Increasing Diversity in the Geosciences

Studies show that increasing students' "sense of belonging" may help retain underrepresented minorities in geoscience fields. A few programs highlight successes.

Graduate students at Michigan Technological University involved with the Michigan AGEP Alliance interdisciplinary learning community. AGEP stands for Alliances for Graduate Education and the Professoriate. Credit J. E. Huntoon

By Jacqueline E. Huntoon, Courtney Tanenbaum, and Jill Hodges 9 March 2015

Similar to many science, technology, engineering, and mathematics (STEM) disciplines, the geosciences suffer from a lack of racial and ethnic diversity, particularly at doctoral levels and within academia.

Unfortunately, the geosciences have the lowest diversity of all the STEM fields at all levels of higher education [*National Center for Science and Engineering Statistics,* 2015].

To increase the capacity of institutions of higher education to prepare domestic underrepresented minority students for academic positions in STEM, the National Science Foundation (NSF) created the Alliances for Graduate Education and the Professoriate (AGEP) grant program. Through AGEP grants, studies have identified factors that reduce the likelihood that underrepresented minority students will complete a Ph.D. and pursue an academic career in STEM.

Emerging research (http://www.nsf.gov/geo/diversity/geo_diversity_strategy_document_jan_01.jsp) focuses on ways to mitigate those factors, enhance underrepresented minorities' persistence in doctoral programs, and increase their interest and success in academic careers. Increasing students' sense of belonging in STEM appears to be a particularly promising strategy for enhancing diversity.

Facing Stereotype Threat and Imposter Syndrome

Two general categories of factors disproportionately and negatively impact underrepresented minority students: stereotype threat and imposter syndrome. Both adversely affect students' persistence and career aspirations in STEM.

Even though group-wide generalizations normally prove false for specific individuals, they still influence how people see themselves and can have negative impacts.

"Stereotype threat (http://www.apa.org/research/action/stereotype.aspx)" is a term used to describe the concept of some people being good or not good at something simply because they self-identify as a member of a group for which a stereotype of ability applies. Even though group-wide generalizations normally prove false for specific individuals, they still influence how people see themselves and can have negative impacts. For example, a common misperception holds that women are not good at math; identifying with this stereotype can, in and of itself, affect women's performance in math [*Spencer,* 1999].

Research shows that the impact of stereotype threat is most pronounced among people who care deeply about how well they will do on a traditional test or another type of assessment [*Steele and Aronson,* 1995; *Steele,* 2003]. This outcome is logical because people who are extremely concerned about their performance are likely to expend mental energy worrying about whether their potential for success is intrinsically limited. Additional research shows that the act of worrying about one's performance, even subconsciously, results in cognitive load that reduces performance [*Steele,* 2010].

Any doubts that stereotype threat is a real phenomenon can be allayed by *Frontline*'s "A Class Divided (http://www.pbs.org/wgbh/pages/frontline/shows/divided/)" [*Peters,* 1985], which shows the impact of stereotypes on behavior and performance. The segment chronicles an exercise in which teacher Jane Elliot divided

her all-white third-grade class into two groups based on eye color. On one day the brown-eyed children were told that they were inferior, were required to wear collars, and were constantly criticized, whereas the blue-eyed children were praised and given special privileges. Subsequently, the roles of the two groups were reversed. In both cases, the "inferior" group performed poorly on assessments, and the "superior" group behaved maliciously. Elliot's exercise has been repeated many times, with the same outcomes.

"Imposter syndrome (http://counseling.caltech.edu/general/InfoandResources/Impostor)" describes the sense of feeling not "good enough" to be a member of a particular community. People who are affected by imposter syndrome often fear that others will discover that they are undeserving of their position and expose them as imposters, which will cause them to lose their status [*Young,* 2011]. Feelings of being an imposter can result in diminished self-efficacy, increased cognitive load, and decreased performance.

People suffering from imposter syndrome also have difficulty accepting and internalizing evidence of their own competence and intelligence. Even people who appear to be highly successful by all outward measures can suffer from imposter syndrome; these individuals suspect that their achievements are the result of luck or accident rather than their own talent and actions.

Imposter syndrome may affect some individuals more than others, particularly those who are in the minority or who lack role models. For example, if no Native American faculty are in a geology department, a Native American student might feel that the goal of becoming a geology professor is unattainable. Even if the student eventually becomes a faculty member, this sense of being an imposter might continue.

A TED talk (http://www.ted.com/talks/amy_cuddy_your_body_language_shapes_who_you_are?language=en) by social psychologist Amy Cuddy explains how nonverbal expressions of power and dominance influence how we think and feel about ourselves as well as how others see us. The popularity of this talk, viewed by more than 23 million people and translated into 40 languages, suggests that many people strive to overcome the feeling that they are imposters [*Cuddy,* 2012].

Seeking Support: Friends and Mentors

Research shows that the effects of stereotype threat and imposter syndrome can be mitigated by increasing students' sense of belonging [*Walton and Cohen,* 2007]. Sense of belonging is characterized by feeling welcomed, recognized, included, and appreciated. The feeling is fostered by trust, supportive relationships, and cross-group and cross-cultural dialogues about belonging in a specific setting [*Steele,* 2010].

When we feel comfortable with someone, we experience a positive emotional response that allows us to be more open to and speak freely about new ideas.

Having a sense of belonging not only mitigates experiences of stereotype threat and imposter syndrome but is also conducive to learning. One set of brain circuitry is used for thinking about those whom we perceive as similar to ourselves ("friends"), whereas a different set is used for thinking about those whom we view as different ("foes"). When we feel comfortable with someone (a member of the friend category), we experience a positive emotional response that allows us to be more open to and speak freely about new ideas. This openness increases the speed of learning and the ability to apply learning to new and different situations [*Rock,* 2009].

Examples of Strong Mentoring Programs

Strong mentoring programs and vibrant intellectual communities increase students' sense of belonging [*Wilson and Linville,* 1982; *Good et al.,* 2012]. For example, Minorities Striving and Pursuing Higher Degrees of Success (MS PHD'S (http://www.msphds.org/)) and the National GEM Consortium (http://www.gemfellowship.org/) connect graduate students and professionals from underrepresented minority groups across the nation to provide students with access to supportive mentors. These organizations build underrepresented minority students' sense of belonging by providing them with opportunities to develop their own professional network [*Johnson and Lucero,* 2003; *Pyrtle and Williamson Whitney,* 2008].

The Michigan AGEP Alliance (http://michagep.org/), currently under way at five research universities in Michigan, promotes STEM students' sense of belonging by engaging students and faculty in campus-based interdisciplinary learning communities and mentoring programs. Together, the learning communities and mentoring programs provide participants with opportunities to share experiences and strategies for academic success in a supportive setting.

The Fisk-Vanderbilt Master's-to-PhD Bridge Program (http://www.vanderbilt.edu/gradschool/bridge/) [*Stassun et al.,* 2011] provides another model for mentoring underrepresented minorities and building their sense of belonging and self-efficacy in a supportive yet challenging environment. One lesson learned by the Fisk-Vanderbilt team is the importance of "making the implicit explicit" [*Stassun,* 2013]. Expectations in academia need to be clearly identified and explained so that students who are not inherently familiar with academic culture and processes can be prepared to meet the challenges they will face.

Increasing Diversity for the Benefit of All

The programs described above, along with many others, help underrepresented minority students earn graduate degrees and pursue academic careers in STEM. Mounting evidence shows that efforts to attract

and retain diverse students are enhanced when successful professionals promote students' sense of belonging by recognizing potential, encouraging aspiration, and providing accurate information to students about how to achieve their academic goals.

Indications of the inherent benefits of diversity are also growing [*Page,* 2008]. A diverse academic workforce will be better prepared to understand and respond to the needs of society by offering a wider array of perspectives and innovative approaches to solving national and global challenges. Thus, increasing diversity in academia may ultimately benefit us all.

Acknowledgments

The authors thank NSF for support received from awards HRD-1305678 (J.E.H.) and HRD-1029477 (C.T.).

References

Cuddy, A. (2012), Your body language shapes who you are, talk presented at TEDGlobal 2012, Edinburgh, U. K. [Available at http://www.ted.com/talks/amy_cuddy_your_body_language_shapes_who_you_are?language=en]

Good, C., A. Rattan, and C. S. Dweck (2012), Why do women opt out? Sense of belonging and women's representation in mathematics, *J. Pers. Soc. Psychol., 102*(4), 700–717.

Johnson, S. D., and C. Lucero (2003), Transforming the academic workplace: Socializing underrepresented minorities into faculty life, in *Pan-Organization Summit on the U.S. Science and Engineering Workforce Meeting Summary,* edited by M. A. Fox, pp. 138–144, Natl. Acad. Press, Washington, D. C.

National Center for Science and Engineering Statistics (2015), *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2015, Spec. Rep. NSF 15-311,* Natl. Sci. Found., Arlington, Va. [Available at http://www.nsf.gov/statistics/wmpd/.]

Page, S. E. (2008), *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies,* Princeton Univ. Press, Princeton, N. J.

Peters, W. (Producer) (1985), A Class Divided, *Frontline,* WGBH Educ. Found., Boston, aired 26 March. [Available at http://www.pbs.org/wgbh/pages/frontline/shows/divided/.]

Pyrtle, A. J., and V. A. Williamson Whitney (2008), To attract, engage, mentor, and sustain: Outcomes from the Minority Students Pursuing Higher Degrees of Success (MSPHD'S) in Earth System Science® Pilot Project, *J. Geosci. Educ., 56*(1), 24–32.

Rock, D. (2009), *Your Brain at Work: Strategies for Overcoming Distraction, Regaining Focus, and Working Smarter All Day Long,* HarperCollins, New York.

Spencer, S. J. (1999), Stereotype threat and women's math performance, *J. Exp. Soc. Psychol., 35*(1), 4–28.

Stassun, K. G. (2013), Addressing chilly climates in science and engineering PhD programs: Lessons from the Fisk--Vanderbilt Bridge Program, paper presented at 2013 STEM Symposium, Am. Inst. for Res., Washington, D. C. [Available at http://bit.ly/EOSFVBridge.]

Stassun, K. G., S. Sturm, K. Holley-Bockelmann, A. Burger, D. J. Ernst, and D. Webb (2011), The Fisk-Vanderbilt Master's-to-Ph.D. Bridge Program: Recognizing, enlisting, and cultivating unrealized or unrecognized potential in underrepresented minority students, *Am. J. Phys., 79*(4), 374–379.

Steele, C. (2003), Stereotype threat and African-American student achievement, in Y*oung, Gifted, and Black: Promoting High Achievement Among African American Students,* edited by T. Perry, C. Steele, and A. Hilliard III, pp. 109–130, Beacon, Boston, Mass.

Steele, C. (2010), *Whistling Vivaldi and Other Clues to How Stereotypes Affect Us,* W. W. Norton, New York.

Steele, C. M., and J. Aronson (1995), Stereotype threat and the intellectual test performance of African Americans, *J. Pers. Soc. Psychol., 69*(5), 797–811.

Walton, G. M., and G. L. Cohen (2007), A question of belonging: Race, social fit, and achievement, *J. Pers. Soc. Psychol., 92*(1), 82–96.

Wilson, T. D., and P. W. Linville (1982), Improving the academic performance of college freshmen: Attribution therapy revisited, *J. Pers. Soc. Psychol., 42*(2), 367–376.

Young, V. (2011), *The Secret Thoughts of Successful Women: Why Capable People Suffer from the Imposter Syndrome and How to Thrive in Spite of It,* Crown Business, New York.

Author Information

Jacqueline E. Huntoon, Department of Geological and Mining Engineering and Sciences and Graduate School, Michigan Technological University, Houghton; email: jeh@mtu.edu (mailto:jeh@mtu.edu); Courtney Tanenbaum, American Institutes for Research, Washington, D. C.; and Jill Hodges, Institutional Equity, Michigan Technological University, Houghton

Citation: Huntoon, J. E., C. Tanenbaum, and J. Hodges (2015), Increasing diversity in the geosciences, *Eos, 96,* doi:10.1029/2015EO025897. Published on 9 March 2015.