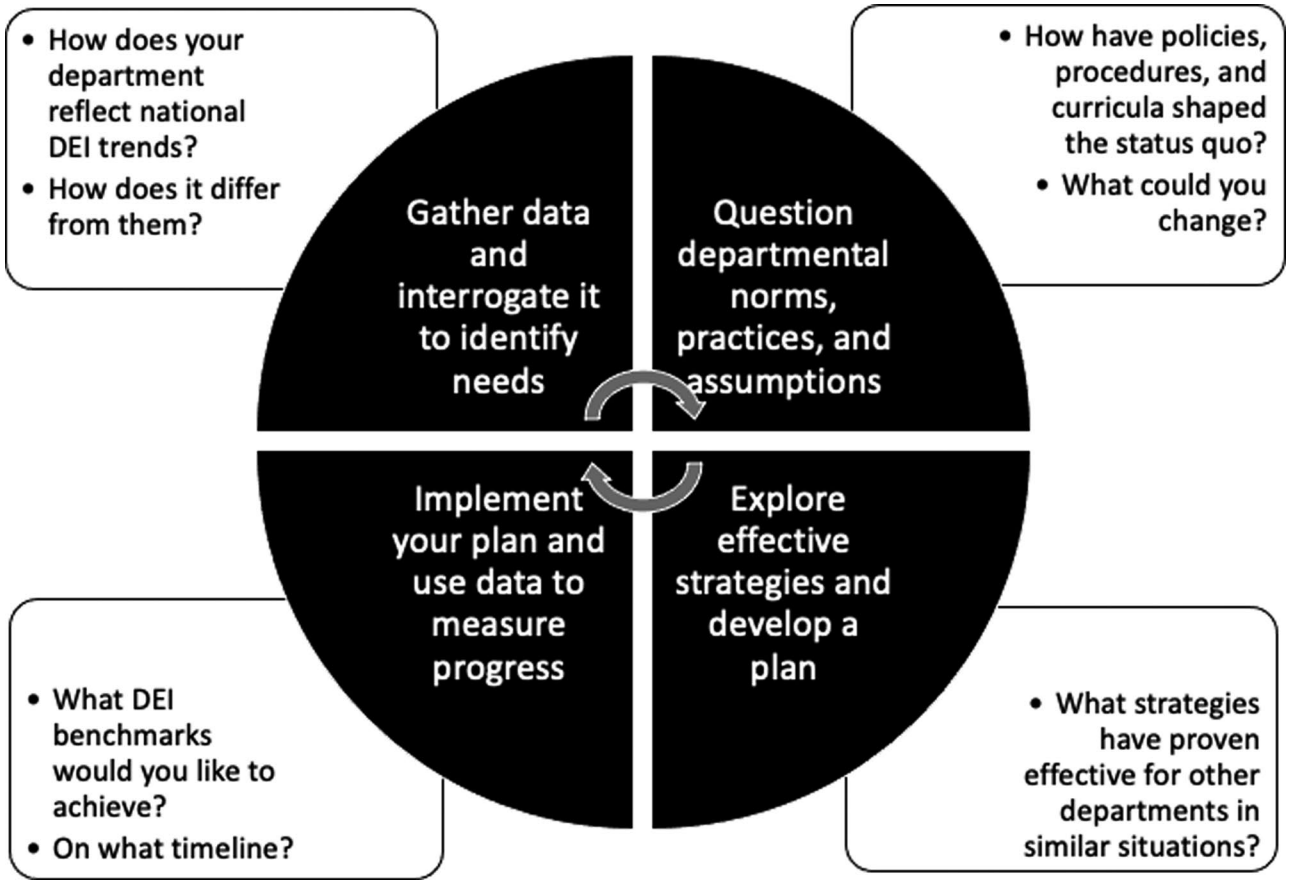


Figure 1. The SAGE 2YC framework for making departments diverse, equitable, and inclusive. In this data-driven, iterative process, a departmental team uses data to identify needs; reflects on the factors that contribute to those needs; explores strategies for change and develops a plan; and implements the plan, using data to measure progress. SAGE 2YC discussion groups focused primarily on step 3 of this process (learning about effective strategies), and we used other elements of the professional development program for other steps in the process. However, discussion groups could take on the full process.

approach. In the early years of this millennium, researchers at the University of Southern California developed the "Equity Scorecard," a tool that allows faculty and staff to recognize and address racial inequities in course outcomes (https://cue.usc.edu/tools/the-equity-scorecard/). The Equity Scorecard has been implemented at colleges and universities throughout California, in the University of Wisconsin system, and beyond (e.g., Bensimon et al., 2016; Harris & Bensimon, 2007). Likewise, the Pathways to Results project uses data to identify equity gaps in educational outcomes and to measure progress toward equity (Bragg et al., 2016).

Our specific recommendations are to compare

1. The demographics of the U.S. population to the demographics of the geoscience workforce (e.g., Gonzales & Keane, 2020; Ormand, 2017). This provides a national context for departmental data.
2. The demographics of the student population at one's institution to the demographics of the students enrolled in courses in one's department. Institutional demographics are available from the Integrated Postsecondary Education Data System (IPEDS, https://nces.ed.gov/ipeds/) or from the National Center for Education Statistics (https://nces.ed.gov/collegenavigator/). Your institutional research office may provide access to course-level demographic data for the purpose of analyzing outcomes by student group or sub-group.
3. The success rates for students enrolled in each of the courses offered in one's department, disaggregated by demographics such as race and ethnicity, gender, socioeconomic status, and any other factors your department is interested in. Your institutional research office has these data. In low-enrollment courses and programs, data can be aggregated over multiple academic terms, or even years, to protect identifying information.
4. The completion rates for students enrolled in degree and certificate programs in one's department, disaggregated by demographics.

A template for steps 2–4 is available on the SAGE 2YC project website: https://serc.carleton.edu/sage2yc/course_data.html.

These data can be a particularly compelling way to invite conversation with colleagues who are not yet fully engaged in improving DEI in the geosciences. Mismatches between institutional and departmental demographics for enrollments, success rates, and degree completion rates raise questions about the causes of those differences and quantify the problems we need to address. While the lack of diversity in the geosciences (and in STEM) is clearly a national problem, it

nonetheless manifests itself on a local level, and that is where each of us has the power to address it.

Question departmental norms and assumptions; identify opportunities for change

Recall that racial and ethnic minorities are *overrepresented* in the population of students who express an interest in STEM majors when they arrive at college (e.g., Asai, 2020; O'Brien et al., 2015; Tsui, 2007), and that female students make up nearly 40% of the students who earn undergraduate degrees in geoscience, but only 24% of the geoscience workforce (Marín-Spiotta et al., 2020). Despite some uneven progress in the diversity of students earning undergraduate geoscience degrees (Beane et al., 2021), diversity within the geoscience profession is almost unchanging, and has been for decades (e.g., Bernard & Cooperdock, 2018; Holmes & O'Connell, 2004; Sidder, 2017). It is therefore undeniable that the pervasive and persistent lack of diversity in the geosciences, and in STEM, is a systemic problem, rooted in the culture of our disciplines. This culture manifests itself in the policies and procedures of our institutions and departments, in our course content and curricula, and, in far too many cases, in the beliefs and behaviors of individuals. If we are not actively working to transform this culture, we are tacitly supporting it. We, the authors of this paper, believe that we, the geoscience community, have a moral responsibility to work to transform this racist, sexist, ableist, homophobic culture. Further, we believe that this responsibility rests primarily on the shoulders of those of us who hold power, both explicitly (tenured faculty) and implicitly (White faculty). Finding and cultivating allies and champions can provide leverage in challenging existing power structures (Posselt et al., 2019; Quardokus Fisher et al., 2019).

What are the policies, procedures, course content, curricular requirements, beliefs (both explicit and implicit), and behaviors that perpetuate the status quo in your department? What changes in policies, procedures, courses, curricula, beliefs, and behaviors could shift your department toward equity and inclusion, thereby attracting, supporting, and preparing a diverse population of students for careers in geoscience? In recent months, scientists – including many who belong to historically underrepresented groups – have been increasingly vocal about what professional societies, departments, and individuals can do to change the culture of the geosciences (e.g., Ali et al., 2020; Ali et al., 2021; Anadu et al., 2020; Houttuijn Bloemendaal et al., 2020; Marín-Spiotta et al., 2020; Miles et al., 2020; Morales et al., 2021; Morris et al., 2020; Núñez et al., 2020; Olcott & Downen, 2020; Popp et al., 2020; Powell et al., 2020). Listening to and amplifying their voices by reading and discussing these papers is a strong strategy for beginning the process of educating ourselves and our colleagues.

Gathering data on the attitudes, behaviors, and experiences of department members can also be illuminating. Resources we know of include a departmental equity and inclusion self-assessment worksheet from the University of California, Berkeley: https://diversity.berkeley.edu/sites/default/files/ei_adviser_tool_-_final_web.pdf and a workplace culture survey from UCAR (University Corporation for Atmospheric Research): https://www.ucar.edu/sites/default/files/documents/related-links/2018-05/UCAR_2017_Culture_Survey_Instrument.pdf. There are also a number of campus climate surveys available, such as the one from the Higher Education Data Sharing Consortium (https://www.hedsconsortium.org/heds-diversity-equity-campus-climate-survey/). While valuable, campus-level surveys may mask an individual department's culture if it diverges from that of the institution overall. Unfortunately, we have been unable to locate a publicly available, professionally designed climate survey for academic departments.

Learn from prior research: Explore evidence-based strategies that address your department's needs

There is a wealth of research into strategies for improving DEI in the STEM disciplines. Callahan et al. (2017) provide a theoretical framework for improving DEI in the geosciences, one that can inform and guide programmatic interventions. The literature review by Wolfe and Riggs (2017) highlights elements of several successful programs and includes recommendations to the geoscience community. Together, these articles provide insights into what programs and practices are likely to be effective in a given departmental and institutional context.

There are also a number of websites that provide excellent starting points to learn more about effective strategies for improving DEI in the STEM disciplines. The NSF-funded ADVANCE-Geo Partnership has a wealth of resources for members of the geoscience community working to transform our workplaces: https://serc.carleton.edu/advancegeo/resources/index.html. These resources provide research summaries, examples, and reference lists on topics such as harassment, bullying, and discrimination; how to respond to hostile behaviors; creating inclusive climates; and challenges and solutions for field training and research. GeoReadingForEquity has an extensive reading list and a list of suggested actions for departments: https://www.georeadingforequity.com, as does the NSF-funded Unlearning Racism in Geoscience (URGE) project: https://urgeoscience.org/curriculum/. Our NSF-funded SAGE 2YC project has engaged our faculty participants in reading and discussing the research literature on DEI, and has used these conversations to motivate and guide faculty members in developing implementation plans, as we describe below.

Choose and implement strategies: Use data to measure progress

Action planning is an essential element of every SAGE 2YC discussion group. What evidence-based practices have been effective in departments similar to yours, facing similar challenges? What strategies seem particularly well-suited to the needs of your department? Taking a metrics-based approach to meeting those needs can help make your plans

concrete. What measurable, equity-based outcomes do you want to achieve, with respect to student enrollments, course success rates, and degree completion? What is a reasonable timeline for achieving those goals? Consider how long it will take to implement the changes you want to make, and also how long it will take for those changes to have the desired effect. Choose an interval for evaluating progress toward your goals – one that will allow you to measure your progress with respect to your intended timeline.

Using discussion groups to engage your colleagues

Why discussion groups?

The culture of geoscience is taught and learned, often subconsciously, where geoscientists are educated: in geoscience departments. Although it is painful to admit, our departments are hostile to certain populations of students – to historically underrepresented minority students, to women, to LGBTQ + students, to students with disabilities – and transformative change requires educating ourselves about the structures, norms, policies, and practices that have built this pervasive and hostile environment (Marín-Spiotta et al., 2020). Discussion groups provide a mechanism for engaging colleagues in deeper learning and substantive discussions on these critically important topics, and can help illuminate our own internal, subconscious biases. A book club, journal club, or other discussion group focused on equity and inclusion in the geosciences, or in STEM, provides a structure for engaging ourselves and others in exploring the rich literature on the strategies that have been documented to be effective in mitigating equity gaps and developing welcoming, inclusive environments that attract, support and prepare all students for careers in STEM. A well-structured discussion group can go beyond exploration; participants in SAGE 2YC's discussion groups have implemented a wide range of evidence-based strategies in their own teaching and in their departments (Ormand et al., 2019; Bragg et al., 2020). The Unlearning Racism in Geoscience (URGE) project is built on this premise as well; participants in the URGE project moved from reading to action by examining and revising departmental policies (see URGE Deliverables, https://urgeoscience.org/pod-deliverables/).

Efforts at departmental transformation within the STEM disciplines have demonstrated that the likelihood of substantive transformation increases as more members of the department become committed to change (e.g., Davis et al., 2020) and as the department develops a shared vision for change (e.g., Iverson et al., 2011; Ormand et al., 2011). For example, faculty learning communities provide a forum for professional development for faculty members and a space to work on collective issues (Cox, 2004). Learning in a community involves a focus on topics directly related to work issues. "Through this interaction, meanings are discussed, shared, negotiated, and developed. It is the discussion of the ideas and the co-construction of knowledge that makes the learning and development more meaningful" (Engin & Atkinson, 2015, p. 165). Change efforts are supported by the collective work of faculty, and are leveraged by opportunities to interact and discuss new evidence-based practices, such as those discussed in this paper (Iverson et al., 2017). These discussions can lead to changes in attitudes as well as programmatic changes (Iverson et al., 2011; Ormand et al., 2011). One strength of the URGE project is that it was structured to take advantage of this principle, with participants forming self-organized "pods" of up to twelve members, and most pods situated in departments.

Many strategies for diversifying the STEM disciplines have been proposed, tested, and shown to be effective, and these are well documented, including in literature reviews (e.g., Wolfe & Riggs, 2017; Tsui, 2007). However, these evidence-based practices have not become widespread (e.g., Beane et al., 2019, who reported on a subset of inclusive teaching practices). We posit that one route to adopting these practices in a department is to develop a community of practice (e.g., Wenger-Trayner & Wenger-Trayner, 2015) that shares a passion for achieving equity in opportunities and in student success within the department's programs: a community of champions for DEI. This community need not be limited to one's own department; it could include champions in other STEM disciplines on campus and beyond. However, we believe that it is essential to have a departmental community committed to DEI. Without such a community, attracting students from historically underrepresented populations into a department raises ethical questions. Students who belong to historically underrepresented populations in departments that are not actively committed to DEI may anticipate discriminatory interactions, and that anticipation – whether the discriminatory interactions happen or not – has negative physiological and psychological impacts (e.g., Pascoe & Richman, 2009; Sawyer et al., 2012).

Having these discussions is a good start, but it is not sufficient. Doing this work requires developing equity-mindedness: uncovering systemic inequities and engaging in educational change-making strategies (Bensimon et al., 2007; Dowd & Bensimon, 2014). As defined by Bensimon et al. (2007), equity-mindedness refers to a state of thinking and knowing about how systems, policies, cultural norms, and everyday practices that appear to be race-neutral may in fact negatively impact certain individuals and groups. Equity-mindedness stimulates cognitive schemas in individuals so that they can see inequities that would have been invisible to them in the past. Addressing systemic inequities requires the deliberate and thoughtful use of equity-focused inquiry methods that rely on data disaggregation as a precursor for change. SAGE 2YC data templates are designed to highlight inequitable patterns of student outcomes, illustrating where gaps, as well as opportunities, exist. An equity-minded approach to these inequities asks how the educational environment contributes to them, shifting the focus away from the students and onto the factors that are preventing students from achieving their full potential (Bragg & McCambly, 2018).

We suggest that a discussion group can develop into a community of practice committed to diversity, equity, and inclusion in the geosciences. "Communities of Practice are groups of people who share a concern or a passion for something they do, and learn how to do it better as they interact regularly" (Wenger-Trayner & Wenger-Trayner, 2015, quoted in Kastens, 2016). There are many advantages to doing this work collectively: transformational change requires critical mass; the community provides a mechanism for accountability in making progress; and working for change within our own department creates community ownership of the process and the outcomes. In addition, the discussants can hold each other accountable to equity-mindedness, challenging data interpretations that blame historically marginalized students for systemic impacts. By engaging in substantive discussions about DEI in STEM, we can develop our equity-mindedness and learn how to foster inclusive and equitable environments for our students and for our colleagues. Discussion groups provide the regular interaction that is needed to move from understanding to action.

Structuring effective discussion groups

From the beginning of the SAGE 2YC: Faculty as Change Agents project in early 2016, faculty discussion series have been a significant component of the professional development program (Ormand et al., 2020). Because our overarching goal is to spark changes in practice, one explicit aspect woven into each of the series is the development of implementation plans: each participant chooses a strategy or strategies to implement from the readings and discussions. Over the five years of the project, we have run 19 discussion series, seven with an explicit focus on broadening participation.

SAGE 2YC discussion series are designed to meet the overarching goal of catalyzing changes in educational practices. A sequence of meetings is scheduled at 2–3 week intervals, with substantive reading or other assignments prior to each meeting, including prior to the first meeting. Materials to be read, watched, or reviewed by participants are selected to highlight key findings on the topic at hand. In addition to reviewing the materials before each synchronous meeting, participants typically also complete a reflective exercise, posting their thoughts to a private, password-protected discussion board. Depending on the topic, participants may also be encouraged to read and respond to others' posts prior to the synchronous discussion. Toward the end of each discussion series, participants develop and share their implementation plans with the group. Sharing implementation plans serves multiple purposes: it encourages deep thinking about the details of the plan, imparts an element of accountability, facilitates the exchange of implementation ideas, and provides a mechanism for peer review of everyone's plans. Although each of our discussion series has been organized and coordinated by one or two facilitators, this work could also be distributed among discussion participants. We've had successful discussion groups with as few as four participants and as many as twenty. In larger groups, we often utilize the breakout room function during our synchronous Zoom meetings.

There is no inherent reason to limit participation in such discussions to faculty members. If you are using a discussion group to shift the culture of your department toward inclusion, consider making the discussion group itself inclusive: invite staff, postdocs, and students to participate. However, given the existing power differentials within departments, an alternative possibility would be to offer all of the departmental discussion materials to all of these groups and invite everyone – staff, postdocs, and students – to form their own discussion group or groups. It is these existing power differentials that make understanding how to find allies and equity champions so crucial.

Discussion series: Examples from SAGE 2YC

SAGE 2YC discussion groups have focused on a range of topics, each related to at least one of the three strands of this NSF-funded project: supporting the academic success of all students, broadening participation in the geosciences/STEM, and facilitating students' career pathways. Each of these series focuses on exploring evidence-based strategies that address the needs identified by SAGE 2YC faculty participants. Most discussion groups explore multiple such strategies, allowing participants to choose those that they think will work well in their institutional context. Descriptions of many of these discussion series are linked from our website: https://serc.carleton.edu/sage2yc/faculty_discussions.html. While we believe that all three of these strands can positively impact DEI in geoscience courses, programs, and departments, some discussion series are more directly related to DEI than others. Here are brief descriptions of three discussion series that focused on broadening participation in STEM; the details of each can be found on the project website. Each of these examples showcases a somewhat different format for the discussion groups: a book club, a journal club, and an implementation group; this third format assumes that participants are already familiar with the research literature pertaining to a topic of interest.

Whistling Vivaldi book club

One factor contributing to the lack of diversity in the STEM disciplines is stereotyping (e.g., Cakmakci et al., 2011; Chambers, 1983). If you doubt that stereotypes affect our collective image of geoscientists, try doing an image search for "geoscientist" in your favorite internet browser. Our mental image may affect which students we "see" as potential geoscientists… and it also affects which students "see" themselves as potential scientists (Schinske et al., 2016). Students who identify with groups that have been historically underrepresented in the geosciences face an insidious barrier to success: stereotype threat. *Whistling Vivaldi: How Stereotypes Affect Us and What We Can Do*, by Claude M. Steele, is an excellent summary of the cognitive science research into the phenomenon of stereotype threat and its effect on student performance, particularly in STEM. It is an excellent

starting point for anyone who wants to understand why students who belong to historically underrepresented groups might be underperforming in our courses relative to their potential. Moreover, the book summarizes extensive research into strategies that can be implemented to mitigate the effects of stereotype threat, thus allowing students to achieve their potential. The SAGE 2YC project has run the *Whistling Vivaldi* book club multiple times; our approach to this book is described on the project website: https://serc.carleton.edu/sage2yc/series/vivaldi.html. One key change we made to our usual discussion group approach was to solicit participants' reflections anonymously, prior to each discussion. We did this because we felt this topic was particularly likely to elicit responses that participants might be uncomfortable sharing publicly, and we felt it was important to discuss those responses. Reflecting on the assumptions we bring to our DEI work is important, and this begins with reflection on our biases.

Book club participants reported making evidence-based adjustments to their own teaching practices in several ways: adding values affirmation exercises to their courses; giving students feedback on assignments that combine the messages of high standards with an expectation that the student can meet them; explicitly teaching students to have a growth mindset – that is, understanding that they can develop the skills of a scientist through practice. Several SAGE 2YC teams shared what they learned from the *Whistling Vivaldi* book club with their colleagues by reproducing part or all of the book club experience on their own campuses.

Sense of belonging journal club

We ran SAGE 2YC journal clubs on broadening participation in STEM, developing students' science identity, and fostering students' sense of belonging. Whether students feel they "belong" has a significant impact on their course of study and choice of career path (e.g., Good et al., 2012; Tellhed et al., 2017; Walton & Cohen, 2007). To develop inclusive departments, we need to pay attention to who feels a sense of belonging – and to who does not – and use evidence-based strategies to foster a sense of belonging in our students. Fortunately, the research literature presents an array of successful strategies from which to choose. When we ran this journal club, participants read two articles prior to the first discussion to establish some common knowledge about key concepts. After that, however, each participant chose their own reading(s) and reported what they learned to the larger group. You can see the details of how this worked on the project website: https://serc.carleton.edu/sage2yc/series/belonging.html. We used this approach because our participants teach at a wide variety of two-year colleges, in distinctly different settings, with distinctly different student populations. However, it would also be a strong strategy for a departmental discussion group that wants to take a "jigsaw" approach to accessing a broad range of literature.

Journal club participants reported making a variety of evidence-based changes to support their students' sense of belonging. For example, participants reported explicitly teaching their students about metacognition and growth mindset or implementing a values affirmation activity. One participant updated departmental displays to showcase student research and to provide information about interdisciplinary student groups and activities, and noted that both of these improvements made the displays more inclusive of under-represented populations. Many SAGE 2YC teams shared what they learned from this journal club with their colleagues through workshops they led on their campuses or in their regions.

Scientist spotlights implementation group

SAGE 2YC implementation groups differ from our book clubs and journal clubs in one essential way: participants are already familiar with the research on the topic at hand. For example, our Scientist Spotlights implementation group built on SAGE 2YC faculty participants' familiarity with, and deep interest in, research on developing students' science identity. In particular, our participants knew about the work of Jeff Schinske and colleagues, using "scientist spotlights" to highlight the contributions of scientists who belong to groups that have historically been underrepresented in STEM (Schinske et al., 2016). We have referenced Schinske et al.'s work in workshops and also in the journal club on developing students' science identity. The goal of the implementation discussion group, then, is to provide participants with the time, opportunity, and support to develop plans to incorporate "scientist spotlights" into their own courses, as well as to provide peer feedback on those plans. This might entail developing new scientist spotlights, or it might mean finding existing spotlights on the Scientist Spotlights project website (https://scientistspotlights.org) or from other, similar sources. You can see how we structured this discussion series on our website: https://serc.carleton.edu/sage2yc/series/spotlights.html.

SAGE 2YC faculty "change agents" have implemented scientist spotlights in a variety of ways, ranging from incorporating information on the scientists in parallel with the science topics covered in courses to incorporating assignments that require students to learn about scientists on their own. One change agent developed a set of posters showcasing a diverse array of geoscience alumni. Her "Just Like Me" posters are used in classrooms, outreach events, and advising offices (Resnick et al., 2019). Another change agent had his students research scientists who belong to groups that have been historically underrepresented and produce short videos about the scientists (Voorhees, 2018). A third change agent updated departmental displays to showcase diverse alumni who are now professional geoscientists (Tvelia, 2019). All of these journal club participants developed their own individualized, context-specific plans to incorporate scientist spotlights into their courses.

Efficacy of discussion series

At the end of each SAGE 2YC discussion series, we invite participants to complete an end-of-event evaluation survey.

Of the 32 participants in the discussion groups described in this paper, 21 (66%) completed the end-of-series survey. All (100%) of the respondents selected "agree" or "tend to agree" that the discussion series facilitated the exchange of ideas among participants, engaged them in active learning, and met the stated goals. Survey responses demonstrate a depth of learning and an appreciation for the structure and format of the discussions. Many respondents cited learning about the topic of the series as one of the most valuable aspects of participation. For example, book club participants reported an increased awareness of stereotype threat and its impact on student academic performance. One wrote, "The book made me far more aware of how stereotypes might affect a student's performance even if my actions are not necessarily negative. This made me aware of many subtle, inadvertent ways my classes may reinforce these stereotypes." Similarly, another participant wrote, "Becoming exposed to the research presented in the book *Whistling Vivaldi* really opened my eyes further to the topics of bias, identity threat, stereotypes, etc on a topic that I thought I was already well versed in." Yet another wrote that reading this book "opened my eyes to many aspects of stereotyping that I had not considered before." A second theme in the comments about what was most valuable to participants was the structure and format of the series, including the opportunity to discuss the readings, and related questions, with their colleagues. One participant also reported discussing what they were learning with their Vice President, including "what we are doing in our department to increase participation, and the success(es) and difficulties we have had."

Conclusions: Recommendations and resources

Ibram X. Kendi writes (2019, p. 208) that the route to cultural transformation isn't through education; it's through policy. We think that both are essential. We have seen the power of learning to motivate faculty to work for transformative change (e.g., Kastens & Manduca, 2017; Macdonald et al., 2019; Manduca et al., 2017; McDaris et al., 2019b; Ormand et al., 2011). Nonetheless, we won't transform the culture of geoscience, and of geoscience departments, until we change our policies and practices. Our first recommendation, then, is to identify opportunities to incentivize systemic change (McGee, 2020, p. 136). Enlisting the support of those in power – tenured faculty, the department chair, a Dean, a higher level administrator – is one strategy for developing those incentives.

Develop a departmental community committed to diversity, equity, and inclusion

Changing departmental policies and practices requires a dedicated community of champions for diversity – a community of practice focusing on DEI - working together over time. We know from SAGE 2YC that discussion groups can provide a mechanism for building such a community and for sustaining its efforts (Bragg et al., 2020). You don't need to have this community to begin the work; the work can help you find and develop the community. Figure 1 illustrates the iterative process we used throughout the SAGE 2YC project.

Gather and interrogate relevant data

Do your course enrollments match the demographics of your institution? SAGE 2YC faculty participants have identified demographic gaps in their enrollments and have made changes to their course offerings, course content, and course descriptions to attract a more diverse population of students into their courses or programs (e.g., Anders & Boryta, 2019; Bair, 2019; Benford et al., 2019; Layou, 2019; Leinbach et al., 2019; Mrofka & Walker, 2019; Resnick et al., 2019; Tvelia, 2019; Woodall & Braley, 2019). Do your course-level outcomes data indicate equity gaps? Some SAGE 2YC faculty participants have identified equity gaps in their courses and have made changes to their teaching to better support the academic success of under-represented student populations, with significant success in closing the equity gaps (Bair, 2019; Bragg et al., 2020). A few SAGE 2YC faculty members have needed the support of an institutional administrator, such as a Dean, in obtaining the data they needed from their institutional research offices, but most have been able to obtain these data without such assistance (Bragg, pers. comm.). Information about how participants in the SAGE 2YC project have interrogated their data – and the template they used to do so – are available on the SAGE 2YC website: https://serc.carleton.edu/sage2yc/course_data.html.

Question your departmental assumptions and norms

Where do your curricula present unequal barriers to different demographic groups? What alternatives could you offer that would create equivalent opportunities for learning without the barriers? Or how could you eliminate the barriers entirely? What can your department do to ensure that students who belong to under-represented groups are able to learn in an inclusive, supportive environment, free of microaggressions, harassment, bullying, and other forms of intimidation, in the classroom, in the lab, and in the field? How can your department eliminate financial barriers associated with learning in the field? What can you do to ensure that students with disabilities have equal access to learning? What subconscious messages are hidden in your hallway displays about who does geoscience and where it is done? What messages are conveyed by your departmental website? Who are your seminar speakers? Who in your department receives awards and scholarships? Do your courses downplay the colonial history of geological exploration? Do you teach your students about the inequitable impacts of natural hazards on BIPOC (Black, Indigenous, People of Color) communities? If you have graduate students, what are your graduate student admission criteria?

Learn from prior research: Explore effective strategies and develop a plan

There is no shortage of research on the lack of DEI in the geosciences, in STEM, and in higher education. Fortunately, there is also an abundance of research on successful strategies and approaches for improving equity, inclusion, and therefore diversity in STEM, including in the geosciences (e.g., Ballen et al., 2017; Carabajal et al., 2017; Carpi et al., 2017; Eddy & Hogan, 2014; Estrada et al., 2019; Huntoon & Lane, 2007; McDaris et al., 2019a; Núñez et al., 2020; Posselt et al., 2019; Powell et al., 2020; Schinske et al., 2016; Sue et al., 2019; Wolfe & Riggs, 2017). The SAGE 2YC project website includes extensive descriptions of several discussion groups, including reference lists and suggestions for structuring conversations, which you can adopt or adapt to facilitate evidence-based professional development experiences for yourself and your colleagues: https://serc.carleton.edu/sage2yc/faculty_discussions.html. You need not be limited by the topics we have explored; build your discussion group around the topics that are of high interest to you and your colleagues. The URGE project has developed a robust curriculum on racism in the geosciences: https://urgeoscience.org/curriculum/. The ADVANCE-Geo Partnership project website has brief, informative summaries about many DEI-related topics: https://serc.carleton.edu/advancegeo/resources/index.html. The Race and Equity Center at the University of Southern California has a set of racial equity tools designed for educators to use in educating ourselves and transforming our own practices: https://www.cue-tools.usc.edu.

Choose and implement strategies; use data to measure progress

Take a metrics-based approach (e.g., Williams, 2014) to making changes in your department:

1. Set departmental goals for student enrollments, course success rates, and degree completion that reflect institutional demographics;
2. Set a timeline for departmental progress toward those goals;
3. Choose research-based strategies to move your department toward those goals;
4. Evaluate departmental progress at regular intervals and adjust strategies as needed.

The SAGE 2YC project website has a suite of resources that can provide the scaffolding for this work in your department. For example, we have written a detailed description of how our faculty members are using student outcomes data from their institutional research offices to identify equity gaps in their own courses and departments. You, too, can use course-level student outcomes data, in conjunction with institutional enrollment data, to evaluate your own department's successes and failures with respect to attracting and supporting students in your courses.

Make a commitment

The status quo is untenable. Together, we can transform the geosciences. Let's do it.

Acknowledgements

We are indebted to the SAGE 2YC community, including all of the faculty Change Agents as well as the project team, for engaging in this work with us, and to the National Science Foundation for supporting our work. All of the geoscientists we know who belong to one or more historically marginalized groups inspire and motivate us to transform the culture of geoscience. In particular, Drs. Hendratta Ali and Ángel Garcia inspired and galvanized the first author to think deeply about the culture of geoscience departments and what we can do, as members of the community, to transform that culture. This manuscript benefited from the thoughtful and constructive reviews of three anonymous reviewers as well as from JGE's editorial team.

Funding

The *SAGE 2YC: Faculty as Change Agents* project is supported by the National Science Foundation Division of Undergraduate Education under grants 1525593, 1524605, 1524623, 1524800, and 1835935. Any opinions, findings, conclusions, or recommendations expressed in this work are those of the authors and do not necessarily reflect the views of the National Science Foundation.

ORCID

Carol J. Ormand http://orcid.org/0000-0002-1586-1706
R. Heather Macdonald http://orcid.org/0000-0002-0014-8991
Eric M. D. Baer http://orcid.org/0000-0003-0597-9919
Pamela Eddy http://orcid.org/0000-0002-2293-0597

References

Ali, H. N., et al. (2020). Call for a robust anti-racist action plan from all professional geoscience societies and organizations. Retrieved November 9, 2020, from https://www.change.org/p/geoscientists-call-for-a-robust-anti-racism-plan-for-the-geosciences.

Ali, H. N., Sheffield, S. L., Bauer, J. E., Caballero-Gill, R. P., Gasparini, N. M., Libarkin, J., Gonzales, K. K., Willenbring, J., Amir-Lin, E., Cisneros, J., Desai, D., Erwin, M., Gallant, E., Gomez, K. J., Keisling, B. A., Mahon, R., Marín-Spiotta, E., Welcome, L., &., & Schneider, B. (2021). An actionable anti-racism plan for geoscience organizations. *Nature Communications*, *12*(1), 3794. https://doi.org/10.1038/s41467-021-23936-w

Anadu, J., Ali, H., & Jackson, C. (2020). Ten steps to protect BIPOC scholars in the field. Eos, 101. https://doi.org/10.1029/2020EO150525

Anders, T.-M., & Boryta, M. (2019). Making waves – increasing the visibility of ocean sciences at 2YCs in spite of one-course offerings. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 110-7. https://doi.org/10.1130/abs/2019AM-339985

Asai, D. J. (2020). Race matters. *Cell*, *181*(4), 754–757. https://doi.org/10.1016/j.cell.2020.03.044

Bair, A. R. (2019). Supporting and advancing geoscience education at a 2YC: Lessons from the SAGE 2YC – Faculty as change agents project at delta college. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 98-11. https://doi.org/10.1130/abs/2019AM-339239

Ballen, C. J., Wieman, C., Salehi, S., Searle, J. B., & Zamudio, K. R. (2017). Enhancing diversity in undergraduate science: Self-efficacy drives performance gains with active learning. *CBE- Life Sciences Education*, *16*(4), ar56. https://doi.org/10.1187/cbe.16-12-0344.

Beane, R. J., Baer, E. M. D., Lockwood, R., Macdonald, R. H., McDaris, J. R., Morris, V. R., Villalobos, I. J., & White, L. D. (2021). Uneven increases in racial diversity of US geoscience undergraduates. *Communications Earth & Environment*, *2*(1), 126. https://doi.org/10.1038/s43247-021-00196-6

Beane, R. J., McNeal, K. S., & Macdonald, R. H. (2019). Probing the National Geoscience Faculty Survey for reported use of practices that support inclusive learning environments in undergraduate courses. *Journal of Geoscience Education*, *67*(4), 427–445. https://doi.org/10.1080/10899995.2019.1621714

Bell, R., Lozier, S. (2020). AGU commits to 8 action areas to combat systemic racism. Retrieved November 9, 2020, from https://fromtheprow.agu.org/agu-commits-to-8-action-areas/.

Benford, B. A., Spears, C. L., & Smith, J. (2019). Active learning with a three-dimensional man-made outcrop advances geological education at a two-year college - Lone Star. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 154-10. https://doi.org/10.1130/abs/2019AM-332119

Bensimon, E. M., Dowd, A. C., Witham, K. (2016). Five principles for enacting equity by design. Retrieved December 7, 2020, from https://www.aacu.org/diversitydemocracy/2016/winter/bensimon.

Bensimon, E. M., Rueda, R., Dowd, A. C., & Harris, F.III, (2007). Accountability, equity, and practitioner learning and change. *Metropolitan*, *18*(3), 28–45.

Bernard, R. E., & Cooperdock, E. H. (2018). No progress on diversity in 40 years. *Nature Geoscience*, *11*(5), 292–295. https://doi.org/10.1038/s41561-018-0116-6

Bragg, D., Bennett, S., & McCambly, H. (2016). Introduction to Pathways to Results. (Rev. ed.). Office of Community College Research and Leadership, University of Illinois at Urbana-Champaign.

Bragg, D., Eddy, P., Iverson, E. R., Hao, Y., & O'Connell, K. (2020). The final report for Supporting and Advancing Geoscience Education in Two-Year Colleges (SAGE 2YC): Lessons from a major NSF investment in geoscience education.

Bragg, D., McCambly, H. (2018). Equity-minded change leadership. https://www.washington.edu/ccri/equity-mindedbrief/.

Cakmakci, G., Tosun, O., Turgut, S., Orenler, S., Sengul, K., & Top, G. (2011). Promoting an inclusive image of scientists among students: Towards research evidence-based practice. *International Journal of Science and Mathematics Education*, *9*(3), 627–655. https://doi.org/10.1007/s10763-010-9217-4

Callahan, C. N., LaDue, N. D., Baber, L. D., Sexton, J., van der Hoeven Kraft, K. J., & Zamani-Gallaher, E. M. (2017). Theoretical perspectives on increasing recruitment and retention of underrepresented students in the geosciences. *Journal of Geoscience Education*, *65*(4), 563–576. https://doi.org/10.5408/16-238.1

Carabajal, I. G., Marshall, A. M., & Atchison, C. L. (2017). A synthesis of instructional strategies in geoscience education literature that address barriers to inclusion for students with disabilities. *Journal of Geoscience Education*, *65*(4), 531–541. https://doi.org/10.5408/16-211.1

Carpi, A., Ronan, D. M., Falconer, H. M., & Lents, N. H. (2017). Cultivating minority scientists: Undergraduate research increases self-efficacy and career ambitions for underrepresented students in STEM. *Journal of Research in Science Teaching*, *54*(2), 169–194. https://doi.org/10.1002/tea.21341

Chambers, D. W. (1983). Stereotypic images of the scientist: The draw-a-scientist test. *Science Education*, *67*(2), 255–265. https://doi.org/10.1002/sce.3730670213

Cleveland, D. R., Sailes, D. J., Gilliam, D. E., & Watts, J. (2018). A theoretical focus on cultural axation: Who pays for it in higher education. *Advances in Social Sciences Research Journal*, *5*(10), 95-98. https://doi.org/10.14738/assrj.510.5293

Cox, M. D. (2004). Introduction to faculty learning communities. *New Directions for Teaching and Learning*, *2004*(97), 5–23. https://doi.org/10.1002/tl.129

Davis, W., Pape-Lindstrom, P., Reiness, G. (2020). Enabling change agents with systems thinking tools. Webinar presented by the Accelerating Systemic Change in STEM Higher Education Network. Recording available at https://ascnhighered.org/ASCN/webinars/2020/systems_thinking/index.html.

Dowd, A. C., & Bensimon, E. M. (2014). *Engaging the race question: Accountability and equity in U.S. higher education*. Teachers College Press.

Dutt, K. (2020). Race and racism in the geosciences. *Nature Geoscience*, *13*(1), 2–3. https://doi.org/10.1038/s41561-019-0519-z

Eddy, P., Iverson, E., Hao, Y., Bragg, D., & O'Connell, K. (2019 *Faculty as leaders: Building innovative and sustainable change in community colleges*. Research Symposium at the 61st Annual Council for the Study of Community Colleges Conference, San Diego, CA.

Eddy, S. L., & Hogan, K. E. (2014). Getting under the hood: How and for whom does increasing course structure work? *CBE Life Sciences Education*, *13*(3), 453–468.

Egger, A. (2020). NAGT's Continued Efforts to Fight Racial Injustice. Retrieved November 9, 2020, from https://nagt.org/nagt/news/9_29_2020.html.

Engin, M., & Atkinson, F. (2015). Faculty learning communities: A model for supporting curriculum changes in higher education. *International Journal of Teaching and Learning in Higher Education*, *27*(2), 164–174.

Estrada, M., Young, G. R., Nagy, J., Goldstein, E. J., Ben-Zeev, A., Márquez-Magaña, L., & Eroy-Reveles, A. (2019). The influence of microaffirmations on undergraduate persistence in science career pathways. *CBE Life Sciences Education*, *18*(3), ar40–15.

Gewin, V. (2020). The time tax put on scientists of colour. *Nature*, *583*(7816), 479–281. https://doi.org/10.1038/d41586-020-01920-6

Gonzales, L. (2019). Participation of women in the geoscience profession. Geoscience Currents Data Brief 15. American Geosciences Institute. 1–2.

Gonzales, L., & Keane, C. (2020). Diversity in the Geosciences, Geoscience Currents Data Brief 2020-023, American Geosciences Institute, 1–5.

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology*, *102*(4), 700–717. https://doi.org/10.1037/a0026659

Harris, F., III,. & Bensimon, E. M. (2007). *Responding to the realities of race on campus: New directions for student services* (Vol. 120, pp. 77–84). Wiley.

Hill, C., Corbett, C., & St. Rose, A. (2010). *Why so few? Women in science, technology, engineering, and mathematics*. American Association of University Women.

Hofstra, B., Kulkarni, V. V., Munoz-Najar Galvez, S., He, B., Jurafsky, D., & McFarland, D. A. (2020). The diversity-innovation paradox in science. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(17), 9284–9291. https://doi.org/10.1073/pnas.1915378117

Holmes, M. A., & O'Connell, S. (2004). Where Are the Women Geoscience Professors? Leaks in the Geoscience Pipeline. Report of a joint NSF/AWG workshop, Sept. 25–27, 2003, 44. pp. Retrieved November 11, 2020, from Untitled.

Hong, L., Page, S. E. (2004). Groups of diverse problem solvers can outperform groups of high-ability problem solvers. *Proceedings of the National Academy of Sciences*, *101*, 16385–16389.

Houttuijn Bloemendaal, L., Matos, K., Walters, K., & Sengupta, A. (2020). Raising our voices for diversity in the geosciences. *Eos*, 101. https://doi.org/10.1029/2020EO150436

Hughes, B. E. (2018). Coming out in STEM: Factors affecting retention of sexual minority STEM students. *Science Advances*, *4*(3), eaao6373. https://doi.org/10.1126/sciadv.aao6373

Huntoon, J., & Lane, M. J. (2007). Diversity in the geosciences and successful strategies for increasing diversity. *Journal of Geoscience Education*, *55*(6), 447–457. https://doi.org/10.5408/1089-9995-55.6.447

Iverson, E. R., Bragg, D., & Eddy, P. L. (2020). How faculty change agents enact midlevel leadership in STEM. *New Directions for Community Colleges*, *2020*(191), 67–79. https://doi.org/10.1002/cc.20407

Iverson, E. R., Lee, S., Ormand, C. J., Feiss, G., Macdonald, R. H., Manduca, C. A., & Richardson, R. (2011). Building strong geoscience departments: Case studies and findings from six years of programming. American Geophysical Union fall meeting, San Francisco, CA.

Iverson, E. R., McDaris, J., Ormand, C. J., & Macdonald, R. H. (2017). Supporting and Advancing Geoscience Education in Two-Year Colleges (SAGE 2YC): Building a foundation for change through a network of regional communities of practice. Poster presented at the Earth Educators' Rendezvous, Albuquerque, NM.

James, B. R. (2019). Supporting academic success, facilitating professional pathways, and broadening participation of 2YC students in an online classroom environment. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 110-1. https://doi.org/10.1130/abs/2019AM-341193

Kastens, K. A. (2016). What Makes a "Community of Practice" Effective? Presentation at the Earth Educators' Rendezvous, Madison, WI. Presentation retrieved April 26, 2017, from http://serc.carleton.edu/earth_rendezvous/2016/program/morning_workshops/w3/program.html.

Kastens, K., & Manduca, C. A. (2017). Leveraging the power of a community of practice to improve teaching and learning about the Earth. *Change: The Magazine of Higher Learning*, *49*(6), 14–22. https://doi.org/10.1080/00091383.2017.1398997

Kendi, I. X. (2019). *How to Be An Antiracist*. One World Publishing.

Kezar, A., & Lester, J. (2020). Grassroots leadership: Making the invisible visible. In A. Kezar & J. Lester (Eds.), *Enhancing campus capacity for leadership* (pp. 3–28). Stanford University Press.

Kuh, G. D. (2008). *High-impact educational practices: What they are, who has access to them, and why they matter* (pp. 44). Association of American Colleges & Universities.

Layou, K. M. (2019). Encouraging science identity through geoscience career exposure. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 154-6. https://doi.org/10.1130/abs/2019AM-336557

Leinbach, A. A., Miller, G. L., & Rollins, S. M. (2019). Change agents facilitate impactful transformations to geoscience classrooms. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 98-10. https://doi.org/10.1130/abs/2019AM-339947

Macdonald, R. H., Beane, R. J., Baer, E. M. D., Eddy, P. L., Emerson, N. R., Hodder, J., Iverson, E. R., McDaris, J. R., O'Connell, K., & Ormand, C. J. (2019). Accelerating change: The power of faculty change agents to promote diversity and inclusive teaching practices. *Journal of Geoscience Education*, *67*(4), 330–339. https://doi.org/10.1080/10899995.2019.1624679

Manduca, C. A., Iverson, E. R., Luxenberg, M., Macdonald, R. H., McConnell, D. A., Mogk, D. M., & Tewksbury, B. J. (2017). Improving undergraduate STEM education: The efficacy of discipline-based professional development. *Science Advances*, *3*(2), e1600193i. https://doi.org/10.1126/sciadv.1600193

Marín-Spiotta, E., Barnes, R. T., Berhe, A. A., Hastings, M. G., Mattheis, A., Schneider, B., & Williams, B. M. (2020). Hostile climates are barriers to diversifying the geosciences. *Advances in Geosciences*, *53*, 117–127. https://doi.org/10.5194/adgeo-53-117-2020

McDaris, J. R., Iverson, E. R., Manduca, C. A., & Huyck Orr, C. (2019a). Teach the Earth: Making the connection between research and practice in broadening participation. *Journal of Geoscience Education*, *67*(4), 300–312. https://doi.org/10.1080/10899995.2019.1616272

McDaris, J. R., Macdonald, R. H., Ormand, C. J., Iverson, E. R., Baer, E. M. D., & Hodder, J. (2019b). Increasing diversity, equity, and inclusion in two-year college geoscience: Lessons learned from the SAGE 2YC project. American Geophysical Union Fall Meeting, San Francisco, CA.

McGee, E. O. (2020). *Black, Brown, Bruised: How Racialized STEM Education Stifles Innovation*. Harvard Education Press.

Medin, D. L., Lee, C. D. (2012). Diversity makes better science. Association for Psychological Science. https://go.nature.com/2EixIJk.

Miles, M. L., Brockman, A. J., & Naphan-Kingery, D. E. (2020). Invalidated identities: The disconfirming effects of racial microaggressions on Black doctoral students in STEM. *Journal of Research in Science Teaching*, *57*(10), 1608–1631. https://doi.org/10.1002/tea.21646

Morales, A., Walker, C. L., Carroll-Smith, D. L., & Burt, M. A. (2021). Code-switching and assimilation in STEM culture. *Eos*, 102. https://doi.org/10.1029/2021EO161232

Morris, V., White, L., Fuentes, J. D., Atchinson, C. L., Smythe, W. F., Burt, M., Williams, L., Tripati, A., Demoz, B. B., Armstrong, R. (2020). *A call to action for an anti-racist science community from geoscientists of color: listen, act, lead*. Retrieved December 10, 2020 from https://notimeforsilence.org/

Mrofka, D. D., & Walker, B. (2019). Institutional impact of the SAGE 2YC Change Agent program: Facilitating pathways. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 154-8. https://doi.org/10.1130/abs/2019AM-340424

National Center for Science and Engineering Statistics (NCSES). (2019). *Women, minorities, and persons with disabilities in science and engineering*. https://ncses.nsf.gov/pubs/nsf19304/.

Núñez, A.-M., Rivera, J., & Hallmark, T. (2020). Applying an intersectionality lens to expand equity in the geosciences. *Journal of Geoscience Education*, *68*(2), 97–114. https://doi.org/10.1080/10899995.2019.1675131

O'Brien, L. T., Blodorn, A., Adams, G., Garcia, D. M., & Hammer, E. (2015). Ethnic variation in gender-STEM stereotypes and STEM participation: An intersectional approach. *Cultural Diversity & Ethnic Minority Psychology*, *21*(2), 169–180.

Olcott, A. N., & Downen, M. R. (2020). The challenges of fieldwork for LGBTQ+geoscientists. *Eos*, 101. https://doi.org/10.1029/2020EO148200

Ormand, C. J. (2017). Women and Minorities in Science and Engineering. *SAGE Musings: The SAGE 2YC Project Blog*. Retrieved November 12, 2020, from https://serc.carleton.edu/sage2yc/musings/NSFdata2017.html.

Ormand, C. J., Macdonald, R. H., Baer, E. M. D., Emerson, N. R., Hodder, J., McDaris, J. R., & O'Connell, K. (2020). Engaging your faculty colleagues in evidence-based practices using SAGE 2YC resources: Book clubs, journal clubs, and implementation groups: Earth Educators' Rendezvous (Virtual conference).

Ormand, C. J., Macdonald, R. H., McDaris, J. R., Hodder, J., Baer, E. M. D., & Emerson, N. R. (2019). SAGE 2YC virtual professional development for geoscience faculty in two-year colleges: Engaging faculty in exploration of evidence-based practices. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 110-9. https://doi.org/10.1130/abs/2019AM-334061.

Ormand, C., Manduca, C. A., Macdonald, R. H., Bralower, T., Clemens-Knott, D., Doser, D., Feiss, G., Rhodes, D., Richardson, R., & Savina, M. (2011). Building strong geoscience departments through the visiting workshop program. American Geophysical Union fall meeting, San Francisco, CA.

Pascoe, E. A., & Richman, L. S. (2009). Perceived discrimination and health: A meta-analytic review. *Psychological Bulletin*, *135*(4), 531–554. https://doi.org/10.1037/a0016059

Popp, A. L., Hall, C. A., & Yilmaz, Y. A. (2020). How to combat bullying and discrimination in the geosciences. *Eos*, 101. https://doi.org/10.1029/2020EO151914

Posselt, J. R., Chen, J., Dixon, P. G., Jackson, J. F. L., Kirsch, R., Nuñez, A.-M., & Teppen, B. J. (2019). Advancing inclusion in the geosciences: An overview of the NSF-GOLD program. *Journal of Geoscience Education*, *67*(4), 313–319. https://doi.org/10.1080/10899995.2019.1647007

Powell, K., Terry, R., & Chen, S. (2020). How LGBT + scientists would like to be included and welcomed in STEM workplaces. *Nature*, *586*(7831), 813–816.

Quardokus Fisher, K., Kaufman, K., Calagna, O., Myles, L., Brinkworth, C., Simmons, D. R., & Dixon, P. G. (2019). Developing scientists as champions of diversity to transform the geosciences. *Journal of Geoscience Education*, *67*(4), 459–471. https://doi.org/10.1080/10899995.2019.1618692

Quaye, S. J., Karikari, S. N., Rashad Allen, C., Kwamogi Okello, W., & Demere Carter, K. (2019). Strategies for practicing self-care from racial battle fatigue. *Journal Committed to Social Change on Race and Ethnicity*, *5*(2), 95–131. https://doi.org/10.15763/issn.2642-2387.2019.5.2.94-131.

Resnick, C. E., Bauer, J. E., & Lam, A. R. (2019). Building 2YC students' science identities through digital media to broaden participation in the geosciences. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 154-7. https://doi.org/10.1130/abs/2019AM-340847

Sawyer, P. J., Major, B., Casad, B. J., Townsend, S. S. M., & Mendes, W. B. (2012). Discrimination and the stress response: Psychological and physiological consequences of anticipating prejudice in interethnic interactions. *American Journal of Public Health*, *102*(5), 1020–1026. https://doi.org/10.2105/AJPH.2011.300620

Schinske, J. N., Perkins, H., Snyder, A., & Wyer, M. (2016). Scientist spotlight homework assignments shift students' stereotypes of scientists and enhance science identity in a diverse introductory science class. *CBE-Life Sciences Education*, *15*(3), ar47. https://doi.org/10.1187/cbe.16-01-0002

Sidder, A. (2017). Geosciences make modest gains but still struggle with diversity. *Eos*, 98(7). https://doi.org/10.1029/2017EO071093

Sue, D. W., Alsaidi, S., Awad, M. N., Glaeser, E., Calle, C. Z., & Mendez, N. (2019). Disarming racial microaggressions: Microintervention strategies for targets, White allies, and bystanders. *American Psychologist*, *74*(1), 128–142. https://doi.org/10.1037/amp0000296

Tellhed, U., Bäckström, M., & Björklund, F. (2017). Will I fit in and do well? The importance of social belongingness and self-efficacy for explaining gender differences in interest in STEM and HEED majors. *Sex Roles*, *77*(1), 86–96. https://doi.org/10.1007/s11199-016-0694-y

Tsui, L. (2007). Effective strategies to increase diversity in STEM fields: A review of the research literature. *The Journal of Negro Education*, *76*(4), 555–581.

Tvelia, S. (2019). Creating community and growing programs at community colleges: A legacy of SAGE 2YC and the contributions of Heather Macdonald. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 154-1. https://doi.org/10.1130/abs/2019AM-339347

Voorhees, D. H. (2018). Improving science identity through videos. *Geological Society of America Abstracts with Programs*, *50*(6), abstract no. 132-4. https://doi.org/10.1130/abs/2018AM-317963

Walker, B., & Mrofka, D. D. (2017). Development of a geotechnician certificate program for community college students: A potential pathway for the recruitment and retention of a diverse geoscience workforce. *Geological Society of America Abstracts with Programs*, *49*(6), abstract no. 18-9. https://doi.org/10.1130/abs/2017AM-302226

Walker, D., Dutrow, B. (2020). *Advancing GSA's mission toward greater diversity, equity, and inclusion*. Retrieved November 9, 2020, from https://www.geosociety.org/GSA/News/GSA/News/message-board.aspx.

Walton, G. M., & Cohen, G. L. (2007). A question of belonging: Race, social fit, and achievement. *Journal of Personality and Social Psychology*, *92*(1), 82–96.

Wenger-Trayner, E., Wenger-Trayner, B. (2015). *Introduction to communities of practice: A brief overview of the concept and its uses*. https://wenger-trayner.com/introduction-to-communities-of-practice/.

Williams, J. C. (2014). Hacking tech's diversity problem. *Harvard Business Review*, *92*(10), 94–100.

Williams, J., Phillips, C., Hall, K. W., & V, E. (2014). *Double Jeopardy? Gender bias against women of color in science*. WorkLifeLaw. https://doi.org/10.13140/2.1.1763.8723

Wilson. (2019). *2018 Report on the Status of the Geoscience Workforce* (p. 178). American Geosciences Institute.

Wolfe, B. A., & Riggs, E. M. (2017). Macrosystem analysis of programs and strategies to increase underrepresented populations in the geosciences. *Journal of Geoscience Education*, *65*(4), 577–593. https://doi.org/10.5408/17-256.1

Woodall, D., & Braley, K. (2019). Building the geosciences in a Florida 2YC via faculty as change agents. *Geological Society of America Abstracts with Programs*, *51*(5), abstract no. 110-5. https://doi.org/10.1130/abs/2019AM-339237