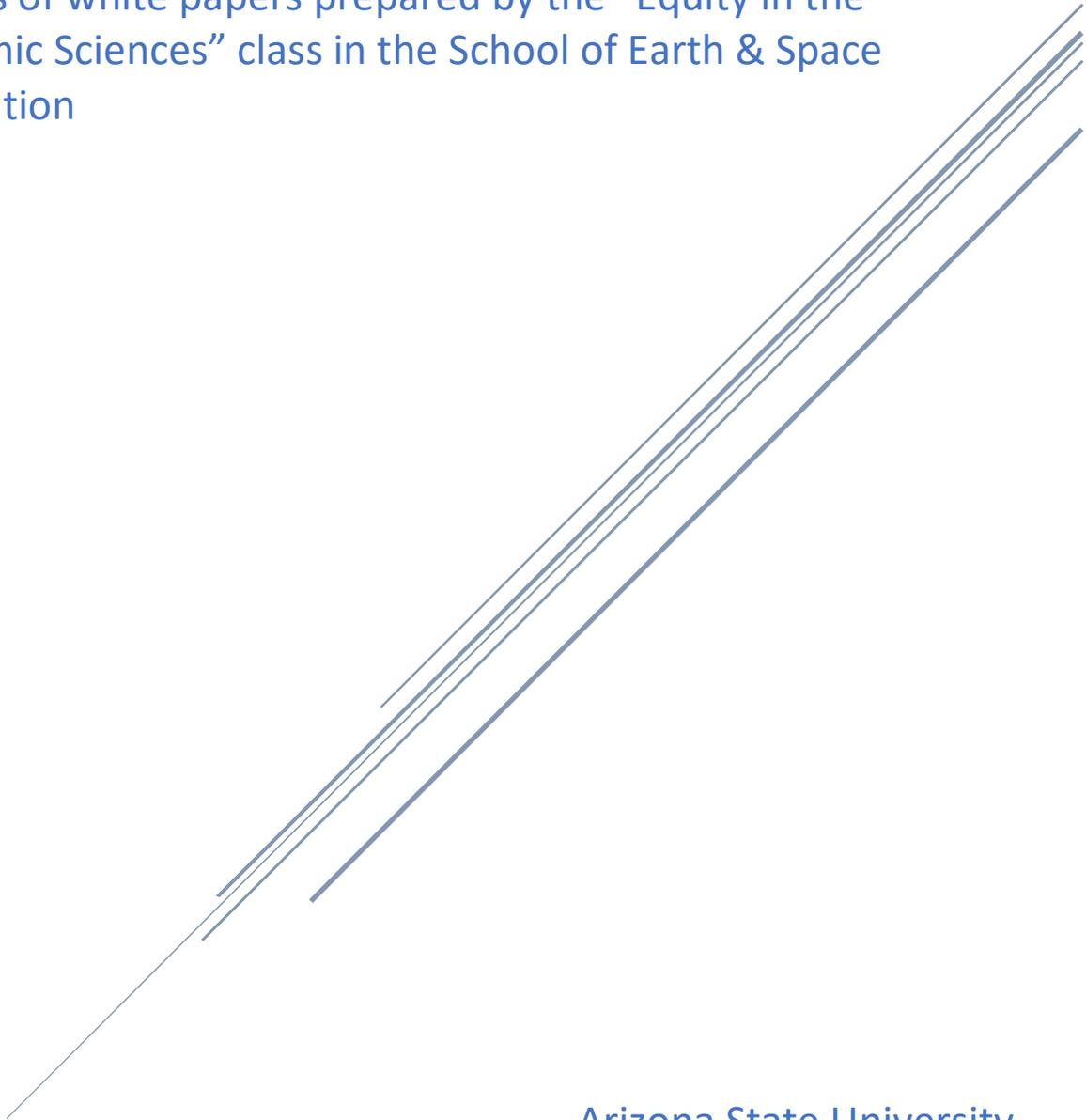


RECOMMENDATIONS FOR IMPROVING EQUITY & INCLUSION IN THE ACADEMIC SCIENCES

A series of white papers prepared by the “Equity in the Academic Sciences” class in the School of Earth & Space Exploration



Arizona State University
Fall 2020

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Description

Over the course of the Fall 2020 semester, each student enrolled in SES 494/598 “Equity in the Academic Sciences”, a course offered in the School of Earth & Space Exploration (SESE) at Arizona State University (ASU), conducted a semester-long research project on a topic of their choosing on how to make our academic scientific communities, systems, and structures more equitable and inclusive. Each week the students found and read at least one piece of primary literature summarizing research on their chosen topic and/or conducted interviews to gather information about the current state of relevant systems and practices within SESE and ASU, and then identified their natural next question to guide their research the following week. In class, the students presented their research findings, synthesized their research into recommendations, and refined their natural next questions with feedback from the group each week, following a course inquiry cycle primarily developed by the Interplanetary Initiative at ASU and Beagle Learning. Through this process they built self-guided research skills and engaged with a variety of education, physical and social sciences literature on these topics. At the conclusion of the semester, the students synthesized their research into the following series of White Papers that summarize their research topic and resulting recommendations, along with a one page infographic.

-- Dr. Christy B. Till (Course Instructor)
SESE Associate Professor
SESE Associate Director for an Inclusive Community
December 2020

Author Biographies

Alexa R. Drew is an Astrobiology Ph.D. student at Arizona State University who is interested in researching the search for life, the origin of life, and Jupiter's moon, Europa. After obtaining her Ph.D. she hopes to work on a Europa related mission before transitioning into politics so that she can promote policies of science, education, equity, and inclusion.

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Helen Madeen is a Geological Science M.S. student at Arizona State University. She is interested in geomicrobiology, particularly, microbe interactions and carbon assimilation modes utilized by microbes in the deep subsurface.

Claire Richardson is a Geological Sciences PhD student at Arizona State University. She studies 3D global mantle structure with a focus on improving the quality of seismic data measurements and sharpening seismic images of Earth's mantle.

Course Instructor Biography

Dr. Christy B. Till is a geologist who teaches classes and leads a multidisciplinary research program on the role of magma in the formation and evolution of planets, known as the E.P.I.C. lab. Dr. Till is also the current Associate Director for an Inclusive Community in the School of Earth & Space Exploration, where she works to empower and facilitate individual action, dialog, education, long-term planning and systemic change around JEDI in the School and chairs the School's JEDI Task Force.

Creating Inclusivity to Improve Retention for Minoritized Students in SESE
Alexa R. Drew, Ph.D. Student in School of Earth and Space Exploration

Executive Summary

Although diversity in academia has increased, inclusivity, or the feeling that an individual belongs, has not. Feelings of being on the outside and of a lack of safety impact minoritized students by decreasing their persistence, especially in STEM fields. As a result, their probability of graduating and pursuing a higher degree or career in STEM is reduced. Numerous barriers prevent inclusivity and thus retention, but universities have found solutions to these such as hiring diverse staff, bringing awareness to biases, restructuring courses, and so on. This paper will discuss issues of inclusivity in academia before sharing recommendations that can be adapted by the School of Earth and Space Exploration and its goal of promoting JEDI efforts.

Problem Statement

For decades, universities have taken action to encourage campus diversity by recruiting from minoritized groups. These efforts have increased the number of minoritized students, but they do not experience the same level of retention as white, male students, and especially for STEM degree programs¹. For instance, 20% of Latino and 40% of Black students in first-year natural science majors will not earn their degree, while the loss is only 1.5% and 7% for white and Asian students respectively². Similarly, 59% of full-time, first-year, white students will graduate with their bachelor's within six years, whereas only about 38% of Black students will do the same³.

These issues of retention arise because although diversity has increased, feelings of inclusion have not⁴. Research from College K, or the Kalamazoo College in Michigan, shows that minoritized students define inclusion as feeling safe and that they belong, but often face the opposite of this in college. Common experiences include microaggressions, harassment, and a refusal from institutes and faculty alike to acknowledge their struggles, many of which are systemic⁴. When these issues arise, minoritized students can feel unwelcome and overwhelmed, which decreases persistence, confidence, and chances of a future STEM career¹⁻⁵.

Rather than examine the environment of STEM academia, the onus of failure is often placed on the student which can further exacerbate issues of representation and retention¹. Ultimately then, this diversity will not last and retention issues will only worsen over time if change is not made to create more inclusive communities in academia. One such way universities have attempted to address this is to recruit more diverse faculty¹, but ASU's School of Earth and Space Exploration is already working on this. Therefore, this white paper will instead focus on the many other possible recommendations that SESE can use to continue striving for inclusive excellence and inspiring positive campus-wide change.

Recommendations

This list has primarily been modeled after the University of Maryland's Meyerhoff Scholars Program (MSP), which continues to be one of the most successful programs in the country for creating inclusive environments⁶. For a broader overview of inclusion, its definition, benefits, barriers, and recommendations, please see Appendix A which contains a distillation infographic.

- 1.) **Consider partnering with MSP's leadership directly.** Schools that have done this have exceeded early MSP metrics with their minoritized students having increased GPA's, being twice as likely to graduate with a BS, and five times more likely to pursue higher education degrees⁵. This was despite the universities being very large or lacking in diversity too, and they credit their success to close communication with MSP leadership⁶.
- 2.) **Raise and commit departmental funds to support JEDI-related goals.** This provides the freedom to pursue JEDI related goals and was key for inclusive excellence according to schools that have replicated the MSP or seen success through similar efforts⁶.
- 3.) **Eliminate confusion by communicating a definition for inclusion that aligns with minoritized group viewpoints** (e.g. feelings of safety & belonging). Schools that fail to do this have higher levels of conflict and harassment between peers, faculty, etc⁴. Research has also shown that quantitative data that highlights the benefits of inclusion can help ease the common fear that objectivity will disappear if accommodations are provided to those that need them⁷. For a list of benefits SESE might use, please see Appendix A.
- 4.) **Consider hiring full-time, experienced, and diverse staff** whose roles focus on creating and promoting inclusive efforts. This has similar effects to hiring diverse faculty in that students see themselves in prominent positions and thus a future in STEM. However, there is also the added benefit that some of the more demanding tasks needed for inclusive change can be shifted to staff and not just faculty. This is particularly valuable since experienced staff will be more familiar with available tools and resources^{6, 8}.
- 5.) **Ensure everyone in SESE undergoes inclusivity and unconscious biases training.** General inclusivity training can help build trust and make students want to stay in their program. This is because most programs teach how to have more productive discussions regarding privilege and other sensitive topics that are known sources of conflict and discomfort^{5,9}. Unconscious biases training, on the other hand, brings awareness to a common set of phenomena that disproportionately affects minoritized students. Implicit prejudices are one such bias that affects up to 75% of people¹⁰. These should be addressed through confidential implicit association tests (See Appendix D) that bring awareness to an individual's biases. Afterward, they can practice opposing these beliefs by negating stereotypes, affirming counter-stereotypes, and priming their thoughts^{2,10}.

- 6.) **Expand on camp SESE by turning it into a longer summer bridge program.** Programs like this are welcoming, build teamwork, and create feelings of belonging, all of which are predicted to increase retention⁸. Activities can be modified as needed using post-camp surveys based on Chavis' sense of community index (See Appendix C), which measures trust, inclusion, etc⁵. Similarly related, holding more informal events in SESE, like celebrations, can create a deep sense of community by humanizing professors, allowing laid back networking, and providing a break from work for students, faculty, and staff^{8,9}.
- 7.) **Restructure classes before they start by reducing their size and applying a moderate structure or active learning format.** Reducing the size of more traditionally challenging courses has been shown to prevent students from dropping a class, as it increases the accessibility of resources (like office hours), combats the "weed out" mentality, and allows professors to allocate their time more equitably³. Applying a moderate structure format is beneficial because it increases performance for all students, but especially for Black and first-generation students who had their achievement gaps halved and eliminated respectively¹¹. For reference, this format spends 15-40% of a class on direct engagement (e.g. clicker questions, worksheets) and the rest lecturing. In addition, this structure has either one graded preparatory assignment (e.g. reading quiz) or one graded review assignment (practice questions) each week, but never both simultaneously. Students in this format report being able to complete more reading assignments, spend more time studying efficiently, and feel an increased sense of community¹¹.
- 8.) **Offer pre-course surveys, timely feedback, non-graded clicker questions, material that refutes STEM stereotypes, and study groups.** Pre-course surveys on day one can assess the resources, previous experience or knowledge, and disabilities held by the class's enrolled students. Results can then be tailored to what learning tools and platforms are made available, which creates a more inclusive environment, allows faculty to practice reflecting on assumptions they make about their students, and reduces class dropout rates^{2,12}. Timely feedback and clicker questions, on the other hand, allow students to track their understanding of course material and learn from their mistakes rather than wait until the day of a test to assess their level of comprehension⁸. Refuting stereotypes about STEM combats imposter syndrome by reshaping a student's belief that only certain types of people or methods belong in their field. This is best done by showcasing relevant achievements of non-traditional scientists, sharing personal challenges about one's own time in STEM, and explaining how science is a non-linear process^{8,13}. Finally, creating study groups can encourage students to not only spend more time on course material but also interact with peers outside their immediate friend groups. Both have benefits for all students, but especially for incoming first-year minoritized students in connecting with others and gaining confidence among their peers.⁸

- 9.) **Draw attention to and/or invest in existing paid research opportunities.** These not only increase feelings of belonging in STEM in general but also provide students with research experience and the ability to support themselves. This is important since many students must find a non-STEM, off-campus job to support themselves, which can be difficult to juggle with classes and may lead to them dropping out¹¹. A few currently existing ASU examples include ASU NASA Space Grant, Fulton Undergraduate Research Initiative (FURI), and School of Life Sciences Undergraduate Research program (SOLUR).
- 10.) **Use surveys and scales to measure progress with results that allow for change when necessary.** An initial survey, for example, might assess items that all of SESE should have access to. Dr. Gaudiano's list of 9 necessary categories to measure for inclusion are helpful to use in a survey of this nature (seeAppendix B). Other surveys might be more specific to the perceived benefits of resources for students over time, such as scholarships, advising, programs, social activities, faculty interaction, and more⁵. Finally, Chemer's Scientific Identity and Self-Efficacy Scales can be used to determine a student's belief that they belong in STEM and have the skills to succeed. Both these scales have been used in the past to measure inclusivity, as students with higher scores tend to report higher feelings of community belonging and a desire to remain in their program¹⁴.

Impact Statement

From the research, it is apparent that inclusion is the missing silver bullet for minoritized student retention in STEM academia. These students have long been forced through an ineffectual pipeline, but change is achievable as evident by the universities that have taken action to address this issue. By following the aforementioned recommendations, SESE can accomplish the same and will in turn see the retention of its minoritized students increase through a rise in graduations. Achievement gaps will be halved or removed entirely¹¹, and minoritized students will see their GPA's increase as a result⁵. They will also find it easier to see a future in STEM for themselves, and thus be more likely to persist through their studies, be twice as likely to graduate with a BS, and five times as likely to pursue a higher education degree⁵. Teamwork and collaborations will get better, and lead to an increase in published papers^{16, 17}. Finally, any developed surveys will show improved student satisfaction and happiness, increased confidence in skills and knowledge, and any other metrics SESE decides to track^{14, 15}. SESE may even well inspire other schools to follow suit, thus increasing retention for more minoritized students and transforming ASU into one of the best universities for students of all backgrounds. This will be especially important in the upcoming years as the demographic landscape is transformed and issues of equity and inclusion become more prominent. These recommendations will bring our actions in alignment with SESE's mission statement of maintaining a team-oriented, positive community that aims to look beyond traditional boundaries, or in this case, rise above them.

Annotated Bibliography

This section contains all referenced material. Each one has a single sentence descriptor, and if applicable, parentheses to dictate the most important sections or pages a reader should focus on.

1.) Provides additional details and expands on many of this white paper's recommendations.

Martinez-Acosta, Veronica G, and Carlita B Favero. "A Discussion of Diversity and Inclusivity at the Institutional Level: The Need for a Strategic Plan." *J Undergrad Neurosci Educ*, vol. 16, no. 3, 2018, p. A252.

2.) Provides an overview of what faculty specifically can do to help create inclusive classrooms.

Killpack, Melón. "Toward Inclusive STEM Classrooms: What Personal Role Do Faculty Play?" *CBE Life Sciences Education*, vol. 15, no. 3, American Society for Cell Biology (ASCB), Sept. 2016, p. es3–, doi:10.1187/cbe.16-01-0020.

3.) Explains how to increase WoC persistence based on their experiences (Discussion).

Booker, Keonya. "Connection And Commitment: How Sense Of Belonging And Classroom Community Influence Degree Persistence For". *International Journal Of Teaching And Learning In Higher Education*, vol 28, no. 1812-9129, 2016, Accessed 19 Nov 2020.

4.) An insightful exploration of different perspectives on inclusivity between student groups.

College, K., 2013. *In Their Own Words: Students' Experiences With Diversity And Inclusion At K Report On Focus Groups And Survey*. [online] Hdl.handle.net. Available at: <<http://hdl.handle.net/10920/30718>>.

5.) Explains the mechanisms behind MSP operations and its successes.

Maton, Kenneth I., et al. "Outcomes and Processes in the Meyerhoff Scholars Program: STEM PhD Completion, Sense of Community, Perceived Program Benefit, Science Identity, and Research Self-Efficacy." *CBE Life Sciences Education*, vol. 15, no. 3, American Society for Cell Biology (ASCB), Sept. 2016, p. ar48–, doi:10.1187/cbe.16-01-0062.

6.) Details how a few schools replicated the MSP and even surpassed its initial success.

Sto. Domingo, Mariano R., et al. "Replicating Meyerhoff for Inclusive Excellence in STEM." *Science (American Association for the Advancement of Science)*, vol. 364, no. 6438, American Association for the Advancement of Science (AAAS), Apr. 2019, pp. 335–37, doi:10.1126/science.aar5540.

7.) Shares how to overcome the struggles of promoting inclusivity when facing resistance.

Sensoy, DiAngelo. "'We Are All for Diversity, but . . .': How Faculty Hiring Committees Reproduce Whiteness and Practical Suggestions for How They Can Change." *Harvard Educational Review*, vol. 87, no. 4, Harvard Education Publishing Group, Dec. 2017, pp. 557–80, doi:10.17763/1943-5045-87.4.557.

8.) Shares detailed recommendations that laid much of the groundwork for this white paper.

Murray, Teri. "Factors That Promote and Impede the Academic Success of African American Students in Prelicensure Nursing Education: An Integrative Review." *Journal of Nursing Education*, vol. 54, no. 9, Sept. 2015, pp. S74–S81, doi:10.3928/01484834-20150814-14.

9.) Shares recommendations based on what helps WoC succeed in school (pg 23 – 27).

Ong, Jaumot-Pascual. "Research Literature on Women of Color in Undergraduate Engineering Education: A Systematic Thematic Synthesis." *Journal of Engineering Education (Washington, D.C.)*, vol. 109, no. 3, John Wiley & Sons, Inc, July 2020, pp. 581–615, doi:10.1002/jee.20345.

10.) Highly recommended; lays out different unconscious biases and how to overcome them.

Banaji, Mahzarin R., Max H. Bazerman, and Dolly Chugh. "How (Un)ethical Are You?" *Harvard Business Review* 81, no. 12 (December 2003).

11.) Explores how changing course structure impacts student success.

Eddy, Hogan. "Getting Under the Hood: How and for Whom Does Increasing Course Structurework?" CBE Life Sciences Education, vol. 13, no. 3, American Society for Cell Biology, Sept. 2014, p. 453–, doi:10.1187/cbe.14-03-0050.

12.) Helpful recommendations for any person serving as a professor, advisor, mentor, etc.

Vaccaro, Camba-Kelsay. "Cultural Competence and Inclusivity in Mentoring, Coaching, and Advising." New Directions for Student Leadership, vol. 2018, no. 158, Wiley Periodicals, Inc, 2018, pp. 87–97, doi:10.1002/yd.20290.

13.) Describes some of the ways faculty can unintentionally deter WoC in STEM.

Johnson, Angela. "Unintended Consequences: How Science Professors Discourage Women of Color." Science Education (Salem, Mass.), vol. 91, no. 5, Wiley, Sept. 2007, pp. 805–21, doi:10.1002/sce.20208.

14.) Contains the scientific identity and self-efficacy scales used for measuring inclusivity.

Syed, Zurbriggen. "The Role of Self-Efficacy and Identity in Mediating the Effects of STEM Support Experiences." Analyses of Social Issues and Public Policy, vol. 19, no. 1, Wiley, Oct. 2018, pp. 7–49, doi:10.1111/asap.12170.

15.) Discusses how gender diversity and inclusion increase workplace happiness.

Mousa, Mohamed. "Does Gender Diversity Affect Workplace Happiness for Academics? The Role of Diversity Management and Organizational Inclusion." Public Organization Review, July 2020, doi:10.1007/s11115-020-00479-0.

16.) Describes how diversity in ethnicity leads to greater contributions to science.

Freeman, Huang. "Collaborating with People Like Me: Ethnic Coauthorship Within the United States." Journal of Labor Economics, vol. 33, no. S1, University of Chicago Press, July 2015, pp. S289–S318, doi:10.1086/678973.

17.) Shows how inclusive teams have increased cooperation and ways to measure this.

Fitzpatrick, S., & Sharma, M. (2017). *Can inclusion be measured in a quantitative way, just qualitative, or a combination?* Retrieved [insert date] from Cornell University, ILR School site: <http://digitalcommons.ilr.cornell.edu/student/152>

Appendices

A.) An overview of inclusion in the form of an infographic is located on the next page. A version with higher resolution is located as a link below. For both versions, it is highly recommended that viewers enter full screen, zoom in, and then scroll from left to right so that all the information can be read.

<https://www.dropbox.com/s/kazi2mw7sme6z1y/Appendix%20A%20Inclusion%20Infographic.png?dl=0>

B.) The website below contains 9 necessary categories for measuring inclusivity

<https://www.forbes.com/sites/paoloquadiano/2019/04/29/inclusion-is-invisible-what-you-should-measure/?sh=3af25a35e1f3>

C.) The link below contains a pdf file named "Appendix C Chavis' Sense of Community Index"

<https://www.dropbox.com/s/c8gj3key6s6h34r/Appendix%20C%20Chavis%E2%80%99%20Sense%20of%20Community%20Index.pdf?dl=0>

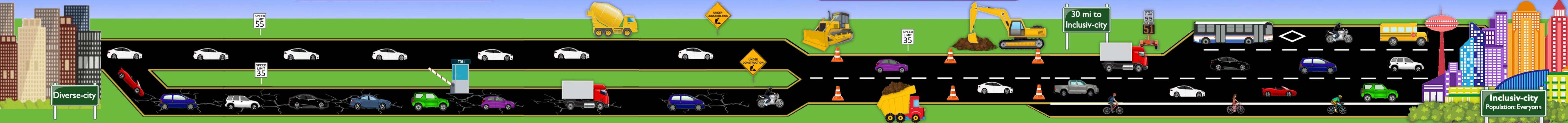
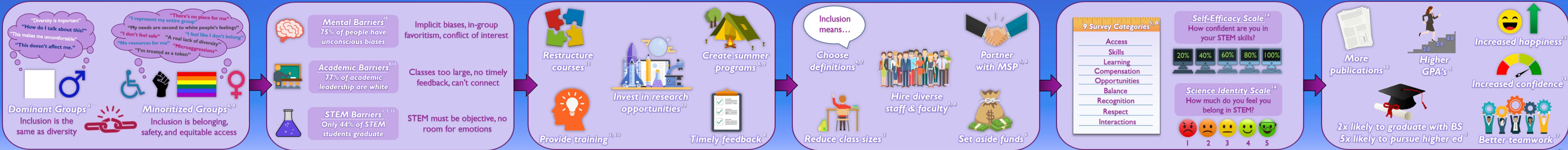
D.) The websites below contain various implicit association tests for different groups and beliefs

<https://implicit.harvard.edu/implicit/> & www.tolerance.org/hidden_bias

Disconnected definitions and other barriers prevent inclusion

Inclusivity is achievable through changes to the system

Measuring inclusivity can aid in achieving its benefits



Achieving the Equitable Classroom Environment: Recommendations for SESE Faculty to Increase Student Retention
Searra Foote

Executive Summary

Retention in STEM fields is a significant issue for undergraduate students, especially for those in marginalized groups. While largely unintentional, personal privilege, implicit biases, and stereotype threat are barriers to historically marginalized students. Faculty play an essential role in student success, which can be achieved by building an equitable classroom environment. New and pre-tenured faculty are monitored more closely regarding their teaching styles in the classroom, but continued training should be available to tenured faculty as well. It is possible to solve the issue of student retention among marginalized groups and foster an environment that is positive and prepares students for success. The first step is to equip SESE faculty with the proper knowledge to pursue equity through an off-site, multi-day workshop. The second step is to require SESE faculty to promote equity among their own students in the classroom as part of their improved pedagogy.

Problem Statement

The STEM community is becoming more diverse, with an increased amount of students of color enrolling in college over the past three decades.¹ However, this diversity in the changing student population is not being met with equitable education or an increase in retention. For example, 20% of Latino and 40% of Black students do not end up earning the natural sciences degree they initially set out to pursue, while this is observed for only 1.5% of white students.¹ These statistics are often due to seemingly invisible barriers, such as personal privilege, implicit biases, and stereotype threat. For example, white privilege is both invisible and detrimental to women of color in the field and most people do not even know they have it.² In order to dismantle these barriers, intersectional identities need to be better understood. Intersecting identities cannot reduce a student to just one experience or identity and can reveal serious inequities that are present in college education.² Without an understanding of the unique barriers that prevent students from obtaining an equitable education, it is more challenging to mitigate these barriers.

Marginalized groups experience inequity in undergraduate classes. For example, there is both a gender and ethnicity gap in some college STEM courses.³ In a study, white and male students were found to have higher course grades and higher attendance than non-white and non-male students.³ A possible cause is stereotype threat, which can negatively affect the students' education and the classroom environment. Stereotyping students by which demographic categories they fit into can imply that student is expected to act a certain way, which causes stress to the student and increases their cognitive load. In one study, before completing a math test, students were first asked demographic questions, which was found to negatively impact the performance of students that belonged to underrepresented groups.¹ Similar gaps in performance, attendance, and retention have been observed between first generation and continuing-generation students.⁴ First generation college students comprise about one-third of students that attend college and are often disadvantaged by being subjected to classroom competition that leads to impostor syndrome.⁴ When students are subjected to these barriers, it is harder for them to succeed in the college classroom which can affect their readiness for future careers.

Achieving the Equitable Classroom Environment: Recommendations for SESE Faculty to Increase Student Retention
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A key factor in student success is sustained faculty interaction, but marginalized students face additional barriers in this domain as well. One study found that students of color were less likely to enter a mentoring relationship with their professors, which is often due to the lack of interaction or behavioral cues in the classroom.⁵ Overall, these barriers inhibit students' growth as both scientists and people, but there are certainly many recommendations to dismantle these barriers. SESE leadership can especially consider these recommendations to combat these issues.

Recommendations

The following recommendations can be implemented in SESE to combat the issue of undergraduate student retention among marginalized groups.

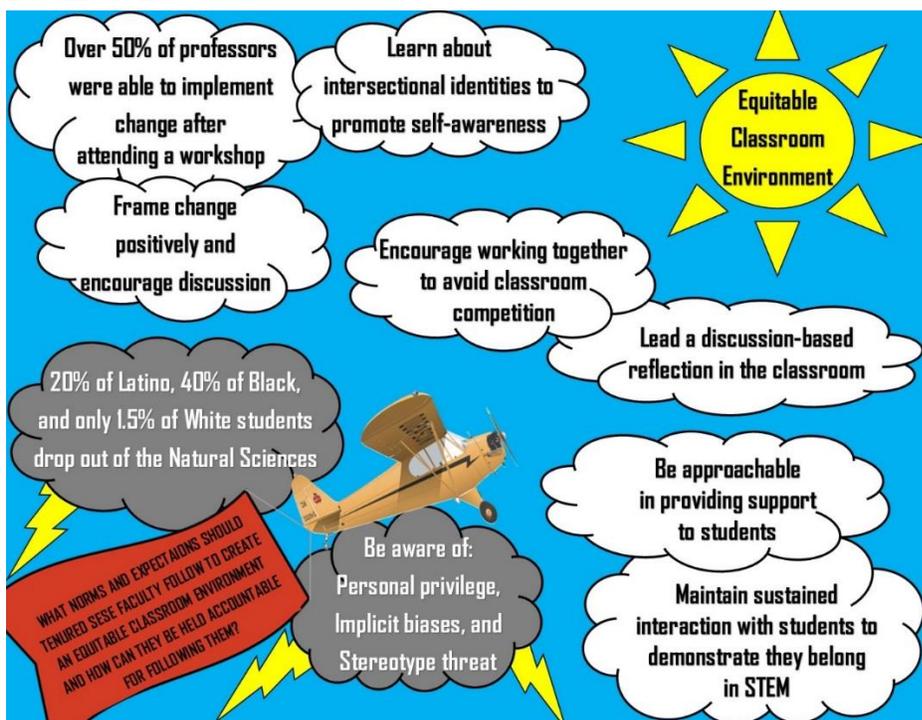
- 1. Design and implement a required, off-site, multi-day workshop for faculty.** Many instances of inequity are simply due to lack of knowledge on the topic, and training has been proven to be the most successful way to educate.⁶ The workshop should inform the faculty about intersectional identities and methods for inclusive learning. The workshop should be framed positively to foster an encouraging space that allows for self-reflection. In this effort, surveys are necessary to measure workshop effectiveness and participant growth over time. After attending the Inclusive Excellence Workshop, 96.6% of the participants reported that they felt confident to translate this knowledge to real change in the classroom, with more than half reporting numerous pedagogy changes they had made.⁶ The Bias Literacy Workshop, held at 41 university STEM departments, provides another successful example that framed implicit biases as a habit of the mind that can be changed with proper education. Participants reported an increase in their personal awareness of implicit biases, which then translated into behavioral changes in their classrooms.⁷
- 2. Encourage faculty to include a discussion-based intervention in their classes.** Universities in the United States implemented interventions such as a reflective writing exercise and exposure to student testimonials that highlighted various struggles of students, which resulted in increased student engagement.³ These activities helped students view the classroom as a safe place and feel less alone in their struggles without revealing them to the class or feeling vulnerable. Students then completed a series of surveys, and results demonstrated that course performance, grades, and attendance of students belonging to ethnic and gender minorities had improved when compared to those that did not participate.³
- 3. Build awareness around competition.** As an example, faculty should be aware of what they may be unintentionally signaling to their students about the rigor of the course and how that may result in competition among classmates. In a study of first generation and continuing generation STEM students, one group was told that their program was competitive and the other was not. The first-generation students that were aware of competition had less motivation, lower scores, and higher rates of anxiety and depression, while the other group was unaffected.⁴

Achieving the Equitable Classroom Environment: Recommendations for SESE Faculty to Increase Student Retention

Searra Foote

- Adjust faculty job requirements to allow more time for sustained interaction with their students.** Faculty mentorship plays a significant role in student retention.⁸ Sustained interaction with faculty may increase self-efficacy and identity in STEM, instill community values, and encourage retention by way of integration in the community.⁸ However, professors at HBCU universities report that they do not have time nor the incentives to help students more often due to strict university requirements regarding research productivity.⁵ This is likely similar at R1 universities such as ASU, where mentorship could be incentivized by tenure and promotion policies.

Distillation



Impact Statement

Enhancing the role that faculty play is essential to building an inclusive program in SESE. The success of these efforts can be measured by implementing surveys for students and faculty, as well as by comparing the number of students that enter the program with the percentage of students that graduate. Following these recommendations will lead to an increased number of students involved in the program and an increase in those that persist in their STEM degrees. The SESE program would be distinguished from STEM departments at other universities due to the number of diverse graduates that attribute their success in their careers to their experience with faculty while in SESE. Since SESE is already known for its stellar research program and unique set of highly qualified and diverse faculty, holding faculty to an even higher standard will raise the bar for other universities. While faculty may be implementing individual changes, department-wide support and policies must be provided to accomplish the systemic change that SESE strives for.

Achieving the Equitable Classroom Environment: Recommendations for SESE Faculty to Increase Student Retention
Searra Foote

Annotated Bibliography

- 1) Killpack, Tess L, and Laverne C Melón. "Toward Inclusive STEM Classrooms: What Personal Role Do Faculty Play?." *CBE life sciences education* vol. 15,3 (2016): es3.
This describes personal privilege, implicit biases, and stereotype threat as barriers.
- 2) Sparks, David M. "Navigating STEM-Worlds." *Journal for Multicultural Education*, vol. 11, no. 3, 2017, pp. 162-17
This includes a discussion of intersectionality regarding women of color in STEM and the importance of understanding intersectional identities to increase retention.
- 3) Binning, Kevin R., et al. "Changing Social Contexts to Foster Equity in College Science Courses: An Ecological-Belonging Intervention." *Psychological Science*.
This describes a discussion-based intervention in the classroom to encourage a sense of belonging in STEM.
- 4) Canning, Elizabeth A., et al. "Feeling Like an Imposter: The Effect of Perceived Classroom Competition on the Daily Psychological Experiences of First-Generation College Students." *Social Psychological and Personality Science*, vol. 11, no. 5.
This describes how to effectively create a classroom environment that is competition-free, which allows the students to thrive without the stress of competing with their peers.
- 5) Hurtado, Sylvia et al. "'We Do Science Here': Underrepresented Students' Interactions with Faculty in Different College Contexts." *The Journal of social issues* vol. 67.
This details the ingredients to successful faculty-student interactions including approachability, ethics of care, and rigor vs. support.
- 6) Shapiro, Casey, et al. "Creating Inclusive Classrooms by Engaging STEM Faculty in Culturally Responsive Teaching Workshops." *International Journal of STEM Education.*, vol. 7, no. 1
This outlines the successes of a training workshop for STEM faculty and how they implement it.
- 7) Isaac, Carol, et al. "Difficult Dialogues: Faculty Responses to a Gender Bias Literacy Training Program." *Qualitative Report*, vol. 21, no. 7, July 2016, pp. 1243–1265.
This provides insight on another type of successful training workshop.
- 8) Hernandez, Paul R., et al. "Testing Models of Reciprocal Relations between Social Influence and Integration in STEM across the College Years." *PLOS ONE*, vol. 15, no. 9.
This describes the influence professors have on students and how they can effectively encourage the student to succeed and pursue opportunities.

Helen Madeen

Executive Summary

Fields of research within SESE have inherently benefited from settler colonialism and white supremacy that continue to negatively impact indigenous communities (Prescod-Weinstein et al., 2020). An example that may be familiar is the Thirty Meter Telescope on Mauna Kea, which is on native Hawaiian land that astronomers are actively colonizing with the use of this telescope. Decolonization within SESE curriculum is essential to acknowledge the impact this field of science has on indigenous communities to date, to support students from indigenous communities, and help train the next generation of scientists on how to build more inclusive scientific communities and do inclusive scientific research. Ways in which SESE can work to decolonize curriculums include: 1) the addition of land acknowledgments to websites and syllabi that emphasizes that this land is occupied and un-surrendered, 2) activities in class that discuss the continued impact colonization has on earth and space science and 3) changing the language used in class or laboratories to reflect a move away from colonial based language.

Problem Statement

Often, colonization is thought of as historical and may not seem like it applies to Arizona State or SESE. However, colonization has ongoing effects in academia today (refer to Appendix). Many initial scientific discoveries in many areas of science benefitted from the control and use of indigenous communities. For example, the famous astronomer Giovanni Domenico Cassini played a role in the colonization of the Caribbean, using Caribbean islands to collect data, which ultimately aided in the understanding of latitudes and longitudes used in the Atlantic slave trade (Prescod-Weinstein et al., 2020). NASA still has a mission named after him without acknowledgment of his role in the colonization of the Caribbean and the advancement of the Atlantic slave trade. Colonialism has a great impact on institutions of higher education as well, including Arizona State University. Arizona State was founded in 1886, almost 30 years before Arizona became a state. Meaning that ASU actively played a role in the colonization of Arizona in the 1800's. However, colonization did not simply stop in the 1800's. ASU played a continued role in colonization in the 1990's as described in the court case *Havasupai Tribe v. Arizona State University Board of Regents* which explains the unethical research anthropology researchers from ASU conducted on the Havasupai Tribe in the 1990's (Drabiak-Syed, 2010).

Acknowledgment not only of the land ASU occupies but also the historical and more recent colonial impact ASU had on indigenous communities in Arizona is vital. Although SESE may not have directly or actively played a role, many fields within SESE have benefitted from colonialism. A good example of this in astronomy, the Thirty Meter Telescope on occupied native Hawaiian land (Prescod-Weinstein et al., 2020) and the Mount Graham Observatory on occupied sacred land of the San Carlos Apache. The narrative surrounding colonization must change to reflect the historical and present day effects colonization has had on higher education. Indigenous narratives are also often not represented in western science or higher education (McGinty et al., 2015). Institutions of higher education also have different definitions and articulations of decolonizing within higher education, however, oftentimes actions taken by universities are considered performative and do not lead to real change (Andreotti et al., 2015).

For example, land acknowledgments are useful but often do not provide resources for further action beyond the written statement. There are many ways institutions of higher education like ASU and departments like SESE can implement other actions that take a step further towards the decolonization of earth and space science, outlined below.

Recommendations

Below I summarize three initial steps that can be taken to work towards decolonization in SESE curriculums as well as one long term recommendation that may take longer or require more resources to enact.

Short-term recommendations:

1. The addition of a Land Acknowledgment statement to the SESE website as well as syllabi for all SES and GLG courses. This land acknowledgment must take into account the use of the specific language to adapt this land acknowledgment to specifically recognize this land as occupied, un-surrendered, or stolen land belonging to the Pima (Akimel O'odham) and Maricopa (Pipaash) Indigenous Communities. (Beeman-Cadwallader et al., 2011)
2. Inclusive activities at the beginning of the semester to go over the updated syllabus containing the land acknowledgment that also includes a discussion of Arizona State's history of colonization in Arizona as well as an active conversation with students about colonization and its relation to SESE and Geology. For example, doing an activity that involves asking what indigenous land their great grandmother was born on or asking what land their hometown occupies. Also, discuss with students how colonization manifests in research and teaching and what that looks like in Geology/SESE. For example, discussing the Thirty Meter Telescope and the Mount Graham Observatory in the context of colonization, not just research science.
3. Updating the language used in classroom settings and syllabi to reflect a move away from colonial-based language (Beeman-Cadwallader et al., 2011). One particular example would be changing the language of Laboratory 9 for Geology 103 from "Settling Painted Canyon" as this implies colonization of this area. A new way to word this could be "Developing a Community in Painted Canyon". Another side of this would be to acknowledge colonization in earth and space science when discussing historical scientific discoveries made by researchers that actively played a role in colonization, for example, John Wesley Powell or Giovanni Domenico Cassini who both played a role in colonization while doing research. (Prescod-Weinstein et al., 2020)

Long term recommendation:

4. Integrating place-based learning in curriculums to emphasize local and regional surroundings, issues, and knowledge that includes the community and other cultures (Semken et al., 2014). Especially considering the locations of fieldwork or field camp, place-based systems of knowledge are important to factor in. However, this step will take more effort and funding for pedagogical change within the SESE, especially providing training to all educators on how to implement place-based learning and knowledge into curriculums.

Impact Statement

Implementing these recommendations will improve decolonization efforts in SESE curriculums and impact students in SESE and beyond. It is the responsibility of those teaching within SESE, both professors and graduate students, to enact positive change to curriculums that are not inclusive and do not move decolonization forward in higher education. Enacting these recommendations when teaching as well as by SESE as a whole will increase student understanding of the historical role ASU played in the colonization of Arizona as well as the ongoing influence of colonization in higher education and scientific research. These recommendations will also expand SESE's ability to recruit and support students from indigenous communities and help train the next generation of scientists on how to build more inclusive scientific communities and do inclusive scientific research. Using activities with students to discuss specific use of language and how colonization continues to impact and influence earth and space science will allow for a more inclusive curriculum and take the next steps toward decolonization of curriculums in SESE and ASU.

Annotated Bibliography

1. Drabiak-Syed, Katherine, 2010. "Lessons from Havasupai Tribe v. Arizona State University Board of Regents: Recognizing Group, Cultural, and Dignitary Harms as Legitimate Risks Warranting Integration into Research Practice". *Journal of Health & Biomedical Law*, 1, 175-225.

This paper discusses the court case *Havasupai Tribe v. Arizona State University Board of Regents* that involved unethical research by researchers at ASU using the Havasupai tribe.

2. Semken, S., Apple, J., Lemus, J., 2014. "Teaching Geoscience in the Context of Culture and Place." *Journal of Geoscience Education*, 62, 1-4.

This paper discusses place-based systems of knowledge and education which uses the sense of place to emphasize local and regional surroundings, issues, and knowledge that integrates the community of that place and promotes environmental and cultural sustainability.

3. Andreotti, V., Stein, S., Ahenakew, C., and Hunt, D., 2015. "Mapping interpretations of decolonization in the context of higher education." *Decolonization: Indigeneity, Education & Society*, 4, 21-40.

This paper discusses the different definitions and articulations of decolonizing in higher education. One important aspect is the section of actions taken in higher education that could be considered performative and involving tokenistic recognitions of cultural diversity.

4. Prescod-Weinstein, C., Walkowicz, L., Tuttle, S., Nord, B., & Neilson, H., 2020. "Reframing astronomical research through an anticolonial lens — for TMT and beyond". *Instrumentation and Methods for Astrophysics (astro-ph.IM)*.

These authors lay out recommendations regarding Astronomy research on Mauna Kea but these could also be applicable to other areas of research.

5. McGinty, M., & Bang, M., 2015. "Narratives of dynamic lands: science education, indigenous knowledge and possible futures." *Cultural Studies of Science Education*, 11, 471–475.

This paper discusses how Indigenous narratives and Western science narratives are represented in education and the negative connotations western science has implied for Indigenous narratives.

6. Beeman-Cadwallader, N., Quigley, C., & Yazzie-Mintz, T., 2011. "Enacting Decolonized Methodologies: The Doing of Research in Educational Communities." *SAGE*, 18(1), 3–15.

This paper discusses the language that should be used when teaching science. Colonial power relations need to be discussed and acknowledged as factors influencing western science and science needs to be taught and learned in different contexts of cultures, people, and experiences.

7. Sefa Dei, G., 2016, "Decolonizing the University: The Challenges and Possibilities of Inclusive Education". *The Journal of the Society for Socialist Studies*, 11 (1), 23-61.

This paper discusses the reframing of the curriculum in academia to make it more inclusive and accessible. This paper also has a section on "concepts for decolonization" that includes decolonization of curriculum, notions of inclusion, inclusive education, and practical institutional approaches to adapting curriculum.

WHAT IS COLONIZATION?

Is this what you think of?



Wasn't that a long time ago?

Colonization is often thought of as historical but colonization is still active in science today!

NO

HOW DOES THIS RELATE TO SESE?

Geoscience and Astronomy benefit from the continued colonization of indigenous land.

However, this is often not reflected in curriculums within higher education

For example

Thirty Meter Telescope, Occupied Hawaiian land



SCIENTIFIC ADVANCEMENT IS OFTEN USED TO JUSTIFY CONTINUED COLONIALISM IN SCIENCE

WHAT IS ONE THING I CAN DO TO START TO DECOLONIZE MY GEOSCIENCE CURRICULUM?

Activities to acknowledge ASU's history of colonization in Arizona as well as active conversations with students about colonization and its relation to SESE and Geology.

Increasing Academic Success of Low-Income Undergraduate Students at ASU in Online Course During Covid-19

Desmond A. Hanan

EXECUTIVE SUMMARY:

During this pandemic, it is important for Universities to put their students first. Due to the Covid-19 pandemic university classes have undergone an emergency transition to online classrooms. Many courses have transitioned poorly and, importantly, this transition has highlighted the many barriers to academic success that students are currently facing and accentuated those barriers in online education that have existed for students prior to the pandemic. Many of these barriers to academic success, such as unequal access to internet or software, particularly harm low-income students. In addition, the financial strain of the pandemic has increased student stress and anxiety. In order to mitigate the challenges that undergraduate students are facing I recommend three courses of action: (1) implement *robust and mandatory Faculty/TA training for online education*, (2) increase *administrative engagement with and support for course planning*, and (3) provide *greater student support services outreach*.

PROBLEM STATEMENT:

Covid-19 has the potential to drastically effect low-income student retention. Prior to the pandemic, online courses offered the opportunity to reduce costs and, thereby potentially broaden access to more people¹. However, with the emergency shift from more classical in-person education during the spring semester of 2020 and continued online courses during the fall semester and likely going forward, students are paying the price of in-person tuition for online courses. These online courses suffer the common drawbacks of their kind, such as a lack of teacher-student ‘co-creation of knowledge,’ in addition to the effects of an emergency mass shift of courses designed for in-person classrooms to the internet, including subpar lesson plans and teaching resources^{1,2}. It is, therefore, unsurprising that undergraduate students’ satisfaction with their courses has decreased across the board with all student groups³. Low-income students in particular were more likely to face broadband, hardware and software issues while attending these classes². Some students also faced other barriers like needing to share the devices used for online courses with others or being unable to find quiet space for instruction. In one survey, 1% of students also had to use public Wi-Fi to access the online instruction for their courses². Student experience with classes and interaction with the university as a whole are both known factors that impact retention, particularly for low-income students⁴. It is, therefore, important that ASU makes decisions that improve student experience with classes and interactions with faculty while they are unable to more fully interact with the university.

As we look forward and see the potential for the end of the pandemic, it is important that universities don’t rest on their laurels. Many students are facing the problems of financial strain

in the short term, but many of the barriers that prevent students (especially low-income students) from succeeding in their classes or completing online work existed prior to the pandemic and have now only been exacerbated³. Changes that the university makes to prepare for another semester during Covid-19 have the potential to effect deeper changes that will help students succeed even after the pandemic is over.

RECOMMENDATIONS:

Although Covid-19 will be temporary, there will be at the very least another semester of online instruction. Some barriers to a successful academic classroom are relatively unique to pandemic learning, however, many of these recommendations are applicable to online education farther into the future as well. The below recommendations are intended to mitigate the impact of those barriers facing students, particularly for low-income students, by increasing faculty and staff awareness.

Robust and Mandatory Faculty/TA training for online education

At ASU, trainings of this sort already exist. For example, ASU is currently offering SYNC classroom orientations for faculty members designing online courses for the spring semester of 2021. ASU has also offered orientations and training through the Online Faculty Center for many years now, including Quality Matters course design assessments and checklists for faculty to follow. In addition, many faculty members have spent a lot of time transitioning classes to the online environments. However, these courses and assessments are optional for the faculty and few exist that are designed with graduate teaching assistant in mind at all. Specific trainings and workshops for designing lesson plans that are feasible and accessible for online, over-Zoom instruction and for maintaining the quality of formerly in-person classes may moderate the negative effects the emergency transition to online education^{2,3}. Additionally, training may inspire or provide new approaches for teaching existing online coursework. Optional trainings and assessments of course design and implementation are not enough to ensure that the many, many courses now being developed for fully online semesters are good for the students. It is important that increased trainings and orientations are made mandatory for faculty and TAs dealing with the transition to online education during the pandemic and for online educators once the pandemic is over.

Increased administrative engagement with and support for course planning

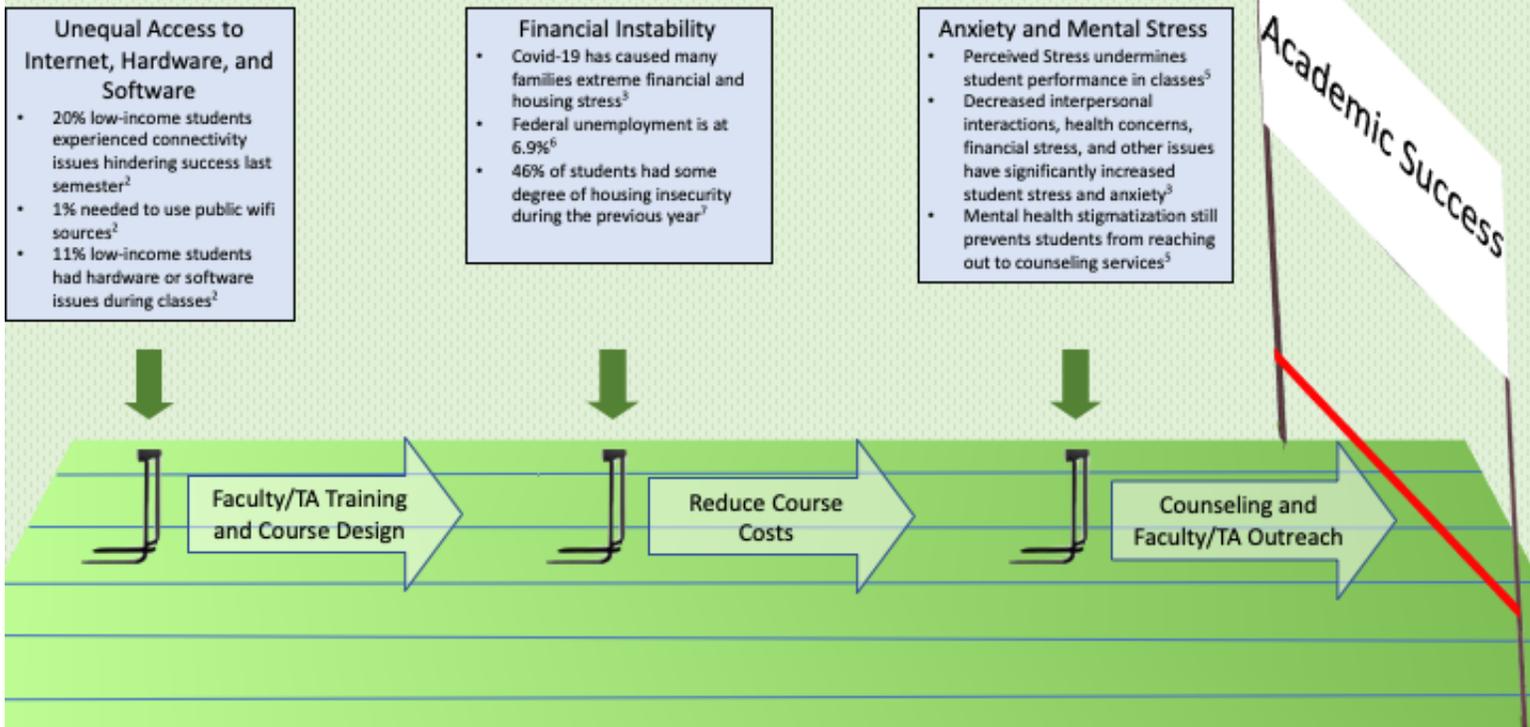
There are materials and resources necessary for student success beyond just textbooks. These may include software or online resources and they may also include access to computers and the internet³. ASU provides options for students to borrow laptops and work using the University's internet. ASU also provides students and staff with access to many software suites, such as adobe

creative cloud. But, although many software packages are already made available through ASU, it is important that that knowledge is included in course design. Traditional online courses have long provided a detailed list of technology requirements to students ahead of the beginning of the course. Faculty must, while designing their courses, track which software students will be required to use. By reviewing this information, administrators support could mitigate the costs incurred on students by ensuring that courses don't require excessive software use outside of university provided resources. This may also include ensuring that students can take courses regardless of what operating systems they have access to. From a financial perspective, it is important that ASU is aware and actively trying to reduce the financial burden that classes will have upon students. This will work best when faculty and administrators work together to design courses that work best for the students.

Greater student support services outreach

Student stress, due to increased financial strain or the pandemic more generally, is a problem that the university will need to address more robustly as the pandemic continues. ASU counseling services has previously provided tailored trainings for faculty and staff addressing a variety of mental health and student support issues. Since online education makes it more difficult for students and faculty to interact directly, it is more difficult to identify when students are struggling in class or facing problems outside of classes that are affecting their academic success. It is particularly pressing now that educators are trained to recognize indicators of exceptional stress and to mitigate its impacts on students' success by directing them to appropriate support^{3,5}. There is still a stigma associated with mental health counseling that students will need to overcome when using student support services; however, research has shown that when students do take advantage of these services it can alleviate their perceived stress to some extent⁵.

Overcoming the Hurdles of Online Education



IMPACT STATEMENT:

During Covid-19 or following Covid-19, student success and satisfaction in and with online classrooms can be improved. Giving faculty and TAs the training and support necessary to create well developed courses that take advantage of the resources students have available to them will mean that the university will be better able to retain students even during this period of high stress and strain. Administrative assessment of course design will improve student experience in online courses and somewhat reduce the financial burden of excess technological requirements for courses. From a broader perspective, the success of these recommendations can be assessed on wider level through student surveys and metrics on student retention and academic performance at the end of each semester. By putting the experience and success of the students first, we can return to the promise of online education as a viable, desirable alternative to the traditional classroom.

ANNOTATED BIBLIOGRAPHY:

- 1) Hill, Christopher, and William Lawton. "Universities, the Digital Divide and Global Inequality." *Journal of higher education policy and management* 40.6 (2018): 598–610. Web.

Although many institutions have been offering fully online degrees, these programs tend to run into three main problems: access, quality and value. Of note in the authors' arguments is that, even in the U.S., some areas, most notably rural regions, have little access to the internet. Furthermore, the quality of online education has always suffered in comparison to in-person teaching.

- 2) Means, B., and Neisler, J., with Langer Research Associates. (2020). *Suddenly Online: A National Survey of Undergraduates During the COVID-19 Pandemic*. San Mateo, CA: Digital Promise.

A report analyzing data collected from a survey of students taken after a shift to online classes due to Covid-19. It covers a number of specific issues that are facing students due to covid and also breaks down the data to analyze it by group.

- 3) Gillis, Krull. "COVID-19 Remote Learning Transition in Spring 2020: Class Structures, Student Perceptions, and Inequality in College Courses." *Teaching sociology* 48.4 (2020): 283–299. Web.

An analysis of two professors switch to online learning and how students were affected. This study includes specific mention of many barriers that students faced, in particular the author's noted that specific technology and internet barriers occurred more frequently than expected. The authors also noted increased stress levels in students relative to before the pandemic as a result of these barriers, especially low-income students.

- 4) Herzog, Serge. "Financial Aid and College Persistence: Do Student Loans Help or Hurt?" *Research in higher education* 59.3 (2017): 273–301. Web.

A good source discussing the many confounding factors that influence the retention of students, particularly low-income students. The authors argue that student experience, especially first year experience, is a major factor in retention and therefore studies of retention ought to be conducted per school to tailor specific recommendations.

- 5) Adams, Danielle R, Steven A Meyers, and Rinad S Beidas. "The Relationship Between Financial Strain, Perceived Stress, Psychological Symptoms, and Academic and Social Integration in Undergraduate Students." *Journal of American college health* 64.5 (2016): 362–370. Web.

A study on how financial stress impacts undergraduate student outcomes. The authors determined, through analysis of their data, that financial strain caused perceived stress to negatively impact both undergraduate student success and psychology. The authors also

found that robust student support services mitigated these impacts when taken advantage of; however, mental health stigmatization and other barriers can prevent at risk students from seeking this aid.

- 6) THE EMPLOYMENT SITUATION — NOVEMBER 2020. Bureau of Labor Statistics, 2020, www.easybib.com/mla8-format/website-citation/custom.

A report by the Bureau of labor statistics describing the current state of employment during the covid-19 pandemic.

- 7) #RealCollege 2020: Five Years of Evidence on Campus Basic Needs Insecurity. The Hope Center: For College, Community and Justice, 2020, hope4college.com/wp-content/uploads/2020/02/2019_RealCollege_Survey_Report.pdf.

A report on multiple surveys conducted over the past 5 years across multiple universities of many 100,000s of students. It notes that there are very high numbers of food-insecure and housing-insecure undergraduate students.

Ensuring Equity: Graduate Education as a Site of Strategic Intervention in Disciplinary Cultures

Aliya R. Hoff, PhD Student, School of Human Evolution and Social Change

Executive Summary

Despite targeted recruitment efforts, Black, Indigenous, and People of Color (BIPOC) remain severely underrepresented in STEM graduate programs in the United States. As a result, the pool of scientists eligible to hold faculty positions remains overwhelmingly white. Increasing recruitment without addressing the underlying aspects of disciplinary cultures that reproduce systems of oppression is insufficient and short-sighted. Graduate programs socialize the next generation of scholars into disciplinary cultures by implicitly and explicitly communicating racialized and gendered ideas about what it means to be a good scientist.¹ As a result, graduate education offers a critical opportunity to disrupt and transform science by interrogating disciplinary norms and values that guide decision-making, expanding definitions of scientific excellence, and providing scientists with holistic mentorship and varied forms of social support. Graduate programs must be intentionally retooled to support the persistence and well-being of BIPOC graduate students in the School of Earth and Space Exploration.

Problem Statement

While there have been recent gains in the representation of BIPOC students enrolled in STEM undergraduate programs, there is a steep drop-off in the racial and ethnic diversity of graduate students in the United States.² In 2016, only 13% of science and engineering doctorates were awarded to BIPOC scholars, substantially lower than the 31% required to reflect the broader US population.³ As a result of this bottleneck, the proportion of STEM faculty who are white increases with rank.⁴ The persistence of marked disparities in higher levels of academia has caused researchers to critique diversity efforts that focus solely on recruiting BIPOC students as insufficient and unsustainable because they fail to address the root causes of such disparities.⁵

¹ Levya & Alley 2020

² Espinosa et al. 2019; Arizona State University is no exception to this trend. In fall 2019, minoritized students made up 44% of total undergraduate (immersion) enrollments but only 23% of graduate enrollments (Office of Institutional Analysis 2020). Diversity is even lower in the School of Earth and Space Exploration: in fall 2016, minoritized students made up 30% of undergraduate and 15% of doctoral enrollments (Arrowsmith et al. 2017).

³ Bernard & Cooperdock 2018; NSF 2018, 2019. Geosciences have the lowest proportion of doctorates earned by BIPOC scholars in STEM (6%) and have not made significant gains in the past forty years.

⁴ Espinosa et al. 2019

⁵ Clancy et al. 2017; NASEM 2020; see also Slay & Posselt 2019 on the diversity “bait and switch” move

Enduring institutional change requires the transformation of entrenched disciplinary cultures that shape scientists' values, beliefs, and practices.⁶

As the principal location for the selection and training of the next generation of scientists, graduate education offers a critical site of intervention for equity work.⁷ During graduate school, students are socialized into particular disciplinary cultures as they develop their identity as a scientist and cultivate the knowledge and skills necessary to conduct research.⁸ However, to demonstrate mastery of their discipline, graduate students must also successfully navigate the “hidden curriculum”—the tacit norms and values that underlie expectations of how scientists should think and behave.⁹ As these norms and values become internalized and taken-for-granted, they become increasingly difficult to identify and challenge.

Thus, graduate education offers an ideal opportunity to analyze disciplinary norms and practices that systematically exclude certain groups of people and allow academia to remain a white, patriarchal space.¹⁰ It also offers a unique opportunity to enact long-lasting and widespread disciplinary change: strategically intervening in graduate student socialization by embedding equity work as a valuable and expected part of doing science can have considerable downstream effects as new PhDs move on to work and teach at other institutions.¹¹ The following section discusses recommendations for interrogating implicit disciplinary norms, values, and beliefs so they can be intentionally retooled to promote the persistence and well-being of BIPOC graduate students.

Recommendations

The School of Earth and Space Exploration is already pursuing several recommended paths for increasing recruitment of BIPOC graduate students (e.g., robust public outreach, partnerships with Minority-Serving Institutions, and participating in PhD bridge programs). However, the unit must continue to address foundational norms, values, and beliefs that shape everyday scientific practices and social interactions if the ultimate goal is to achieve equity (see Figure 1). Equity goes beyond diversity and inclusion because it requires *disrupting* entrenched systems of power rather than *assimilating* people with diverse backgrounds into unchanged systems.

1. Excavate and interrogate the foundational norms and values that guide decision-making in your department and discipline(s). For example,

⁶ Posselt 2020; Posselt et al. 2017; Marín-Spiotta et al. 2020; Clancy et al. 2017

⁷ Posselt 2020

⁸ Austin 2002; Gardner 2006; Golde 2005; Gopaul 2011

⁹ Margois & Romero 1998

¹⁰ See Levya & Alley 2020 for a theorization of white, patriarchal spaces in education

¹¹ Posselt 2020; Posselt et al. 2017; Perez et al. 2019; see also NASEM 2018 for significance of graduate education to science in general

disciplinary cultures that value brilliance and overwork, promote the myth of meritocracy and performance of masculine stereotypes, and tolerate incivilities and confrontation tend to have fewer women in the field.¹² Similar aspects of disciplinary culture may contribute to the underrepresentation of BIPOC scholars.

- a. **Educate graduate students about the social dimensions of science and its role in reproducing systems of oppression.** Encourage students to take relevant coursework outside of SESE or, alternatively, co-design a course tailored for SESE students. Invite colleagues from the College of Global Futures, School of Life Sciences, School of Human Evolution and Social Change, and the School of Social Transformation to present in department colloquia, journal clubs, and faculty meetings.
 - b. **Create opportunities for individual reflection and peer discussion to develop critical consciousness and racial literacy.**¹³ Communities of practice help individuals reflect on their exposure to power and privilege and use this knowledge to engage in activism. Attend carefully to group composition to prevent graduate students from expending emotional labor to educate faculty.¹⁴
2. **Expand and reimagine definitions/criteria of scientific potential, merit, and excellence** with careful attention to how specific criteria may reproduce historical inequities in access to resources. **Revise all departmental evaluative processes and reward structures to align with these definitions** (e.g., graduate admissions, annual evaluations, comprehensive exams, allocation of funds and research positions, honors and awards). A study of an applied physics program that trained 10% of *all* Black physicists in the U.S. over the past decade found that formalizing expansive definitions of student potential and success in evaluation criteria was key to recruiting and retaining BIPOC scholars.¹⁵
- a. **Disrupt the hidden curriculum by explicitly defining program expectations and criteria for success.** Create rubrics to standardize evaluation processes and iterate as needed. Regularly retrain and debrief faculty who serve on review committees to avoid drift.¹⁶
 - b. **Collect and analyze demographic data to detect systematic bias** in graduate admissions, awards and grants, allocation of TA/RA positions, outcome of comprehensive exams, time to degree, etc.¹⁷

¹² Rodrigues & Clancy 2020 (in NASEM 2020); Marín-Spiotta et al. 2020; see also Harding 2015

¹³ Friere 1970; Mosley et al. 2020

¹⁴ Porter et al. 2018

¹⁵ Posselt et al. 2017

¹⁶ Rudolph & Basri 2020; see Posselt 2016 for in-depth recommendations regarding graduate admissions and Lamont 2010 for evaluation processes in academia more generally.

¹⁷ Rudolph & Basri 2020

3. **Provide graduate students with holistic mentorship and manifold sources of social support.** Science is an inherently social enterprise that requires holistic mentorship to develop competencies across different domains (e.g., technical, professional, cultural, etc.). Quality of mentorship is one of the most important factors in graduate student well-being and degree completion, while peer support is instrumental for retention and successfully navigating the hidden curriculum.¹⁸
 - a. **Provide mentorship training for all members of the department.**

Instead of reproducing inherited modes of mentorship that serve particular people, mentors must be prepared to provide individualized support to students with diverse backgrounds, perspectives, and experiences. Continue encouraging students to cultivate multiple mentors within and beyond SESE and extend existing peer mentoring programs. Require faculty to draft explicit mentorship compacts with their mentees and submit an annual reflection/evaluation of their mentorship style and its efficacy.
 - b. **Promote safe and supportive working environments.** Continue offering workshops to develop sociocultural competencies necessary for collaborative research (e.g., bystander intervention, microaggressions, sexual misconduct, universal design, culturally responsive pedagogy).¹⁹ Draft policies that explicitly define expected norms of conduct, reporting mechanisms, and accountability measures for SESE members. Encourage faculty to tailor these policies for their research groups and field sites. Policies must align with disciplinary values to avoid becoming yet another bureaucratic checkbox.²⁰
4. **Collaborate with social scientists to identify areas in need of attention and to evaluate the perceived efficacy of specific interventions.** Semi-structured interviews provide nuanced understandings of lived experience, while focus groups provide insight into shared beliefs and perceptions. Ethnographic research is ideal for surfacing cultural norms and values via the observation of everyday practices and interactions. Social scientists are trained to minimize risk to participants and protect confidentiality.

Without targeted and intentional interventions to change disciplinary cultures, other diversity and inclusion efforts are unlikely to be successful or durable. Interrogating and challenging taken-for-granted assumptions and engrained patterns of behavior requires a sustained commitment to the growth of ourselves and our communities. Cultural change is neither quick nor comfortable, but it is a prerequisite for transforming systems

¹⁸ NASEM 2018, 2019, 2020

¹⁹ Marín-Spiotta et al. 2020; Rudolph & Basri 2020

²⁰ Ahmed 2012

of oppression in service of equity. Graduate education is a critical site of intervention where science can be reimagined as a more expansive, equitable, and supportive enterprise that benefits *all* scientists and serves as a corrective for historical and ongoing injustices.

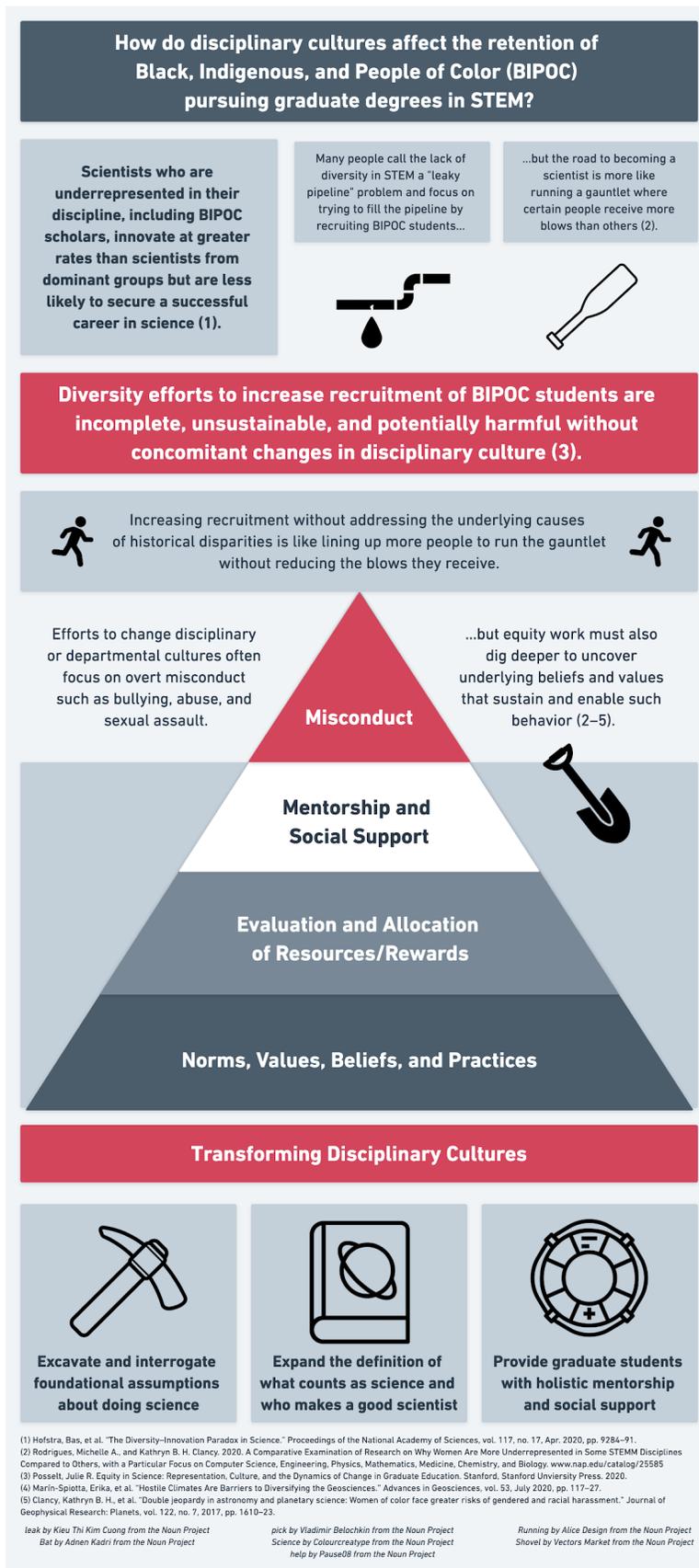


Figure 1. How do disciplinary cultures affect the retention of Black, Indigenous, and People of Color pursuing graduate degrees in STEM?

Recommended Reading

Posselt, Julie R. 2020. *Equity in Science: Representation, Culture, and the Dynamics of Change in Graduate Education*. Stanford: Stanford University Press.

Posselt's book is a must-read for those interested in graduate education. The first chapter explains why graduate education is a key site for equity work, while the final chapter provides a useful synthesis and recommendations. The case-studies are also worth reading: they detail successful and unsuccessful aspects of JEDI efforts in physics, astronomy, and the geosciences.

National Academies of Sciences, Engineering, and Medicine. 2020. *Promising Practices for Addressing the Underrepresentation of Women in Science, Engineering, and Medicine: Opening Doors*. Washington, DC: The National Academies Press.

This consensus report provides a comprehensive literature review and evidence-based recommendations. The commissioned paper by Michelle A. Rodrigues and Kathryn B.H. Clancy is an excellent resource that explores how specific disciplinary cultures, practices, and histories result in various degrees of severity of women's underrepresentation across STEM.

National Academies of Sciences, Engineering, and Medicine. 2019. *The Science of Effective Mentorship in STEMM*. Washington, DC: The National Academies Press.

A must-read NASEM report for anyone with mentoring responsibilities. The commissioned papers provide in-depth reviews of different approaches to mentoring, while the companion website provides easy access to recommendations and tools.

Marín-Spiotta, Erika, et al. 2020. "Hostile Climates Are Barriers to Diversifying the Geosciences." *Advances in Geosciences* 53: 117–27.

Succinct and powerful description of the dismal state of diversity in the geosciences that directs attention to historical legacies of exclusion, power dynamics, and aspects of disciplinary culture that reproduce inequities.

Clancy, Kathryn B. H., et al. 2017. "Double jeopardy in astronomy and planetary science: Women of color face greater risks of gendered and racial harassment." *Journal of Geophysical Research: Planets* 122(7): 1610–23.

Reports shockingly high instances of negative workplace experiences in the earth and space sciences and highlights the "double jeopardy" that women of color face due to the intersection of racism and sexism.

Posselt, Julie R. 2016. *Inside Graduate Admissions: Merit, Diversity, and Faculty Gatekeeping*. Cambridge, MA: Harvard University Press.

Posselt demonstrates how tacit assumptions of what constitutes excellence, merit, and potential in science open the door for implicit bias in graduate admissions and other processes of evaluation.

Ahmed, Sara. 2012. *On Being Included: Racism and Diversity in Institutional Life*. Durham, NC: Duke University Press.

Ahmed interviews diversity workers in the U.K. While the organization of higher education and policy landscape is different, this book is helpful for anticipating common ways that JEDI work “gets stuck” or comes up against institutional walls.

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***Tools for Fostering Equity and Inclusion in SESE :
Sustainable Change at Every Level of Academia***

Mara Karageozian, Dec. 2020

Executive Summary

Recently there has been a push for academic institutions to shift away from the old guard of elitist institutions and to usher in a new phase of academia that is focused on the growth of students and building positive environments for learning. This push comes in a time of rapid social change aimed at making institutions more equitable, diverse, inclusive and just.

Over the next several years, The School of Earth and Space Exploration (SESE) at Arizona State University has made a commitment to fostering a more socially just department in order to build foundations of progress and reform. It is necessary that SESE fosters change at all levels of the department, i.e. administrative, faculty, and student. This white paper will address tools for change at all of these levels in order to best aid SESE in its plans for reform now and in years to come. By using a combination of these tools at all academic levels, maintaining them over time, and by consistently measuring for progress, SESE will be able to shape the department to be more just, equitable, inclusive and diverse.

Problem Statement

The tense social and political climate of 2020 in the United States has brought systemic inequality and injustice to the forefront of the general public's attention. This social awakening, decades in the making, is reflected in academia's gradual shift away from the traditional academic institution (Morley, 1997), where dissemination of knowledge was top priority. As the general academic ideals shift focus towards a student-success driven model, now more than ever SESE has the opportunity to build upon social and institutional momentum to foster a more equitable and inclusive community for all of its members.

With the induction of the justice, equity, diversity, and inclusion (JEDI) task force, SESE has made a commitment to dedicate time, energy, and funds to improving the department with these pressing issues in mind. Universities and university departments that focus their energy towards measures that improve JEDI in academic spaces, see an increase in workplace productivity, personal professional growth of its constituents, and an increase in happiness measures across all departmental levels (Mousa, 2020; Price et al., 2005). The JEDI task force has a finite amount of resources to make impactful change in the department and it is crucial that the task force stay informed on where to best expend these resources. There are two approaches to a one-sided systematic change, the top-down approach, where change is fostered in the administration only, or the bottom-up course where change is fostered with student and faculty bodies. There are numerous examples of one-sided not resulting in lasting change and sometimes resulting in more harm than good (Hernandez & Watt, 2014; Honig, 2004; Laver et al., 2018). With the recommendations below, SESE can craft a fully integrated plan for progress that utilizes tools at every level of the department rather than focusing all efforts on a one-sided approach. Only with this level of top-down and bottom-up integration will change be efficient and have longevity.

Recommendations

The greatest success in fostering JEDI initiatives in SESE will be achieved by using equity and inclusion tools at every level of the department whether that be from the administration, top-down, or from the faculty and students, bottom-up. Progress in SESE will be attained by using these tool and monitoring for long-term change with measures of accountability. Here I will summarize eight tools that, when used in tandem, have the power to make SESE a more equitable, inclusive, and diverse community space. SESE has already implemented several of these tools successfully, however, maintaining their usage and incorporating other tools should be top priority for leadership.

Tools for SESE Administration

Hiring Practices – This is one of the first steps that an academic administration can take to shape their department for years to come. Hiring practices with a focus on building an equitable, diverse, and inclusive community will shape department culture for years if retention is closely monitored (Price et al., 2005). However, ensuring that existing faculty members recognize the importance of equitable hiring practices is paramount to their success. This can be achieved through clear and open communication regarding hiring practices and yearly workshops focused on shaping the department culture around hiring (Sekaquaptewa et al., 2019). Once, hiring culture is established, practices like “cluster hiring” can create an open opportunity for a more diverse group of faculty members, and increase interdisciplinary work among departments (Muñoz et al., 2017). However, above all other practices, the initial hiring intent and focus on retention of diverse faculty are the two factors that influence the success of hiring initiatives in an academic department (Muñoz et al., 2017).

Open Communication Structures – Having open communication structures for constructive criticism and for the advocacy of constituents at all levels creates a more equitable and inclusive work environment (Uslu, 2018). It is important that these communication structures be supported by the voices and actions of the highest authorities in the department, and that community members at every level are allowed to build their own structures as well. Examples of open communication structures are weekly emails, listening sessions, office hours, and annual reviews.

Yearly Progress Assessments – It is important that SESE set goals that are achievable in a short time scale and on a longer timescale. Measuring these goals annually is crucial to maintaining any initiative set forth by the department (Petty & Porter, 2010; Price et al., 2005). Longevity of initiatives is a defining factor of their impact in academia. This can be achieved by publicizing a set of goals or initiatives set out by the administration, detailing short-term and long-term change that is to be seen over several years. Community feedback regarding these goals and assessment of their achievement will allow the department to assess the success of goal achievement.

Accountability Standards – Along with setting goals, the department should focus on building accountability to uphold JEDI initiatives at every level (Petty & Porter, 2010). The department can build accountability by publishing a code of conduct that sets a precedent of expectation for community behavior, involvement, and culture. When all members of an institution are held accountable for the wellbeing of the community, everyone benefits from the praise of good actions and response to bad behavior (Arnold et al., 2020). Accountability can also be fostered for members of the community by building rubrics for involvement in JEDI work and measuring that involvement in routine assessments like tenure packages and yearly reviews. These rubrics should be written in a way that ensures the newer and more diverse hires are not carrying the bulk of the burden of the JEDI initiatives.

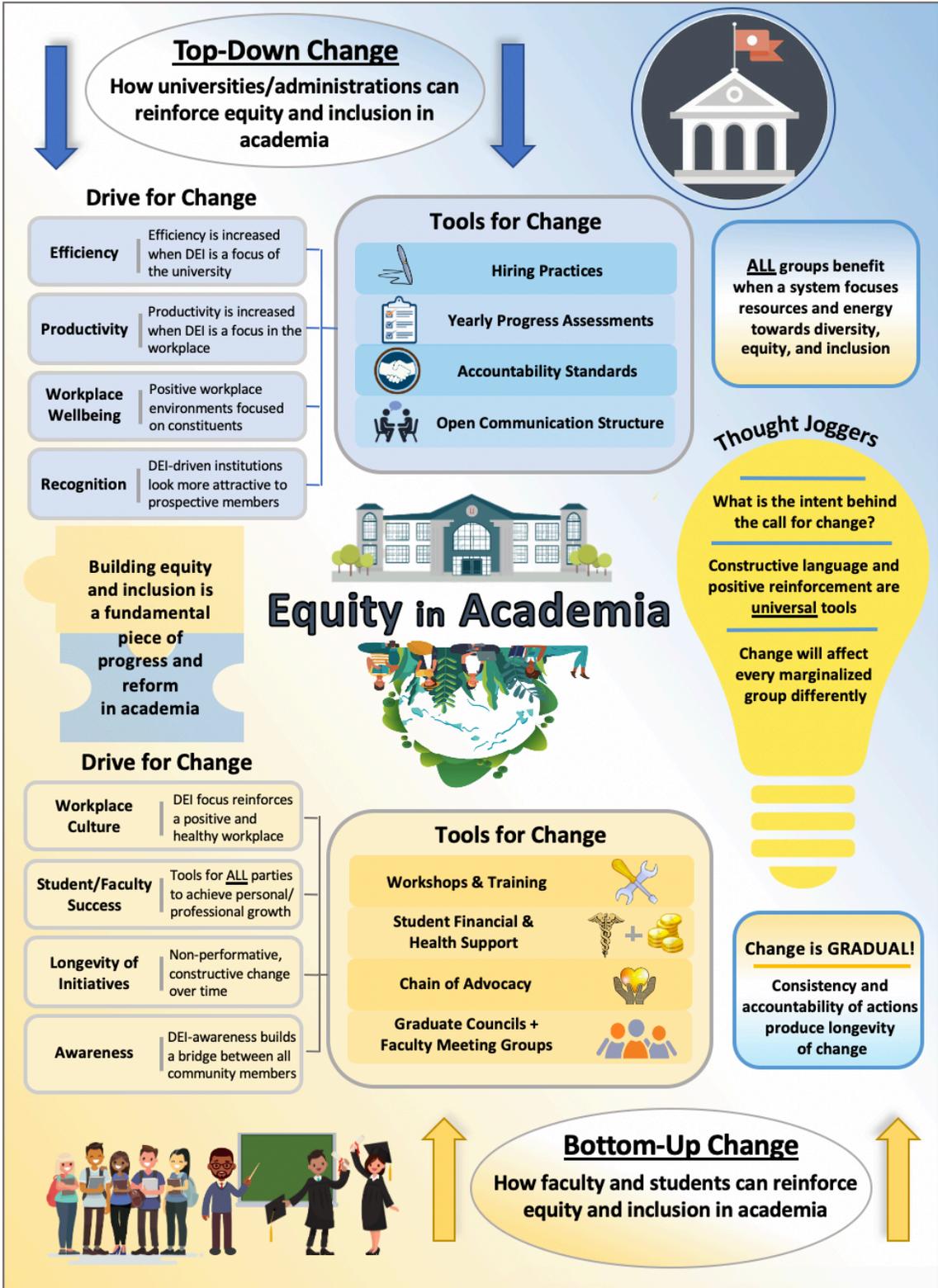
Tools for SESE Faculty and Students

Workshops and Training – Workshops and training for faculty and students play an important role in fostering a positive academic environment. It is important that the intent of incorporating JEDI workshops and the language around them be as constructive as possible (Dover et al., 2020). Intent, language, and realistic expectations of workshop outcomes are important considerations when offering workshops and trainings focused on JEDI initiatives.

Student Financial and Health Support – Offering students financial and health support, such as access to mental health counseling and emergency funding for unanticipated circumstances, is key in their continued success as graduate students. Retention and workplace positivity, as well as lowered psychological stress are all positive outcomes of this tool (Rogers & Molina, 2006). Comprehensive student health care and tuition support should be made routine in graduate student offer packages, at the very least. It is also equally as important that all available student benefits are clearly advertised in the most easily digestible and accessible manner in order to maximize student usage of such benefits.

Building Chains of Advocacy – Advocacy is a key aspect in building a positive workplace culture that empowers students to succeed and educates faculty on the needs of their students (Lee, 2018). Hand-in-hand with open communication structures, forging chains of advocacy among groups in academic settings is important in fostering an equitable and inclusive environment where voices are heard and actions can be taken to defend those voices (Uslu, 2018). Examples of this would be faculty yearly evaluations for constructive feedback, open department wide discussions, TA student-advocacy training, etc.

Graduate Councils and Faculty Meeting Groups – Advocacy, group culture, work-life management, and group mentality all benefit when small groups or coalitions are formed among individuals in an academic setting (Uslu, 2018). Fostering the growth and prosperity of these groups is paramount to building a more equitable and inclusive environment. Examples of groups can be graduate student councils, journal reading groups, identity-focused groups, etc. It is also important that bridges between these groups be well established in order to foster an inclusive ideology.



Impact Statement

SESE's commitment to broadscale change in the near future is important in fostering a more equitable, inclusive, and diverse academic community. The SESE JEDI task force has a finite amount of resources to shape the department for years to come. Using an integrated approach where top-down and bottom-up changes are made in tandem represents the most efficient and long-lasting course of action for the department. Each tool listed above has the potential to make SESE a more diverse, inclusive, equitable, and healthy work space that will, cultivate a more productive, well-rounded, and active community at all levels. It is paramount that, as SESE looks to the future, it takes stock in all of the tools listed above in order to make smaller changes with longevity that will shape the culture and ideology of the community as a whole. Having a positive intent for change and investing energy and time into the maintenance of these tools and their functionality will positively affect every member within the department. Using these tools, SESE will build a happier and more equitable workplace culture, it will foster the growth of a diverse student and faculty body, and will create a more productive academic environment that enables its members to achieve their own goals of success.

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This paper stresses the needs for inclusive, diverse, and equitable practices at the administrative level of academia when hiring and considering promotions, in order to retain faculty hires.

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Uslu, B. (2018). The components of communication systems in universities: Their influence on academic work life. *Tertiary Education and Management*, 24(1), 34–48. <https://doi.org/10.1080/13583883.2017.1359662>

Uslu discusses the communication structures in academia and their importance to a positive workplace environment.

Leveling the playing field: making fieldwork in SESE and CLAS more equitable and accessible

Claire Richardson

Executive Summary

For many disciplines, fieldwork is an integral part of coursework, instruction, and research, however it poses significant and manifold barriers to many whose backgrounds differ from the traditional majority group(s). This is especially true within the framework of justice, equity, diversity, and inclusion (JEDI), as well as when considering accessibility challenges. These barriers arise for a number of reasons and have their own unique ramifications, but all cause net harm. Not only does this negatively affect individuals, but also has larger systemic effects on entire academic fields, as talented individuals are disenfranchised and leave their studies or work altogether. These issues are stark in field-based disciplines, such as geology, but exist in all fieldwork settings. This white paper introduces actionable recommendations in order to address these challenges, both in the short and long terms. They are designed to increase the safety and improve the experiences of all students working in the field, and their implementation will lead not only to enhanced learning and teaching environments, but to the retention of more talent in academic and industrial fields.

1. Motivation

Fieldwork is a fundamental part of sciences within the School of Earth and Space Exploration (SESE) like geology, as well as other fields within the College of Liberal Arts and Sciences (CLAS) like geography, anthropology, ecology, and many more. For students, fieldwork provides an opportunity to tangibly interface with concepts that have been learned in the classroom. For instructors, it provides a distinct teaching environment and a way to better illustrate field-related course material. For researchers, it can be a vital tool for data collection, analysis, and experimentation. For undergraduate students in particular, field trips can expose aspiring scientists to potential field-based career paths, as well as aid in the development of a host of personal, interpersonal and professional skills (e.g., Elkins & Elkins, 2007; Feig, 2010; Fuller, 2006; McKenzie et al., 1986). Indeed, there is virtually no argument against the intrinsic value of fieldwork, however its modern implementation often lacks necessary inclusivity measures (e.g., Giles et al., 2020; Stokes et al., 2019). As fieldwork is such an important part of research and education for so many in SESE and CLAS, this harmful deficiency must be addressed.

Barriers to marginalized students in fieldwork occupy a vast range. These barriers include, but are not limited to, the cost associated with field gear and travel, the time commitment of field courses, trips, and campaigns, hostile policies and/or attitudes in communities that are local to field sites, limited accessibility or total inaccessibility to content for people with disabilities/impairments, and a heightened threat of sexual harassment and assault (e.g., Clancy et al., 2014; Giles et al., 2020; Nelson et al., 2017; Olcott & Downen, 2020). The consequences of

these barriers are, generally speaking, two-fold. First, individual students suffer as a result of having to grapple with these barriers, sometimes sustaining lasting trauma. Second, entire scientific fields suffer because these conditions create negative environments that cause or force students to leave their disciplines. This manifests as a systematic exclusion of talented individuals because of their non-traditional backgrounds, a lack of diverse perspectives on complex scientific problems, and a hinderance of overall scientific progress. Furthermore, these detrimental effects are often compounded due to individual students' intersectional identities (Alfred et al., 2019; Bernard & Cooperdock, 2018; Marín-Spiotta et al., 2020). Elimination or significant mitigation of fieldwork-associated barriers to students from marginalized groups is thus crucial to improving student experience, retention rates, and overall academic advancement. Fortunately, this work is achievable with short-term changes that are straightforward to implement, and long-term changes that will fundamentally improve fieldwork environments. Recommendations for these changes are described in the following section.

2. Recommendations

The recommendations in this section are presented in two categories: 1) short-term (ST) recommendations that are straightforward and can be implemented quickly, and 2) long-term (LT) recommendations that will require larger-scale changes to field curricula, policy, and instruction, which will ensure sustained, positive change. Some of the items, which have both short- and long-term components, appear in both sections. These recommendations, summarized in Appendix 1, are focused on improving the experiences and safety of undergraduate students in the field but may be applicable to others as well, such as faculty who conduct fieldwork with their research teams.

2.1 Short-Term Recommendations

The recommendations in this section focus on how instructors can improve active learning environments and field activities quickly and meaningfully, by bolstering students' sense of belonging and safety.

1. **Be an active ally and advocate for your students.** Fostering a safe and inclusive learning environment as an instructor is imperative. Instructors should be actively anti-discriminatory, and make it clear through words and actions that their goal is accessibility and safety. For example, this can be done through quickly addressing harmful behaviors such as homophobic, sexist, or ableist comments. As a key component of accessible and equitable learning spaces, students should always feel comfortable self-advocating (Roberts et al., 2016; Stokes et al., 2019).
2. **Discuss policies, expectations, and plans before leaving.** Instructors should have a dedicated class meeting before leaving for the field to explicitly discuss behavioral expectations. This meeting should include information about reporting mechanisms for

anyone who experiences harm or discrimination (e.g., sexual harassment or assault), and to discuss the plans for bathroom stops, sleeping and hygiene accommodations, and internet/phone accessibility. Instructors should be clear about zero-tolerance policies and/or consequences for bad behavior and misconduct, and ensure that the process of reporting incidents is as clear and straightforward as possible.

- 3. Acknowledge the first stewards of the land that enables your field instruction.** Fieldwork has long taken advantage of colonization and stolen land. Instructors must acknowledge any Native peoples whose land enables their work in syllabi and/or field material, and include this in the meetings described in ST recommendation #2. This is also expanded upon in LT recommendation #1.
- 4. Minimize costs.** Costs associated with fieldwork are an extremely significant barrier for many students, particularly for undergraduates (Scerri et al., 2020). Instructors should actively review field itineraries for places to cut initial costs. An example of this would be to begin a shareable document that serves as a gear library, where members of the department can list loanable gear for class field trips or longer field camps. Additionally, cooking at camp or making sandwiches during the day instead of going out to eat is good practice. Longer-term solutions are necessary however, which are expanded upon in LT recommendation #2.

2.2 Long-Term Recommendations

This set of recommendations describes actions that will require more substantial changes to field curricula, instruction, and policy. These actions will take more time than those in section 2.1 to develop and carry out as they are designed to build a strong foundation of JEDI and accessibility in SESE and other CLAS fieldwork. Some of these items are more detailed, as they are comprehensive and multi-faceted.

- 1. Develop relationships with the Native peoples of the land you use.** As with ST recommendation #3, it is imperative that the first stewards of the land of field localities are acknowledged. In order to build a meaningful foundation of justice in fieldwork, however, this work must be expanded to include the development of a relationship with local tribes, especially if a site holds Native significance.
- 2. Minimize costs.** As touched on in ST recommendation #4, cost is a significant barrier for many in field-related disciplines. Long-term solutions to this that departments should take are, for example, purchasing camping gear and necessary field tools that can be issued to students for field trips and longer field camps, minimizing “special fees”, and minimizing or subsidizing the excess costs of weeks-long field camps.

- 3. Develop a risk assessment that focuses on student background.** Departments should develop a standardized, comprehensive risk assessment that, in addition to including information about outdoor hazards, oblige instructors to consider the experiences of their minoritized and non-traditional students. This should include potential threats from communities that are local to field sites, (e.g., countries with anti-LGBTQ+ laws, communities that have any record of racial violence/hostility, etc.). If necessary, these assessments should be accompanied in some capacity by relevant trainings (e.g., how de-escalate tense situations) (Anadu et al., 2020; Olcott & Downen, 2020).

- 4. Design field trips and material to be more accessible for students with disabilities or impairments.** Accessibility to field sites and material can be extremely or entirely prohibitive to people with disabilities and/or impairments. Field sites should be scouted and chosen to ensure maximum physical accessibility, and instructors should take advantage of technology and multiple teaching modalities. If all sites cannot be made accessible for people with physical disabilities and/or impairments, remote synchronous and asynchronous learning should be employed via technology like walkie-talkies, iPad applications, Local Area Networks (LANs), GoPro cameras, etc. (Whitmeyer et al., 2020). Additionally, multiple modalities for experiencing field trips should be developed and made available for people with cognitive disabilities or learning impairments, such as tactile geological maps of field areas, audio recordings of lessons, and/or field assistants (e.g., Feig et al., 2019; Hendricks et al., 2017; Stokes et al., 2019; Whitmeyer et al., 2020). Sufficient time should be given to students to finish tasks without rushing to keep up with the class. Keep in mind that, while additional learning modalities are necessary for some individuals, multiple modalities are good resources for *all* students to have access to.

- 5. Critically evaluate learning outcomes and be flexible.** As academia and society become more technologically advanced, and as more data become available to academic communities, both small- and large-scale reconsiderations of the role of fieldwork must occur (Giles et al., 2020; Scerri et al., 2020; Stokes et al., 2019). For any course with a field component, instructors must ensure that field activities are scientifically relevant and in line with current field practices, especially if they are at sites that are directly inaccessible (LT recommendation #4) or potentially dangerous to some students (LT recommendation #3). Learning outcomes should focus on students' academic and professional development as scientists, and field trips should be designed accordingly. In accordance with this and on a larger scale, weeks-long field courses should not be mandatory. As geoscience and other fields that have traditionally involved significant fieldwork components become more diverse, and to facilitate that growth of diversity, it is no longer appropriate to require that all students spend weeks in the field. For example, students with children may not be able to leave home for the duration of the course, and others who want to pursue non-field-based paths may wish to take a different, more relevant course. An online or other alternative option should be developed and made available. Finally, for field trips or field courses, instructors must always be prepared to be flexible with their learning outcomes. Given that field environments can be variable and

unexpected events can occur suddenly that affect a student's safety or ability to continue a project, the instructor should be willing and able to adapt their lessons and plans.

3. Projected Outcomes and Impacts

SESE and CLAS have both responded to the widespread social justice movements of 2020 by renewing and bolstering their commitments to making their academic spaces more just, equitable, diverse, and inclusive. Additionally, challenges related to the COVID-19 pandemic have forced both entities to apply their resources toward effective online learning, which has been informed in part by work that has long been active in the accessibility community (e.g., Carabajal et al., 2017; Cooke et al., 1997; Nairn, 1999; Sugerman, 2001; Whitmeyer et al., 2020). Implementing the recommendations presented here is directly in line with the proposed and ongoing efforts of these commitments and responsibilities, as they not only protect students, but allow for more equal learning experiences and career preparation. With dedication to ensuring these measures, the resulting improvements in accessibility, safety, and the overall environment of fieldwork will ultimately yield higher retention rates of non-traditional students, and healthier, happier, and more productive academic environments for all. These recommendations illustrate ways to make effective, meaningful, non-performative change, and are critical to showing SESE and CLAS members that they are essential and valued in their academic communities.

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

This article discusses issues that BIPOC in particular face in the field and gives ten detailed action items on how to combat them.

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

This article shows that the geosciences are one of the least diverse STEM fields, and that that issue has been persistent for the last four decades.

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>

This is a review of instructional strategies in the geosciences that focuses on mitigating barriers for students with disabilities.

Clancy, K. B. H., Nelson, R. G., Rutherford, J. N., & Hinde, K. (2014). Survey of Academic Field Experiences (SAFE): Trainees Report Harassment and Assault. *PLoS ONE*, 9(7). <https://doi.org/10.1371/journal.pone.0102172>

The survey and results that are described in this article show that sexual harassment and assault are a major barrier for women in fieldwork.

Cooke, M. L., Anderson, K. S., & Forrest, S. E. (1997). Creating Accessible Introductory Geology Field Trips. *Journal of Geoscience Education*, 45(1), 4–9. <https://doi.org/10.5408/1089-9995-45.1.4>

This article presents three accessible field exercises based on best practices, and in accordance with federal accessibility laws.

Elkins, J. T., & Elkins, N. M. L. (2007). Teaching geology in the field: Significant geoscience concept gains in entirely field-based introductory geology courses. *Journal of Geoscience Education*, 55(2), 126–132. <https://doi.org/10.5408/1089-9995-55.2.126>

This study shows that students showed statistically significant improvements in geology concept knowledge after taking a field-based introductory course.

Feig, A. D. (2010). Technology, Accuracy and Scientific Thought in Field Camp: An Ethnographic Study. *Journal of Geoscience Education*, 58(4), 241–251. <https://doi.org/10.5408/1.3534863>

This article discusses the technological dependencies that students can develop, and the knowledge gaps that can result. It advocates for the importance of field instruction.

Feig, A. D., Atchison, C. L., Stokes, A., & Gilley, B. (2019). Achieving Inclusive Field-based Education: Results and Recommendations from an Accessible Geoscience Field Trip. *Journal of the Scholarship of Teaching and Learning*, 19(2), 66–87. <https://doi.org/10.14434/josotl.v19i1.23455>

This article describes a Geological Society of America accessible field trip that took place 2014, including the tools and strategies used. It presents the results and makes recommendations for accessible and inclusive field trips.

Fuller, I. C. (2006). What is the value of fieldwork? Answers from New Zealand using two contrasting undergraduate physical geography field trips. *New Zealand Geographer*, 62, 215–220. <https://doi.org/10.1111/j.1745-7939.2006.00072.x>

This article describes the results of surveys and focus groups of undergraduate students after taking two geography field trips. The results of the study show that fieldwork is highly valued by students.

Giles, S., Jackson, C., & Stephen, N. (2020). Barriers to fieldwork in undergraduate geoscience degrees. *Nature Reviews Earth & Environment*, 1, 77–78. <https://doi.org/10.1038/s43017-020-0022-5>

This article gives an honest discussion of realistic barriers that diverse students face during fieldwork, and expresses a need for the updating of field curricula.

Hendricks, J. E., Atchison, C. L., & Feig, A. D. (2017). Effective Use of Personal Assistants for Students With Disabilities: Lessons Learned From the 2014 Accessible Geoscience Field Trip. *Journal of Geoscience Education*, 65, 72–80. <https://doi.org/10.5408/16-185.1>

This article describes a fieldtrip with a personal assistant for students with cognitive disabilities. It indicates that personal assistants, if available, can be effective in improving accessibility.

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>

This paper discusses current and historical issues in the geosciences and STEM in general, and the problems with metaphorical structures, like the "leaky pipeline", traditionally used to address a lack of diversity. It advocates for a larger-scale overhaul of academic culture and behavior.

McKenzie, G. D., Utgard, R. O., & Lisowski, M. (1986). The Importance of Field Trips: A Geological Example. *Journal of College Science Teaching*, 16(1), 17–20.

This paper gives a historical perspective on the importance of fieldwork for the intellectual development of geology students.

Nairn, K. (1999). Embodied Fieldwork. *Journal of Geography*, 98(6), 272–282. <https://doi.org/10.1080/00221349908978941>

This paper discusses how students learn to think and act like field scientists (particularly field geographers) and how students with disabilities experience this "embodiment".

Nelson, R. G., Rutherford, J. N., Hinde, K., & Clancy, K. B. H. (2017). Signaling Safety: Characterizing Fieldwork Experiences and Their Implications for Career Trajectories: Lived Experiences in the Field. *American Anthropologist*, 119(4), 710–722. <https://doi.org/10.1111/aman.12929>

This is a follow-up study to Clancy, et al., 2014. This paper dives more deeply into the initial survey data to determine longer-lasting effects of sexual assault and harassment that occurs in the field.

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

This article describes the survey results of the experiences of LGBTQ+ geoscience researchers. The survey focuses on intersectional identities of the subjects, and shows that many feel unsafe during fieldwork. A striking imbalance with respect to power dynamics is present in the data.

Roberts, E. L., Ju, S., & Zhang, D. (2016). Review of Practices That Promote Self-Advocacy for Students With Disabilities. *Journal of Disability Policy Studies*, 26(4), 209–220. <https://doi.org/10.1177/1044207314540213>

This paper focuses on self-advocacy as a key part of accessible and inclusive instruction, and gives a review of practices used to foster environments where students are comfortable advocating for themselves.

Scerri, E. M. L., Kühnert, D., Blinkhorn, J., Groucutt, H. S., Roberts, P., Nicoll, K., Zerboni, A., Orijemie, E. A., Barton, H., Candy, I., Goldstein, S. T., Hawks, J., Niang, K., N'Dah, D., Petraglia, M. D., & Vella, N. C. (2020). Field-based sciences must transform in response to COVID-19. *Nature Ecology and Evolution*, 4, 1571–1574. <https://doi.org/10.1038/s41559-020-01317-8>

This article discusses the issues that the COVID-19 pandemic has made apparent in field-based sciences, and gives ways that these fields should transform in response to the lessons learned. Several of these are congruous with accessibility recommendations due to the increase in online instruction.

Stokes, A., Feig, A. D., Atchison, C. L., & Gilley, B. (2019). Making geoscience fieldwork inclusive and accessible for students with disabilities. *Geosphere*, 15(6), 1809–1825. <https://doi.org/10.1130/GES02006.1>

This article describes an accessible Geological Society of America field workshop, and advocates for the employment of accessible field curricula in the geosciences.

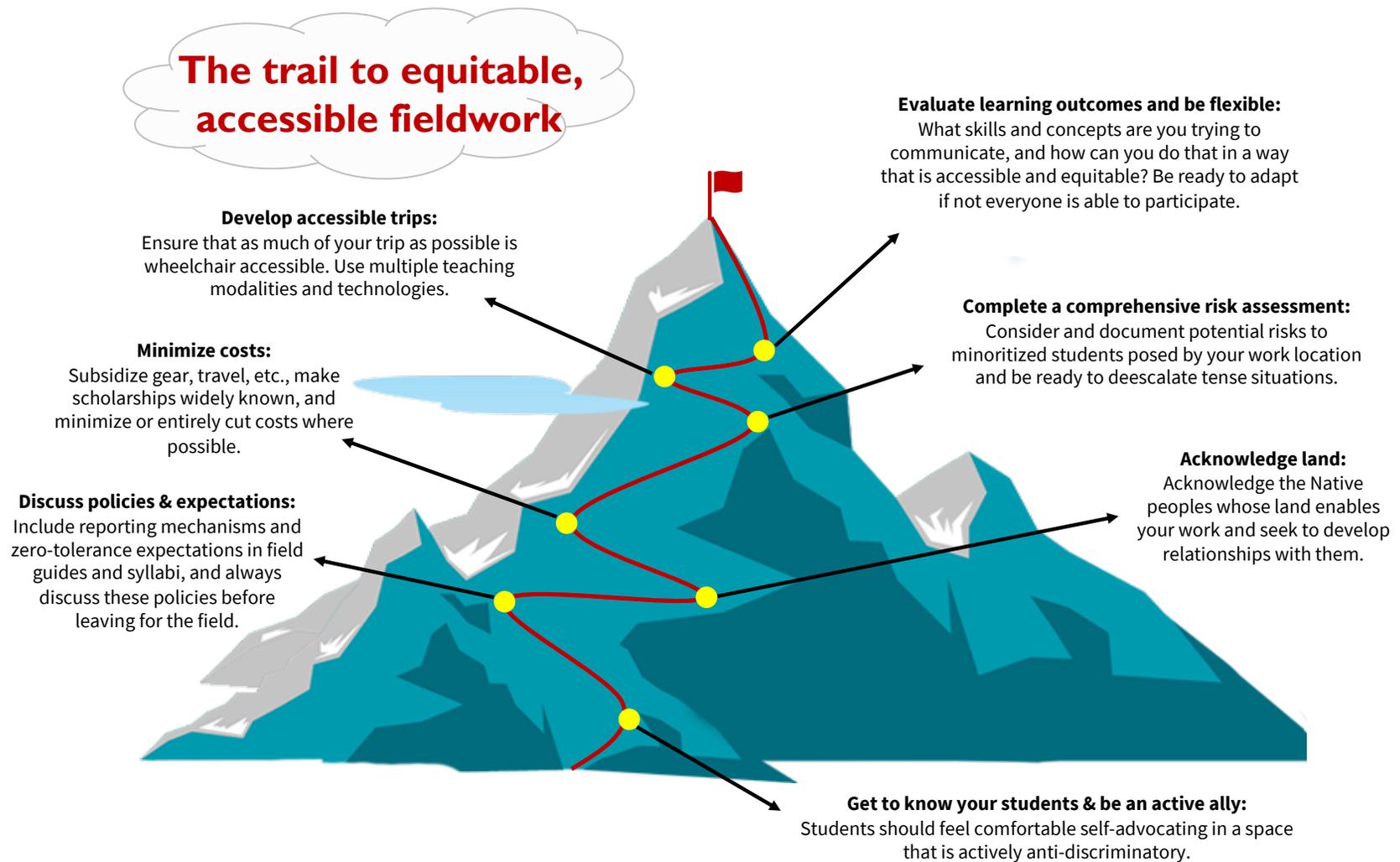
Sugerman, D. (2001). Inclusive outdoor education: Facilitating groups that include people with disabilities. *Journal of Experiential Education*, 24(3), 166–172. <https://doi.org/10.1177/105382590102400307>

This article develops and describes the Model for Inclusive Facilitation for making outdoor education accessible for people with disabilities.

Whitmeyer, S. J., Atchison, C., & Collins, T. D. (2020). Using Mobile Technologies to Enhance Accessibility and Inclusion in Field-Based Learning. *GSA Today*, 30(9), 4–10. <https://doi.org/10.1130/GSATG462A.1>

This article describes two field trips where diverse technologies were used to promote accessible learning. They report on the technology that they used, including the drawbacks, and ultimately conclude with recommendations for the use of technology in fieldwork.

6. Appendix 1



“The trail to equitable, accessible fieldwork” summarizes seven actions that can be taken to make fieldwork environments more safe, accessible, inclusive, and equitable.