



# EarthConnections: Integrating Community Science and Geoscience Education Pathways for More Resilient Communities PA31B-0350

Cathryn A. Manduca, Science Education Resource Center, Carleton College

## Why EarthConnections?

**EarthConnections** is a pilot for a **scalable collective impact alliance** that supports the planning and development of compelling, **locally-contextualized** geoscience pathways that support students from **middle school to career**.

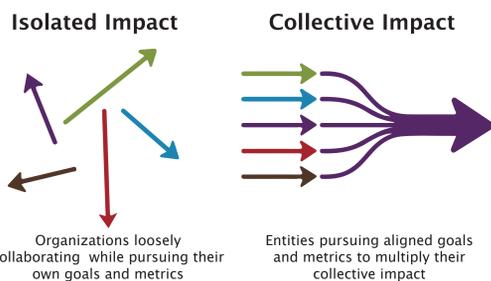
The geosciences lag behind most other STEM disciplines in diversity. On top of that, there are few opportunities for geoscience students of any background to develop their scientific skills and knowledge while learning to work with communities on issues of local importance. There are four mutually reinforcing challenges to developing a diverse geoscience workforce that is able to collaborate with the full fabric of society:

- 1) Communities face pressing challenges related to climate change, natural hazards, and natural resources, but don't have enough trusted, local, culturally-competent experts they can work with.<sup>[1]</sup>
- 2) Geoscience students have a limited view of options in the workforce and have few opportunities to develop the skills necessary to work at the community-science interface.<sup>[2]</sup>
- 3) Geoscience curricula at all levels are largely disconnected from societal issues, and offer little opportunity to engage in community-relevant science investigations.
- 4) Transitions between academic levels and from school into careers are bumpy—students of color and women leave geosciences in higher rates at each transition.<sup>[2,3,4]</sup>

If we want to develop geoscientists who can be partners in this context, we need to simultaneously create opportunities for geoscience students to develop collaboration skills and cultural competency, offer all communities the chance to use geoscience to help advance their priorities, and create school-to-career pathways with smooth transitions, especially for students from underrepresented groups.

## The Collective Impact Approach

**Collective impact** is the commitment of a group of important actors from different sectors to a common agenda for solving a specific social problem.<sup>[5,6]</sup>



A collective impact approach is powerful because it creates a flexible framework and network of resources 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. Our approach is based on five pillars:

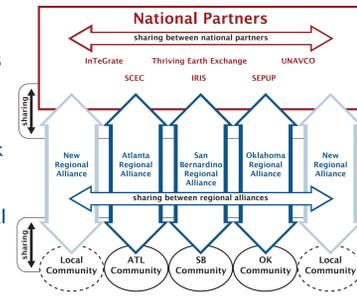
- a **shared vision** for the elements of the pathways;
- a **structured process** for creating pathways customized to address local needs and aligned with existing programs, alliances, and culture;
- a set of **shared metrics** that are used to align pathway designs provide data on the success of the pathways in reaching project goals;
- a **community of practice** that brings together expertise on design and implementation of program elements, regional pathways, and resources;
- a **backbone organization** that supports and amplifies our work while honoring the importance of local context.

## National Alliance

The National alliance is made up of national partners and regional alliances and provides a structure for sharing between these groups.

- **National partners:** facilitate sharing resources, expertise, and experiences between regional alliances; provide overall structure, project management, and evaluation.
- **Regional alliances:** have had success in addressing local Earth-focused societal challenges; have extensive local networks; and represent and work well with their community. They act as case studies for scalable model.

Partnerships led to innovation and value added through sharing between national and regional partners. For example, the San Bernardino alliance made use of the InTeGrate Traveling Workshop Program, and the Oklahoma alliance consulted with San Bernardino to capitalize on tested program models.



## Atlanta Alliance



### Local Challenges

This densely populated, diverse region faces some of the highest possible shortages of available fresh water, as well as water contamination and flooding in west Atlanta. In addition, the statewide economy is largely dependent on agriculture and has faced severe drought in the past.

### Pathway Development

**Embedding in the local community:** The Atlanta alliance has embedded itself into the community through the West Atlanta Watershed Alliance (WAWA), local universities, and other community organizations. It acts to link them to national resources.

**Use geoscience to address a local problem:** The Atlanta alliance is working directly with local community organizations and schools to host and support geoscience-related projects related to watershed and green space issues.

**Mentoring and signposting to support students:** The Atlanta alliance is identifying important connections, relationships, and stations as it continues working to define viable pathways. For example, the alliance plans to have college students mentor area public school students and to have them assist in identifying signposting opportunities or needs.

**Pathway Map (right):** Important components of the pathway include connecting with STEM schools (none of which are local to the neighborhood), local HBCUs, and state universities.



## San Bernardino Alliance



### Local Challenges

This fast-growing region faces some of the highest possible shaking hazards from earthquakes on the San Andreas and other faults. In addition, the region faces severe drought, locally suffers from ground water pollution, and is home to a number of Superfund sites.

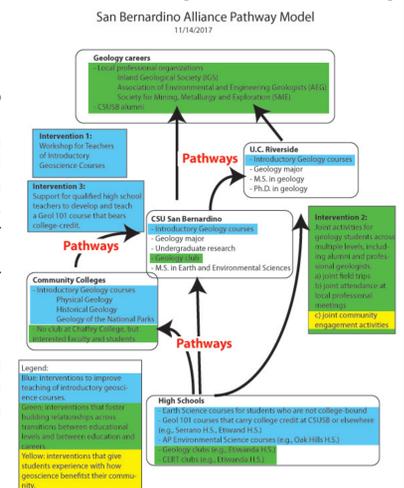
### Pathway Development

**Embedding in the local community:** The San Bernardino alliance has embedded itself in the community by leveraging existing academic relationships. The alliance brings together teachers and students from Etiwanda High School, Chaffey College, and CSUSB, along with CSUSB geology alumni and other professional geologists from the local area.

**Use geoscience to address a local problem:** The alliance has worked with regional organizations to develop and disseminate accurate information about earthquakes. It is also using interventions (teaching workshops, student activities, and courses) to engage students with geoscience.

**Mentoring and signposting to support students:** The joint activities between high school, community college, and university geology clubs, with inclusion of professional geologists will provide opportunities for mentoring of students by faculty, professional geologists, and other students.

**Pathway Map (right):** The map illustrates existing pathways for students along with three interventions to strengthen those pathways.



## Pathway Development

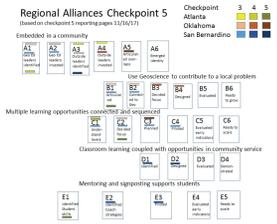
**Pathway Goals:** Community-centered pathways support and guide students through the many steps and transitions to geoscience-related careers in which they have opportunities to support their communities. These pathways:

- 1) are embedded in the local community,
- 2) use geoscience to address a local need or problem,
- 3) connect learning opportunities at multiple educational levels,
- 4) incorporate classroom learning coupled with community service, and
- 5) offer mentoring and signposting that support students in recognizing and navigating the pathway.

**Development Process:**

- 1) Regular checkpoint reporting
- 2) Facilitated group discussion
- 3) Progress measured

Example of visual checkpoint analysis showing progress on and strength of each of the five elements of a pathway. This analysis is performed by an internal evaluator using four to six indicators of strength for each element. The whole group has an opportunity to discuss the analysis and any insights or concerns.



## Oklahoma Tribal Nations Alliance



### Local Challenges

Understanding the relationship of earthquakes to energy industry practices, and the resulting implications for energy production and related jobs is an important issue for all Oklahoma residents, but especially Native Americans in the region, given their close association with the land and their sovereign control of natural resources and land use within their reservation boundaries.

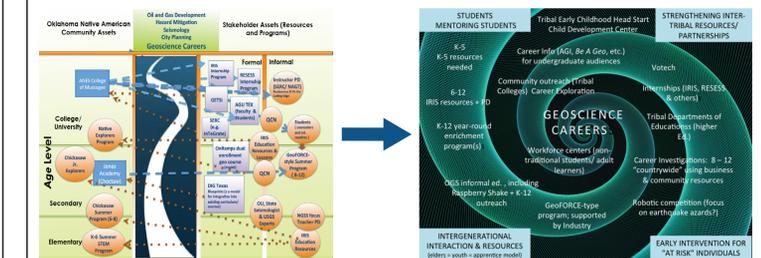
### Pathway Development

**Embedding in the local community:** The Oklahoma alliance is working with Tribal leaders to co-construct a pathway focus and approach. It is also working with representatives from the Jones School, Anadarko School District, OU School of Geology and Geophysics, and OK Geological Survey (OGS) to engage with students.

**Use geoscience to address a local problem:** The alliance is working with partner organizations and Tribal leaders to address earthquake hazards and related issues. In particular, the alliance is working to partner with the OGS which is planning to present earthquake related-activities and deploy seismographs to increase awareness and provide data to improve the monitoring of OK earthquakes.

**Mentoring and signposting to support students:** The pathway consists of assets (stops) along the path to geoscience careers.

**Pathway Map (below):** The evolution of the pathway map shows movement from an asset-focused approach to a pathway-focused approach that uses those resources.



## References

[1] Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockström, J. (2005). Social-ecological resilience to coastal disasters. *Science*, 309(5737), 1036–1039.  
 [2] Stokes, P. J., Levine, R., & Flessa, K. W. (2015). Choosing the geoscience major: Important factors, race/ethnicity, and gender. *Journal of Geoscience Education*, 63(3), 250–263.  
 [3] Levine, R., González, R., Cole, S., Fuhrman, M., & Le Floch, K. C. (2007). The geoscience pipeline: A conceptual framework. *Journal of Geoscience Education*, 55(6), 458–468.  
 [4] Holmes, M. A., O'Connell, S., Frey, C., & Ongley, L. (2008). Gender imbalance in US geoscience academia. *Nature Geoscience*, 1(2), 79–82.  
 [5] Kania, J., & Kramer, M. (2013). Embracing emergence: How collective impact addresses complexity. *Stanford Social Innovation Review*, January, 1–14.  
 [6] Kania, J., & Kramer, M. (2011). Collective impact. *Stanford Social Innovation Review*, Winter, 36–41.

