

Teaching for Earth Resilience: A Strategy for Increased Diversity and Equity

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INTRODUCTION

The geosciences fall behind all other reporting science, technology, engineering, and math (STEM) fields in graduation rates of underrepresented minorities (URM) (Wilson, 2017). Improving diversity and inclusion in our profession is important not only to meet the demand of our workforce, it is critical for improving community and policy outcomes. For this reason, we suggest that geoscience educators adopt a focus on earth resilience and the approaches it requires. Earth resilience is the ability to equitably, justly, and sustainably manage, plan, and adapt to resource challenges at local to global scales. The work of earth resilience professionals (e.g., disaster planning, environmental justice) calls for more than disciplinary skills and habits; it relies on empowering the talents of underrepresented and marginalized communities and networking to improve outcomes. Drawing from these strategies, earth educators might support more diverse and inclusive geosciences by (1) connecting with URM students through culturally and societally relevant curriculum that builds the disciplinary and civic skills and habits needed for social change, and (2) creating networks that expand entry points, mentoring, representation, and career preparation (Fig. 1). We describe examples of strategies that begin to empower URM students and call for greater investment on their behalf.

CURRICULUM FOR SOCIAL CHANGE

Equitably and justly addressing challenges like climate change, natural disasters, air quality, water quality, challenges

that disproportionately impact underrepresented and marginalized populations, calls for a curriculum that goes beyond our traditional view of core competencies (e.g., Mosher et al., 2014). Outcomes in communities will be determined by how well our graduates can navigate codes, laws, and power structures, as well as their ability to work across disciplines, cultures, and identities. Those working on earth-resilience challenges (e.g., disaster response) navigate these challenges by working in and with the communities and engaging them in all aspects of project development (e.g., NRC, 2012). Outcomes improve when barriers to participation are reduced and efforts incorporate the interests and strategies that resonant with communities (NRC, 2012). Education that engages students in communities to address resilience priorities provides a mechanism for developing these skills.

Within our courses, active, societally and culturally relevant engagement provides students with the skills and habits needed for both geoscience and social change. Active learning (e.g., low stakes practice of skills and habits) reduces disproportionately high URM student failure rates in STEM disciplines (Freeman et al., 2014). The historically black colleges and universities geosciences working group has also identified a need to incorporate culturally (e.g., Pan-African) and societally relevant content that appeals to diverse students (Archer et al., 2019). More than 50% of URM STEM students surveyed rated *working for social change* as an “essential” or “very important” professional goal, significantly more than

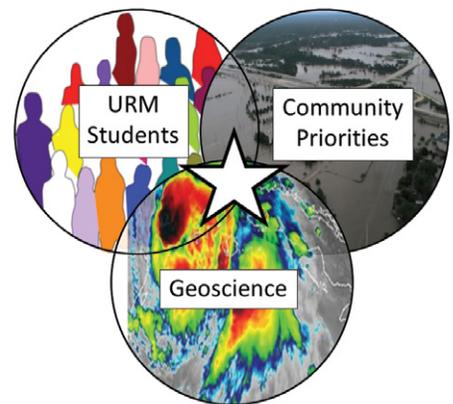


Figure 1. An earth-resilience approach to geoscience education features an intentional focus on improving underrepresented minority (URM) student and community outcomes. Within our courses, active and culturally situated learning co-delivers disciplinary and civic skills and habits needed to improve community outcomes. Networks expand entryways, mentors, representation, resources, and opportunities for URM students.

non-URM students (Garibay, 2015). The InTeGrate Project (<https://serc.carleton.edu/integrate/>) offers insight into how to join the skills and habits identified by professionals with the skills and habits needed for social change (Gosselin et al., 2019). Openly available course modules engage students in evaluating the reliability of information (e.g., *Carbon, Climate and Energy Resources*), analyzing justice issues (e.g., *Environmental Justice and Freshwater Resources*), mirroring the community participatory process (e.g., *Food as the Foundation for Healthy Communities*), and connecting earth challenges to governance and ethics (e.g., *Lead in the Environment*).

NETWORKS TO BUILD CAPACITY

Networks with broader communities are sorely needed to improve geoscience student outcomes. Undergraduates especially need relevant work experience. Yet most geoscience graduates have only completed one research experience, and fewer than 60% have had an internship (Wilson et al., 2017). Access to opportunities is especially important at two-year colleges, which serve the greatest percentage of URM students but often face greater barriers (e.g., time, resources). Building and capitalizing on networks can improve pathways into the geosciences; expand perspectives, representation, or mentoring opportunities; and link learning about Earth to community concerns and employment opportunities. Programs that engage K–12 schools, employers, community groups, alumni, or other programs expand interest, mentoring, representation, and access to research, internship, and geotechnical opportunities.

One example that expands URM student opportunities using networks is NSF-funded *Service Learning Activities Targeting the Earth Science*, which engages students in service-learning opportunities around local water issues. The program unites El Paso Community College, The University of Texas at El Paso, and El Paso Water Utilities in developing activities that attract new geoscience majors and actively work with communities on priority issues (Doser, 2018). Another example is the EarthConnections project. Developed through pilots in three communities, EarthConnections

emphasizes co-creation with the community, coupling of classroom learning and community application, connecting learning opportunities for students of different ages, and mentoring and signposting that help students define an educational path aligned with their interests (Manduca et al., 2018).

The next step toward earth resilience is to move from a few examples to a widespread effort to connect geoscience learning and resilience both locally and globally. This approach will help make our discipline relevant and reciprocal with diverse communities, diversify our science, and strengthen the capacity for living successfully and equitably on Earth.

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