NSF INCLUDES Alliance: Using EarthConnections Pathways to Develop Local Scientific and Workforce Capacity with Communities

Submitted March 30, 2018

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This is an extract from the proposal. Further information:
https://serc.carleton.edu/earthconnections/ECproposal.html

Vision

Intellectual Merit

The EarthConnections Alliance seeks to create a world in which all students in our country can travel along educational pathways toward meaningful careers while linking geoscience learning with opportunities to serve their local community. Individually, these pathways and the students who use them strengthen and diversify the geoscience workforce and enhance the ability of their communities to use science. Collectively, the EarthConnections Alliance links community leaders, scientists, and educators to advance sustainability, resilience, and environmental justice nationally while shifting the culture of geoscience toward more inclusiveness and relevance. This common agenda has been adopted by 120 founding members of the alliance.

Many of the socio-scientific challenges communities face today – adapting to climate change; recovering from natural disasters; dealing with pollution and land degradation; accessing clean water, healthy food, and clean energy – require geoscience knowledge. These challenges are particularly acute for minority, low socio-economic status, and under-served communities (e.g., Blaikie, Cannon, Davis, & Wisner, 2014; Cutter, 2006; Maldonado, Colombi, & Pandya, 2014). Marginalized communities often live in areas disproportionately impacted by natural hazards, climate change, and environmental degradation (Hauer, Evans, & Mishra, 2016; Thornton et al., 2014), while having less access to the benefits provided by scientific innovation (Agyeman, Bullard & Evans, 2002; Bullard, 2000). Science-community partnerships have enormous potential for empowering underserved communities, but research has yet to reveal actionable principles for building such partnerships across contexts (NRC, 2011, NAS, 2016a).

At the same time, the geosciences suffer from a severe lack of diversity—people from these communities are not well represented in the geoscience workforce (Gonzales & Keane, 2010; NSF/NCSES, 2015; PCAST, 2012; Wilson, 2016). The geosciences, like many sciences, are still learning to respectfully collaborate with local knowledge and capacity. This means the most vulnerable communities have less access to current geoscience and less voice in setting a research agenda that addresses their future needs. Research that investigates the ways geoscience pathways can broaden access to contextualized knowledge to solve community-based environmental problems is desperately needed.

Geoscience education is still rising to the challenge: opportunities are unconnected across grade levels and into college, career endpoints are hard to see, research experiences often take students out of their communities and away from community-relevant work, and many institutions do not provide enough support for diverse viewpoints or for integrating multiple ways of knowing (Kesidou and Roseman, 2002; Bodzin, 2012; NSSE, 2015; Macdonald, Manduca, Mogk & Tewksbury, 2005; Levine et al., 2007; NAS 2011; NRC, 2011; Holmes & O'Connell, 2008; O'Connell & Holmes, 2011; Stokes, Levine, & Flessa,

2015). Research offers some guidelines for re-integrating education and community needs, but these have yet to be tested and deployed at scale.

The net result is a positive feedback in the negative direction: too few diverse geoscientists and too little cultural awareness within geoscience leads to a disconnect between geoscience and diverse communities. This contributes to irrelevance of geoscience for those communities, meaning fewer students from those communities enter geoscience or take geoscience training or skills into other careers.

We propose to catalyze a new approach to geoscience education that disrupts this destructive feedback: a geoscience education that focuses on students, especially students from underserved communities, and helps them navigate pathways throughout education (formal and informal) to locally relevant jobs. Four INCLUDES Design and Development Launch Pilots (DDLP) come together to create this new vision. Individually, they have piloted strategies for linking community needs with educational opportunities, connecting educational elements into pathways, and supporting local work in many places to create change on a national scale. Together, we will focus on supporting local communities across the nation in enhancing their existing geoscience educational components into this new kind of transformative pathway.

EarthConnections (EC) pathways emphasize the connections between students, science, and their community, nurturing an identity that links individual agency, community knowledge, and science; and that contributes to persistence in STEM (Estrada, Woodcock, Hernandez, & Schultz, 2011). The pathways address engagement, capacity, and continuity, critical factors in supporting underrepresented groups in STEM (Jolly, Campbell, & Perlman, 2004), while allowing for multiple points of entry, exit, and reentry (NAS, 2016b). By encouraging students and their local community to identify and define what the geosciences mean to them in the context of their own community (Lewis & Baker, 2010), EC pathways enhance geoscience interest (*engagement*). Through facilitated exchanges of knowledge and skills – not just scientific knowledge but the rich traditional, cultural, and historical knowledge communities bring – we frame new learning opportunities for geoscience experts, local communities, and students (*capacity*). Programmatic elements are in place at all educational levels and elements to guide participants along the pathway and into the workforce are embedded (*continuity*). Combining these three ideas – community relevance, educational pathways, and supporting agency and identity – is, we hypothesize, enough to break the negative cycle in any community. Our research team will test this hypothesis by investigating the impact on students, communities, and local educational systems.

It isn't enough to solve this for one community. Every community on Earth, and all citizens, need geoscience literacy, capacity, and workforce. This challenge is profound because each community has its own cultural, historical and geoscience context and, thus, needs to design its own pathways to its own workforce addressing its own local priorities. Fortunately, we have much to build on—established programs throughout the country have created models and resources that can be incorporated into local pathways. Nonetheless, tackling complex and interrelated challenges of this type requires a systems-level approach that addresses multiple aspects of the challenge simultaneously and allows new solutions to emerge from collective efforts (Kania & Kramer, 2011; Meadows, 1999, 2008). The EC alliance will make use of a collective impact model (Kania & Kramer, 2011; Preskill, Parkhurst, & Juster, 2015b) supported by a national community of practice (Gehrke & Kezar, 2016; Kastens & Manduca, 2018; Kezar & Gehrke, 2015; Wenger, 1998). The collective impact model provides a flexible framework that can support pathway development specific to local needs and context, while aligning the pathways to a common vision of quality and measuring effectiveness through common metrics. An essential element of scaling is maximizing the use of existing resources. The community of practice supports movement of expertise and resources from one part of the system to another facilitating adaption, adoption and repurposing of existing solutions for new contexts and purposes.

Broader Impacts

We know that geoscience knowledge, integrated with other ways of knowing and couched in community context and values, can help communities prepare for and manage pressing challenges (NAS, 2017; NRC, 2013). We hypothesize that engaging students from communities that are most vulnerable and helping geoscientists learn to collaborate with those communities can speed the process (Pandya, Galkiewicz, Williams, Furukawa, & Barry, 2014). Beyond the impact of specific pathway activities, the in-depth collaboration between scientists, educators, and community members will enhance the community's capacity to leverage science, their ability to engage science, and their comfort with incorporating science into their decision-making and planning (NAS, 2016, Cash, 2003). By participating in the EC Alliance, individual communities become part of a larger group using geoscience and geoscience pathways to address local priorities. By bringing their experience to that group and drawing on expertise from elsewhere in the nation, both the capacity of individual communities and of the collective increases.

This project has benefits for all of STEM. Although the primary goal is a more diverse geoscience workforce, along the way many more students will identify with STEM practices, consume and synthesize information more critically, communicate evidence-based results, and practice the myriad other skills and traits of effective scientists. These skills and traits will foster educational success, and open doors to college majors and careers in STEM that may not be geosciences, but bring many of the tools of a geoscientist to careers that pay twice, on average, what non-STEM careers pay (e.g., Carnevale, Cheah, Hanson, 2015). Moreover, the economy of tomorrow will be built on STEM disciplines (Sargent Jr, 2017; Vilorio, 2014). Communities with a STEM-capable workforce will have a brighter future with greater economic opportunity.

The EC Alliance will broadly inform secondary and post-secondary curricula and professional development in the geosciences. For example, Frameworks for K-12 Science Education (NRC, 2012) emphasize the connections between humans and Earth, and will require significant revisions of existing curricula, professional development for in-service teachers, and changes to teacher preparation programs in institutes of higher education (e.g., Wysession, 2014). At the undergraduate level, societally relevant geoscience curricular materials are being adopted in introductory geoscience courses across the country (e.g., Gosselin et al., 2015; Manduca, & leadership team of InTeGrate STEP Center for the Geosciences, 2017; O'Connell, Bruckner, Manduca, & Gosselin, 2015). Because of the EC Alliance's depth of engagement with and support for both curricular endeavors and communities of practice at the K-16 level, our work will inform national efforts to align geoscience education across secondary and post-secondary levels with effective practices.