COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./DUE DATE
NSF 16-544 06/24/16

☐ Special Exception to Deadline Date Policy

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Carleton College

AWARDEE ORGANIZATION CODE (IF KNOWN)
0023408000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE
Carleton College
One North College Street
Northfield, MN. 550574001

NAME OF PRIMARY PLACE OF PERF
Carleton College

ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE
Carleton College
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IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions)
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TITLE OF PROPOSED PROJECT **NSF INCLUDES: Engaging Local Communities in Geoscience Pathways**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 300,000	24 months	10/01/16	

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW
☐ BEGINNING INVESTIGATOR (GPG I.G.2)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
☐ HISTORIC PLACES (GPG II.C.2.j)
☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date _____
PHS Animal Welfare Assurance Number _____
☒ FUNDING MECHANISM **Research - other than RAPID or EAGER**

☒ HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number **00003838**
Exemption Subsection _____ or IRB App. Date **Pending**
☐ INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)
☒ COLLABORATIVE STATUS
A collaborative proposal from one organization (GPG II.D.4.a)

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PROJECT SUMMARY

Overview:

The geosciences lag behind most other STEM disciplines in diversity and are also projected to have a deficit in the workforce in the coming years. On top of that lack of diversity, there are few opportunities for geoscience students of any background to develop their scientific skills and knowledge while learning to work with communities on community issues. This project brings together partners who have led successful national efforts addressing components of these challenges with partners in three regions to create pathways in three regional pilots, focusing on key academic transitions in three diverse US communities - Atlanta, GA; San Bernardino, CA; and Oklahoma - and will use these pathways as laboratories and catalysts for a systemic change in geoscience and geoscience education. These pathways will include multiple opportunities for students to 1) learn geoscience in the context of compelling local issues, 2) use geoscience to address local challenges, and 3) explore geoscience career pathways. Experience gained by initial program partners and regional pilots will be used to create national support structures for developing integrated geoscience pathways and a collective action framework for expanded partnerships.

Intellectual Merit :

The project brings together elements from several models for broadening participation in STEM and increasing success for all students. First, the project capitalizes on findings that show that students are more engaged and invested in learning science when it is connected to societal issues, particularly to those of concern to their local community (Boger et al., 2014; Chinn, 2012; Delparte et al., 2016; Gosselin et al., 2015; Johnson et al., 2014; Kirkby, 2014). Second, it makes use of authentic, real world research experiences that increase retention and persistence (Townsend and Wilson, 2009), build students' identity as scientists, clarify career goals, and build research and professional skills (Hunter et al., 2006; Seymour et al., 2004; PCAST, 2012; Kuh, 2008; Miller et al., 2007). Finally, this effort builds on the work demonstrating the importance of continuity of opportunity and the role of mentoring and guidance in ensuring progress (Harrison et al., 2007; Johnson, 2015; Jolly, 2004; Kurdziel, 2002; NRC, 2013). The research team will judge the success of the pathways based on their ability to support students in making strong choices about their futures. The success of the overall project will be judged by students' access to and success on their pathways; communities' success using geoscience to advance local priorities; and the project team's ability to drive an uptick in community-related geoscience teaching, research, and applications.

Broader Impacts :

This project will demonstrate how an alliance of partner organizations with geoscience, educational, and local expertise can learn from each other, mobilize resources, fill gaps, and develop new programs and pathways to greatly enhance the depth and breadth of impact. The alliance's impact will grow as it adds new partners and regional sites. The project will also serve as a model for sites using other STEM-related socio-scientific issues to engage students and their communities. Additionally the project has the potential for broader impact in informing secondary and post-secondary curricula and professional development in the geosciences. Finally, the project advances the use of participatory approaches in the geosciences by nurturing a generation of future scientists who are well-versed in methods and strategies for community engagement, by fostering the development of future alliances focused on community issues, and by demonstrating the community impact and scientific insight that come from collaborative approaches. The positive, tangible community outcomes will increase the public's value of and support for geoscience.

INTELLECTUAL MERIT

Many of the socio-scientific challenges we face today—such as adapting to sea level rise, responding to natural disasters, accessing clean water and healthy food—are particularly acute for minority, low socio-economic status, and under-served communities (e.g., Blaikie et al., 2014; Cutter, 2006; Maldonado, 2014). Geoscience knowledge, integrated with other ways of knowing and couched in community context and values, can help communities prepare for and manage these challenges (NRC 2011b, 2011c). For that work, we need more geoscientists who come from communities that are most vulnerable and more geoscientists who are willing to collaborate with those communities (Pandya, 2014). Unfortunately, the geosciences already lag behind most other STEM disciplines in diversity and are projected to keep that deficit in the coming years (Gonzales and Keane, 2010; NRC 2011a; NSF/NCSES, 2015, PCAST, 2012). On top of that lack of diversity, there are few opportunities for geoscience students of any background to develop their scientific skills and knowledge while learning to work with communities on community issues.

There are four mutually reinforcing challenges to developing a diverse geoscience workforce that is able to collaborate with the full fabric of society.

- Communities face pressing challenges related to climate change, vulnerability to natural hazards, and natural resources (Adger et al., 2005), but many don't have enough trusted, local, culturally-competent experts they can work with to address these challenges (Maldonado et al., 2014).
- Geoscience students, especially undergraduate and graduate students, have a limited view of options in the workforce (Stokes et al., 2015) and have few opportunities to develop the skills necessary to work at the community-science interface—even though the number of geoscience jobs is projected to increase (Wilson, 2014). In some places, participating in the geoscience workforce means moving out of the community.
- Earth Science curricula at all levels—middle school, high school, and college—are largely disconnected from societal issues, and offer little opportunity to engage in community-relevant science investigations (Kesidou and Roseman, 2002; Bodzin, 2012; Macdonald et al., 2005; NSSE, 2015). Therefore students miss connections between the course content and their lives.
- Transitions between academic levels (e.g., between middle and high school or between high school and college) and from school into careers are bumpy—students of color and women still leave geosciences in higher rates at each transition (Stokes et al., 2015; Levine et al., 2007; Holmes and O'Connell, 2008). The transition from high school to college is especially fraught—fewer than 50% of high schools even offer a geoscience course and of those that do 85% offer them as alternative science courses for non-college-bound students (Banilower et al., 2013).

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 and Kramer, 2011; Meadows, 1999). 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. This proposed project will create pathways in three regional pilots, focusing on key academic transitions in three diverse U.S. communities—Atlanta, GA; San Bernardino, CA; and Oklahoma (Table 1)—and will use these pathways as laboratories and catalysts for a systemic change in geoscience and geoscience education. Pilot regions were selected for their combination of socio-scientific geoscience challenges, existing geoscience resources and networks, and diversity of population. Community-centered pathways will support and guide students from engagement in relevant, Earth-related science at an early age through the many steps and transitions to geoscience-related careers in which they have opportunities to support their communities.

These pathways will include multiple opportunities for students to 1) *learn* geoscience in the context of compelling local issues, 2) *use* geoscience to address local challenges, and 3) *explore* geoscience career pathways. They will bring together elements from several models for broadening participation in STEM and increasing success for all students. First, we capitalize on findings that show that students are more engaged and invested in learning science when it is connected to societal issues, particularly to those of concern to their local community (Boger et al., 2014; Chinn, 2012; Delparte et al., 2016; Gosselin et al., 2015; Johnson et al., 2014; Kirkby, 2014). Second, we make use of authentic, real world research experiences that increase retention and persistence (Townsend and Wilson, 2009), build students' identities as scientists, clarify career goals, and build research and professional skills (Hunter et al., 2006; Seymour et al., 2004; PCAST, 2012; Kuh, 2008; Miller et al., 2007). Finally, we build on the work demonstrating the importance of continuity of opportunity and the role of mentoring and guidance in ensuring progress (Harrison et al., 2007; Johnson, 2015; Jolly, 2004; Kurdziel, 2002; NRC, 2013).

We will judge the success of the pathways based on their ability to support students in making strong choices about their future, where strong choices are based on understanding their own interests and strengths, knowing the opportunities for learning and using geoscience within the community, and seeing opportunities in the workforce. Not every student will determine that they want to pursue geoscience, but our pathways will ensure that they have the opportunity to learn, apply, and succeed in using geoscience in an important societal context and to envision a future for themselves that includes geoscience.

We will judge the success of our overall project by students' access to and success on their pathways, communities' success using geoscience to advance local priorities, and the project team's ability to drive an uptick in community-related geoscience teaching, research, and applications.

Table 1: Regional Pilot Locations

The Inland Empire of Southern California, east of Los Angeles, including the San Bernardino-Riverside-Ontario metropolitan areas. According to the 2010 U.S. Census, the portion of San Bernardino County that includes the city of San Bernardino is 60% Hispanic or Latino, and proportions are similar in the surrounding counties U.S. Census Bureau, 2016).. However, only 20% of geology majors at California State University-San Bernardino (CSUSB) are Hispanic. This is a fast-growing region that faces some of the highest possible shaking hazards from earthquakes on the San Andreas and other faults in the region (Jones et al., 2008). In addition, the region is facing severe drought, locally suffers from ground water pollution, and is home to a number of Superfund sites. There is a need for greater Earth literacy in the region, as well as more professional scientists who come from and can work with the communities that are impacted by these hazards.

South Central Tribal Nations of Oklahoma. American Indian students in Oklahoma are quite aware of the unprecedented increase in earthquakes in the state, where the rate of magnitude 3 and greater earthquakes is now 300 times what it was prior to 2008 (Rubinstein and Mahani, 2015). This increase in seismicity has led the USGS to show, through a new seismic hazard map that includes induced seismicity, that the short-term earthquake hazard in parts of Oklahoma now equals the hazard in California (Petersen et al., 2016). Understanding the relationship of these earthquakes to energy industry practices, and the resulting implications for energy production and energy-related jobs in Oklahoma, is an important issue for all Oklahoma residents, but especially American Indians in the region, given their close association with the land and their sovereign control of natural resources and land use within their reservation boundaries. Despite a strong community focus on stewardship and protection of the natural environment, American Indians are poorly represented in the geosciences (Riggs et al., 2007), perhaps due in part to the cultural disconnect between the process of western science research and education and traditional knowledge (Semken, 2005).

Metropolitan North Georgia Water Planning District. The Metropolitan North Georgia Water Planning District is staffed by the Atlanta Regional Commission and comprises 92 cities and 15 counties,

which rely almost entirely on surface water to meet their needs. Access to groundwater is negligible, with the region relying on small rivers and streams for water supply, and rainfall-charged reservoirs to provide relief in times of drought. The region is also home to a large underrepresented population. For example, the City of Atlanta, GA, includes a 61.4% African American population, and proportions are similar in the surrounding counties (U.S. Census Bureau, 2016). This densely populated, diverse region faces some of the highest possible shortage of available fresh water. In addition, the statewide economy is largely dependent on agriculture and has faced severe drought in the past.

BROADER IMPACTS

The broader impacts of this project will result from the development of principles, metrics, and an adaptable model for creating a strong alliance effective in working with highly diverse populations of students, educators, and communities. This project will demonstrate how an alliance of partner organizations with geoscience, educational, and local expertise can learn from each other, mobilize resources, fill gaps, and develop new programs and pathways to greatly enhance the depth and breadth of their impact. The alliance's impact will grow as it adds new partners and regional sites. The project will also serve as a model for sites using other STEM-related socio-scientific issues to engage students and their communities.

By collaborating with three regional pilot sites with very different demographic profiles, and by working in both in-school and out-of-school settings, the project will develop strategies for building relationships with diverse communities and educational systems to attract and retain underrepresented student groups—including Hispanic, African American, and American Indian students—to the geosciences. The project's processes and findings will inform the work of other groups attempting to meet similar challenges.

The project also has the potential for broader impact in informing secondary and post-secondary curricula and professional development in the geosciences. At the K–12 level, the design of program activities and pathways will build on best practices while providing opportunities for further research. For example, the Next Generation Science Standards (NGSS Lead States, 2013), based on the Framework for K-12 Science Education (NRC, 2012), have been adopted by 17 states (including California) and the District of Columbia. These standards 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; O'Connell et al., 2015). We will extend the contextualization of science by creating *multiple* opportunities for students to engage in addressing real-world local problems in both in-school and out-of-school settings. Our findings will inform national efforts to align geoscience education across secondary and post-secondary levels with best practices.

This project will develop resources and expand the capacity of geoscientists and educators to (1) teach geoscience in authentic ways and in the context of societal issues of relevance to diverse communities (e.g., Ellins and Olson, 2012; Ellins et al., 2013); (2) increase matriculation into geoscience programs and persistence to degree, moving geoscience demographics toward national averages (Baber et al., 2010); (3) prepare diverse graduates who enter the workforce to use their geoscience skills and expertise, within and beyond what is traditionally considered the "geoscience workforce"; and (4) support more and more diverse communities, including historically underserved communities, to use geoscience principles to become more resilient and sustainable.

Finally, the project advances the use of participatory approaches in the geosciences by nurturing a generation of future scientists who are well-versed in methods and strategies for community engagement. This will be accomplished by fostering the development of alliances focused on community issues, and by demonstrating the community impact and scientific insight that come from collaborative approaches.

The positive, tangible community outcomes will increase the public's value of and support for geoscience.

A SCALABLE COLLECTIVE IMPACT ALLIANCE FOR NATIONAL CHANGE

Our approach is to create a scalable collective impact alliance that supports the planning and development of regional pilots. Regional pilots will develop multiple pathways for students to engage in geoscience. A primary challenge of creating compelling, locally-contextualized geoscience pathways is the need to customize the pathway for each location to reflect both the relevant environmental challenges and the local educational opportunities. A second significant challenge is that while there are strong programs within regions and strong national programs that have elements of the envisioned pathways, there are currently no models of complete pathways. A collective impact approach is powerful in this case because it will create 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.

Collective impact is the commitment of a group of important actors from different sectors to a common agenda for solving a specific social problem (Kania and Kramer, 2013, 2011). The important actors in this case fall into two overlapping categories: regional pilot partners and project partners. Regional partners have demonstrated success in addressing local Earth-focused societal challenges; have extensive local networks; and represent, include, and work well with their local community. Project partners provide expertise with specific elements of pathway design and implementation. They are leaders of programs that have demonstrated success in creating curricula that connect geoscience and society at different educational levels, in supporting undergraduate research and community-based science experiences, in connecting local communities to geoscience experts, and in programming that incorporates mentoring and career advising.

The founding partners of the alliance are shown in Table 2. These partners share a need to educate a citizenry and workforce who can engage the challenges of earthquake hazards and freshwater availability and bring together the expertise needed to execute regional participatory design of pathways that can make use of research-based educational practices and capitalize on resources developed through previous federal, state, and local investments. The strong match of national and regional leadership provides a robust test of the value proposition of the alliance: that by working collectively we can more easily develop a larger number of robust pathways than would be possible individually.

Table 2: Founding Partners

Regional Pilot Partners

Felicia Davis, Director of the Building Green Initiative (BGI) at Clark Atlanta University has extensive experience working with HBCU campuses, Hispanic serving institutions and Tribal Colleges on national programs supporting broadening participation in science and engineering, and most currently leading the multi-faceted campus-wide sustainability efforts through the BGI.

Kathy Ellins, Program Director of the Jackson School of Geosciences, University of Texas, Austin, has led statewide K-12 curriculum development and teacher professional development activities and is engaged in Oklahoma-based climate education through the South Central Climate Science Center.

Garry Harris is Managing Director for the Center for Sustainable Communities based in the Atlanta region working extensively with many stakeholders including government agencies, universities and colleges, local agencies, professional associations, and national laboratories to launch the Advanced Atmospheric Research and Monitoring Station (AARMS) project. Mr Harris has nearly two decades of experience designing and developing STEM educational programming for a diverse groups of students at the middle school, high school, and university level.

Sally McGill is Professor and Department Chair of Geological Sciences at California State University, San Bernardino, where she leads an active scientific research program that engages K-12 teachers and undergraduate students in earthquake research with outreach extending into the local community (e.g., McGill et al., 2009; Keck et al., 2015).

Norma Neely directs the American Indian Institute (Aii) at the University of Oklahoma, a nonprofit American Indian training, research, and service organization whose goals include promotion and support of Indian education and tribal leadership and organizational development. Aii offers workshops, seminars, conferences, onsite training, and consultation on tribal, state, regional, national and international levels on a variety of topics and issues that affect the Indigenous peoples of North America.

Project Partners

Mark Benthien is Director for Communication, Education and Outreach at the Southern California Earthquake Center (SCEC), University of Southern California. SCEC programing includes California's Earthquake Country Alliance (ECA), a public-private partnership that created the Great California ShakeOut, now a national, FEMA-sponsored program reaching 43.5 million participants in 2015. SCEC also provides educator professional development and curricular resources, installs Quake Catcher Network (QCN) sensors in schools and museums, and coordinates two undergraduate intern programs (Cochran et al., 2009).

Donna Charlevoix, Director of Education and Community Engagement at UNAVCO, manages the portfolio of education, outreach, and geo-workforce development at NSF's Geodetic Facility. Her team includes specialists and activities centered on geo-workforce, and broadening participation through intentional mentoring and professional development (Charlevoix and Morris, 2014, 2015; Fifolt and Searby, 2010; Morris and Charlevoix, 2014), science education (Douglas et al., 2014; Pratt-Sitaula et al., 2015), and communications (Bartel and Charlevoix, 2015). UNAVCO supports over 210 U.S. university and international consortium members (Phillips et al., 2015; Wdowinski and Eriksson, 2009).

Anne Egger is the Director of the Office of Undergraduate Research at Central Washington University, holds leadership positions within the National Association of Geoscience Teachers, and is a PI on the InTeGrate project where she leads teacher preparation activities. She is senior editor of Visionlearning, which creates freely available, online teaching resources that highlight the process of science (Egger and Carpi, 2013), and she has led the development of undergraduate research programs to recruit students into the geosciences (Egger and Klemperer, 2011).

Barbara Nagle brings expertise, experience, and networks in secondary education and is Director of the Science Education for Public Understanding Program (SEPUP) at the Lawrence Hall of Science, University of California, Berkeley. SEPUP materials integrate disciplinary concepts with science and engineering practices in the context of personal and social issues related to science and have been shown to produce measurable gains in science learning and persistence in STEM fields (Scott, 2000).

Raj Pandya is the Program Director for the Thriving Earth Exchange (TEX) of the American Geophysical Union (AGU) which helps communities, including historically under-served communities, leverage relevant science and work with scientists to advance their priorities and address their challenges related to climate change, natural hazards, and resources. TEX has launched 34 projects connecting science and scientists to local communities and mentored over 50 scientists and community leaders.

John Taber is Director of Education and Public Outreach at Incorporated Research Institutions for Seismology (IRIS). IRIS' commitment to workforce development includes a distributed REU program (Hubenthal and Taber, 2014); introducing underrepresented minorities to geophysics via a field experiences program; developing data-rich activities for the undergraduate classroom (Taber et al., 2014); and supporting early career investigators via mentoring, webinars, and workshops (Colella et al., 2015; Hubenthal et al., 2015). As the NSF seismology facility, IRIS supports research and education in a seismology consortium of over 120 university members and 20 educational affiliates (Taber et al., 2015).

Together we will create an alliance that supports the design and implementation of locally-contextualized geoscience educational pathways by developing

- a **shared vision** for the elements of the pathways;
- a **structured process** for creating pathways customized to address locally relevant geoscience needs and aligned with existing programs, alliances, and culture;
- a set of **shared metrics** that are used to align pathway designs with our shared vision and to 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 specific program elements, expertise in the development and implementation of regional pathways, and resources that can be adapted, adopted or repurposed to create customized pathways; and
- a **backbone organization** that supports and amplifies our work through services that capitalize on economies of scale while honoring the importance of local context.

The Science Education Resource Center (SERC) at Carleton College under the direction of Dr. Cathryn Manduca will be the lead partner and backbone for the project and alliance. Manduca is the Executive Director of the National Association of Geoscience Teachers (NAGT); has led community development of the premier portals for geoscience education and use of engaged pedagogies in STEM education; and has successfully led large community activities to improve geoscience teaching, strengthen geoscience departments, and most recently to teach about the Earth in the context of relevant societal issues. National recognition of her visionary leadership includes election as Chair of the AAAS Education Section and to the Board of Directors for the AGU; and appointment to the National Academies of Science, Engineering and Medicine Board on Science Education.

Most recently SERC successfully guided the InTeGrate STEP Center, a five-year, $10M NSF-funded project that has engaged more than 1,500 individuals and 600 institutions in activities to teach about the Earth in the context of societal issues. Within InTeGrate, rubrics and evaluation metrics developed by the project leadership align activities at all scales with the overall project goals, while project-wide structures and processes support information flow and coordination across the project (Kastens and Manduca, 2016). Dr. Ellen Iverson, the Evaluation Director at SERC, has successfully led the collection of shared metrics from more than 123 participating schools. SERC has led 16 NSF projects in the past 15 years and supported more than 40 additional NSF-funded projects at scales from a few thousand to several million dollars. The SERCkit online platform supports management, communication, data collection, and analysis across large sets of coupled activities.

We will use the development of the three regional pilots to develop, test, and refine the elements of our collective impact alliance. In this way, we can discuss and test our vision and metrics on three very different real world examples ensuring that we can describe and use them in diverse settings. We will create our design process using principles of human-centered design (Stanford University Institute of Design, 2016) to ensure a process that will work in multiple contexts. Success metrics for the alliance developed with the external evaluator using the collective impact framework will provide data that can guide the optimization of our collaboration and communication strategies.

Fundamental to our strategic plan and the success of the alliance is the development of a community of transformation (Kezar and Gehrke, 2015; Wenger et al., 2002) that can

- facilitate the exchange of information and the flow of ideas,
- advance the work of people who share the alliance vision while entraining new people,
- create a supportive environment for alliance activities,
- provide a venue for analysis and reflection on what works and for abstracting broader insights and approaches from the individual pathways, and

- build a peer group that can share effective strategies and troubleshoot issues for individual pathways.

STRATEGIC PLAN

In the first two years, we propose to initiate this alliance by addressing two objectives:

1) Develop, test, and refine the elements of our collective impact alliance through work on three regional pilots that capitalize on our collective expertise and resources.
2) Test the ability of the alliance to attract new partners and implement a scalable system for supporting locally customized pathway development.

With funding to develop a full alliance, we would use the experiences from this pilot to scale up the design process to support pathway development nationwide, to create supports for implementation of pathway plans that make use of economies of scale and the expertise of the alliance community, and to collect data on the success of the pathways.

Objective 1: Develop, test, and refine the elements of our collective action alliance through work on three regional pilots that capitalize on our collective expertise and resources.

Work on this objective will yield a scalable system for supporting regional partner development. We will use the hands-on experience of building three regional pilots to test, refine, and document our vision, processes, metrics, and professional development activities.

Strategy 1: Develop pathway design criteria that define the required elements and features of a high-quality pathway and a rubric-based process that supports regional pilot teams in successfully meeting these criteria. The pathway design criteria will allow all members of the alliance to share a common vision of the elements of a high-quality pathway implementation situated in the local community. They will be codified in ways that support the development of the three regional pilot programs. For example, InTeGrate uses rubrics to codify its development of curricular materials (Steer et al., in revision). The codification process will also develop a tool for evaluating the pathway designs at regular checkpoints within the development process. As challenges arise, the leadership team will adjust the criteria, tool, and process as appropriate. This will involve elements such as clarifying the tool, adding professional development opportunities for design teams, or revising the criteria. The design criteria and associated tools will be published for use by the alliance and others.

Strategy 2: Develop and implement plans for pathways at three regional pilot sites. The pathways will be developed using a process that engages regional stakeholders and community members together with alliance partners in identifying opportunities to strengthen, augment, and link local programs, ensuring the pathways are integrated with community needs and opportunities (NRC, 2011a). The regional pathway planning process will be initiated by a culturally and contextually appropriate activity that engages stakeholders and partners (Udu-gama, 2013; Wells et al., 2013; Main et al., 2012; NRC, 2011b; Haacker-Santos et al., 2012). Working with community partners, each regional pathway development team will use this input to create a pathway vision and a cooperative strategy moving forward (e.g., Pandya et al., 2014). This strategy will leverage the expertise and experience of both community leaders and the alliance partners to develop effective educational pathways that are linked with community engagement and career development.

Much of this work builds on existing relationships. To implement pathways, each of the three regional teams will build on partners' existing programs and efforts, leveraging their significant skill in education and science. For example, an existing teacher workshop could be modified to highlight community issues, offer tips on community engagement, and share successful strategies for service learning. A core group of teachers, recruited from these workshops and distributed across middle school, high school, two-year colleges and four-year universities, could work together to develop and implement service learning

curricula that are locally relevant, community-based, and linked across grade level. SEPUP and InTeGrate curriculum materials addressing earthquake hazards could be adapted and connected to local research and community engagement opportunities through SCEC, IRIS, UNAVCO and TEX. Strong connections to local professional geoscience societies could be used to recruit volunteer scientific mentors from industry who would provide project guidance and exposure to career opportunities, alongside mentors from academia.

While we have regional partners in place, additional members of the local communities will be involved in developing the pathways. Preliminary discussions indicate that in the San Bernardino pilot there are strong opportunities to develop connections between CSUSB, a community college, and a high school that share a student population, with possibilities for joint activities and collaborative mentoring to help students remain connected to geosciences across the transitions from one institution to another. The Oklahoma pathway provides an opportunity to fully develop and test our model for community-based, participatory design. A team of ten collaborators with ties to a number of Oklahoma tribes will work together to design culturally appropriate pathways to increase student engagement and retention in the geosciences. The pathway will examine these societally and locally relevant problems and demonstrate how the problems can be tackled via geoscience careers. This will be a community-based participatory research experience with planning team members developing and strengthening a closely linked framework of existing organizations and individuals dedicated to assisting American Indian students to continue from tribal and regional schools, to tribal colleges and to STEM degree programs, and then to a STEM career or graduate school. In Atlanta, lower water consumption in communities is of high interest to the region and education at all levels has been identified as a central strategy. This pathway could provide opportunities for enhancing both in- and out-of-school programming with participatory research opportunities, associated curricular improvements, and a strong emphasis on career pathways with the Metropolitan North Georgia Water Planning District.

Strategy 3: Develop and test shared impact metrics. Metrics will measure success in four areas: (1) ability of the regional partners to identify shared goals related to supporting the movement of underrepresented students along the pathway toward the geoscience workforce, (2) improved geoscience capacity within the regional partner institutions, (3) student progress toward geoscience-related careers, and (4) impact on regional capacity to increase resilience in the face of geologic hazards and limited geologic resources. Each of these areas is important and all are inter-related in that a diverse geoscience workforce is necessary in order to achieve resilience in diverse communities, and an educational focus on local geoscience issues of societal importance will help to attract more diverse students into careers in geosciences. Both of these goals can most effectively be achieved by cooperation of multiple stake holders, and improved geoscience educational capacity in the region may be required. Our strategy for each of the four metric areas are:

(1) To foster the ability of the regional partners to identify and work collaboratively toward shared goals, we will develop a common set of metrics that pilot sites can use to determine the extent to which they a) involve community groups and community members as partners from inception to implementation, and b) engender a strong sense of co-ownership in the shared goal of increasing diversity in the geoscience workforce. This could be measured through formal instruments (e.g., Khodyakov et al., 2013) and other metrics like participation in meetings, quantitative measures of who is speaking most, or attitudinal surveys (Lehman, 1999).

(2) To evaluate growth in geoscience capacity within the regional partner institutions we will track the addition of new geoscience teaching initiatives. For example, these may include new geoscience or environmental science high school courses or curriculum, new geoscience service learning projects, new activities implemented within geoscience clubs, especially collaborative activities between clubs at the high school, community college and/or university level, and new interactions between geoscience

students and local geoscience professional societies.

(3) To measure student progress, we will define common measures that can be used at different points within the pathway to understand students' attitudes and learning, and explore mechanisms for measuring overall shifts in the number of diverse students moving through the pathway and from the pathway into the geoscience workforce (Chinman et al., 2005). Although setting up a baseline and procedures for the tracking of demographic statistics will be an important part of our metrics, we will use the impact on student attitudes toward geosciences and student preparation for careers in geoscience as a shorter term measurer. The DEVISE (Developing, Validating, and Implementing Situated Evaluation Instruments) scales offer one example of a promising starting point. Scales include items related to behavior and stewardship, skills of science inquiry, knowledge of the nature of science, motivation, self-efficacy, and interest in science and the environment. The DEVISE scales were created with NSF funding to measure outcomes in relation to citizen science projects and have been used extensively in a wide range of contexts including undergraduate courses, K-12 schools, informal science learning contexts, and non-profit organizations. Other established geoscience and science attitudinal instruments will be considered for the learning environment and grade-level.

(4) To monitor impact on regional capacity to increase resilience in the face of geologic hazards and limited geologic resources, we will developed metrics that can be used across sites that focus on the quality and success of approaches, such as new initiatives or leveraging of existing community efforts. For example, an improved understanding of and respect for both community knowledge and scientific processes could be measured through attitudinal surveys, measures of cultural competence (Ponterotito et al., 1998; Rogers-Sirin and Sirin, 2009), measures of self-efficacy (Bandura, 2000) and surveys of scientific literacy (Laugksch, 2000).

The framework for the metrics will be developed by the leadership team in collaboration with the regional pilots. The shared metric working group led by Nagle and Iverson, with additional expertise drawn from within and outside the project leadership, will draft, obtain input on, and refine common measures of the program activities and outcomes. To determine the sensitivity and validity of the metrics in a wide variety of settings, and to assess their ability to robustly measure alliance progress toward goals, we will test the metrics in existing partner programs, existing programs in the regional pilot areas, and early implementations of regional pathway elements. These data will provide formative evaluation of the strengths and limitations of the specific program activities, identifying strategies that can be adapted by others. By the end of this grant period, we will be prepared with common metrics, piloted instruments, and baseline data to move forward in evaluating the impact of the alliance as the pathways mature.

Strategy 4: Initiate implementation of the pathways within a community of practice using the alliance to enhance capacity for problem solving. A scalable alliance will not have the resources to fully fund and support the implementation of the regional pathway designs, nor would this be a strong, sustainable strategy. However, the alliance has an important role to play in easing the path to implementation by bringing expertise, a supportive community of practice, and economies of scale. Based on the needs of the three regional pilots, we will experiment with mechanisms for supporting implementation that could include facilitating collaborations to support competitive fundraising, supporting teams drawn across pilots in materials revision or professional development, or providing an implementation timeline with checkpoints and feedback.

Objective 2: Test the ability of the alliance to attract new partners and implement a scalable system for supporting locally customized pathway development.
This objective focuses on building the tools, processes, and customs necessary for scaling the alliance. The alliance will grow through the addition of new partners who bring expertise, resources, and/or opportunities; and will expand to support the development of pathways in communities across the country. As the alliance matures, new pathways will benefit from the experiences of those developed

previously without being constrained to replicate them exactly. Our strategies are designed to prepare for and test scalability.

Strategy 1: Articulate the vision, make the process and metrics visible, and disseminate results. Shared vision and metrics are foundational to collective impact initiatives. Growth of our alliance depends upon the ability to bring in new members who share the vision and support the metrics. Similarly, the work of the alliance and its rewards must be visible to potential partners so that they can evaluate their interest in the alliance. The alliance website will be the hub for information about the alliance and will make visible its work including the alliance vision, design rubric, success metrics, pathway plans, FAQs, lessons learned, and community activities (Kastens and Manduca, 2016). In year two, we will host an open meeting where the pathway plans are presented and the processes discussed. A marketing and dissemination plan will guide our work bringing the alliance to the attention of potential new partners. These plans will leverage AGU's membership of 60,000 members and TEX's formal partnership with several associations of local communities and community leaders (e.g., National League of Cities, International City/County Managers Association). We will use three approaches: extending the reach to neighboring regions from the nucleus of the three initial regional pilots using the networks of the regional partners, establishing nuclei in new regions using the national networks of the leadership team, and actively targeting areas where minority populations are living with serious environmental risk.

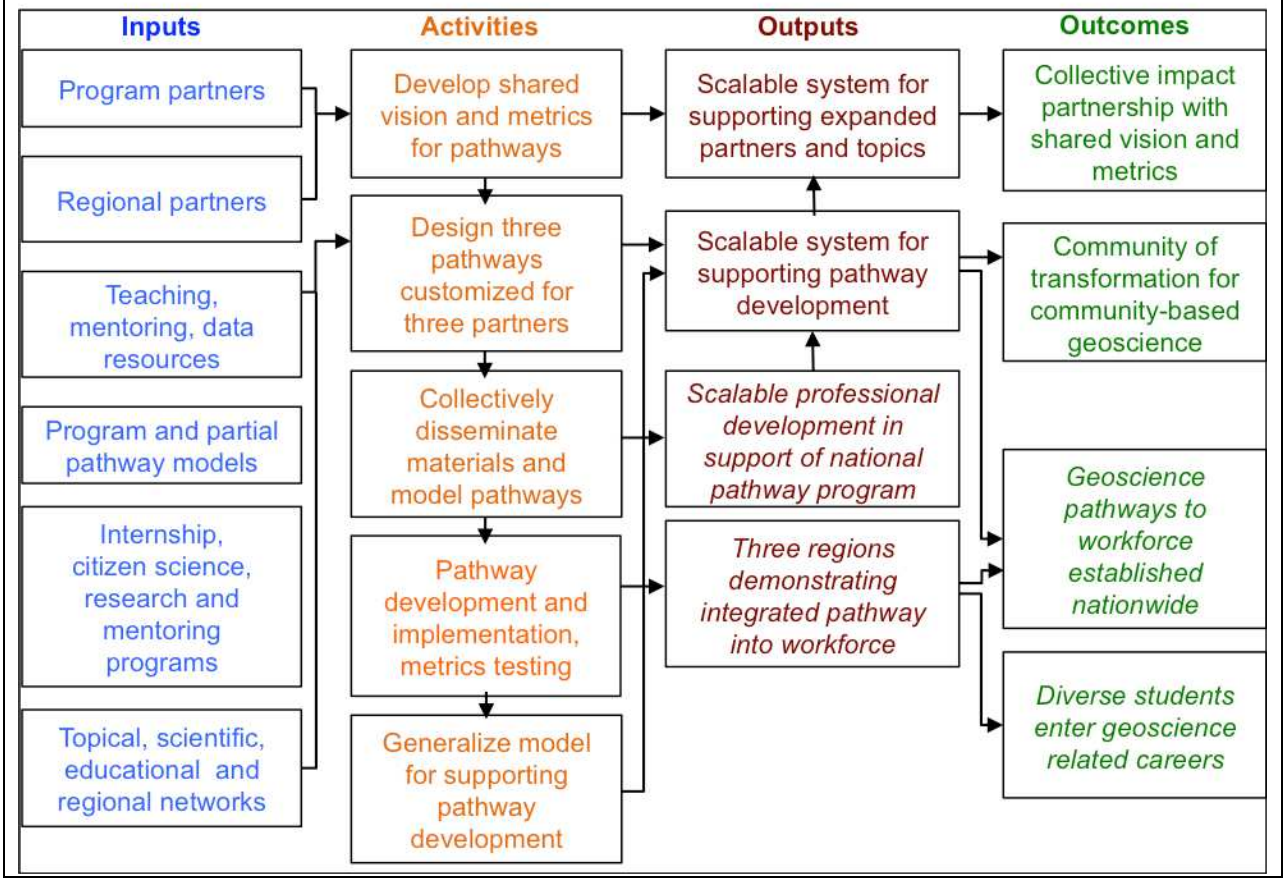
Strategy 2: Develop and test metrics that monitor the health of the collective impact alliance. From the outset, the alliance will require engineering to ensure that the work is able to move forward effectively. Communication and data are essential to sensing the state of the system so that resources can be applied where needed, processes can be streamlined or improved, and problems can be addressed (Kania et al., 2014). As described below, we will work with the external evaluator to establish and test a set of metrics that measure our effectiveness as a collective action alliance. These will be used to monitor the health of our organization allowing us to adapt and invent as necessary to move forward in meeting our goals. During this initial pilot phase, when small scale makes communication relatively easy, it will be essential to make sure that any needed warning appears in the metrics so that we can rely upon them as the alliance grows and information flows become more complicated.

Strategy 3: Formalize the processes for managing the alliance and supporting the pathway development process using principles that support scale up. As we work to support pathway development in the three initial regional pilots, we will monitor how information flows, develop and use a data dashboard, and define processes that are needed to support the collective effort. An important step toward growing our alliance will be the formalization of these processes. This formalization will need to attend to processes for decision making that will allow continued evolution of the vision and metrics in response to lessons learned, mechanisms for scaling up collaboration and support from three pilot working groups to many, and strategies for managing communication flow as the number of participants expands. We will also need to formalize the tools and processes developed to support pathway development in year one so that they can make future pathways development easier and more efficient. These might include guides that help new regional partners set up their leadership team, a step-by-step guide to the planning and design processes, or effective practices synthesized across the three regional pilots. The intent is to prepare as needed for growth, not to ossify the alliance (Zeng and Chen, 2003).

Strategy 4: Solicit and evaluate proposals for round two pathways. Based on year one experiences, we will develop a solicitation for round two pathway proposals to join our alliance, and metrics for evaluating the proposals. The quality and quantity of response to this solicitation will provide evidence of the interest in and need for an alliance moving into the future. Our experience with the InTeGrate project indicates the utility of an open solicitation for new pathway partners. Creation of the call for proposals and evaluation metrics formalizes lessons learned through work on the first set of pathways and requires that all partners have a common vision of the strategy for growing this aspect of the alliance. A call for

proposals opens up the opportunity to participate, allowing interested parties to self-identify and creating an open, scalable partnership. This is the tone we would like to set for the alliance as early as possible. We will use the open meeting in year two to support the proposal response encouraging representatives from interested regions to learn about the alliance, its programs, and the initial pathways that have been developed.

Logic Model for Project Activities: Strategies supporting the two objectives of our strategic plan are integrated in our logic model. While we describe the two objectives independently above, as shown in Figure 1, they are two views onto a single set of activities that produce both an initial set of pathway plans and initial implementation efforts, and a scalable system supporting the development of additional pathways by a collective action alliance. Items in italics can only be addressed beyond the two-year scope of the proposed work.



IMPLEMENTATION PLAN

The project will be managed by the leadership team, which consists of a representative from each of the six project partners, two representatives from each of the three regional pilot partners, and two representatives from SERC, the backbone organization: Dr. Cathryn Manduca, the overall project lead, and Dr. Ellen Iverson, who will manage the internal evaluation process. The leadership team is responsible for establishing a common agenda and shared metrics at the outset of the project, and will refine and revise project activities.

Building effective networks to affect change in education relies strongly on relational ties that support or constrain change (Daly, 2010). In order to ensure the successful development of a common agenda and shared measurement, the leadership team must be working under the same norms and expectations

(Johnson, 2015). This is of particular importance for distributed teams such as with this project (Levi, 2016). The leadership team will participate in a face-to-face kick-off meeting, quarterly virtual meetings, and a final face-to-face meeting, supported by a robust web-based infrastructure provided by SERC. The external evaluator (Karen Peterman) will work with the leadership team to establish appropriate metrics to measure the success of the project in achieving our two objectives and will provide quarterly formative feedback to the leadership team to inform their activities.

Working groups led by appropriate members of the leadership team will manage specific project elements. They will report back to the full leadership team on a checkpoint schedule determined at the kick-off meeting. Working groups with their leaders include

- Program metrics development: *Ellen Iverson and Barbara Nagle*
- Alliance development: *Cathryn Manduca and Raj Pandya*
- Metropolitan North GA Water Planning District pilot: *Garry Harris, Felicia Davis, Donna Charlevoix*
- South Central Tribal Nations pilot: *Norma Neely, John Taber, Kathy Ellins*
- California Inland Empire pilot: *Sally McGill, Anne Egger, Mark Benthian*
- Checkpoint feedback for regional teams: *Ellen Iverson and Raj Pandya*

In the first year, the project will focus on establishing a shared vision, creating highly functional working groups and information flows, completing the plans for the three regional pilots, developing a shared measurement system, and identifying the constructs to be measured. In the second year, the program will focus on supporting initial implementation steps, testing metrics, sharing the vision and initial results, and soliciting and evaluating a second round of proposals.

SERC will provide backbone support for the project and developing alliance including

- Management of the planning process;
- Project management including leadership of quarterly meetings of leadership team;
- Planning and logistics support for the kick-off meeting and open meeting;
- Communications platform including private workspaces, document management, and email communications; and
- Publishing platform for project results including regional plans, planning process, program and process metrics, and evaluation report.

The project website will serve as the communications hub supporting communications between working groups and documenting the work of the alliance. We will use shared authoring tools within private working spaces for all groups to create agendas, keep notes, and work collaboratively on living documents including the vision and plans. These documents can be published seamlessly to a public website at appropriate times. Archiving listservs will support the direct communication of teams including the leadership team, the working groups, and the regional pilots. The website will support the collection of shared metrics and use a data dashboard to support process checkpoint reporting, output measurements (such as participation numbers and responses to participant surveys), and identification of longer-term outcome measures. The website will be built using the SERCkit infrastructure, which provides data management of more than 30 NSF funded educational projects.

EXTERNAL PROJECT EVALUATION

The external evaluation will focus on the success of the project as a collective impact alliance, and will monitor the project through a different lens than the internal data collection and assessment led by Iverson. The internal assessment data will be made available to the external evaluator, and some additional data will also be collected. A developmental evaluation approach will be used to guide adaptation of the alliance as it emerges. Developmental evaluation is ideal for the kinds of emergent and

dynamic environments that occur during the development of projects, programs, and/or policy reforms (Patton, 2011), and thus it is an ideal fit for evaluating the alliance during its initial formative years.

Dr. Karen Peterman will serve as the external evaluator and lead all external evaluation efforts. Dr. Peterman was selected because of her decade-plus experience conducting developmental evaluation of NSF-funded STEM projects. She has conducted research and evaluation on communities of practice, including a current NSF grant that uses Wenger's value creation model (described below) to document the success of a community of practice using common measures and metrics across 24 partner sites. Most recently, Dr. Peterman has begun to apply a STEM-learning ecosystem approach to an evaluation of informal, formal, and teacher professional development programs offered across the state of Hawaii.

Evaluation of the early years of a collective impact initiative generally focuses on early indicators of whether core structures, processes, and relationships are established (Preskill et al., 2015). The external evaluation will investigate to what extent the five collective impact (CI) pillars (common agenda, backbone infrastructure, shared measurement system, mutually reinforcing activities, and continuous communication) are enacted by the project and how the five pillars are aligned to support the project vision and objectives.

Two primary methods of data collection will be used. The first will include a materials audit to ensure that (a) the team is making satisfactory progress in creating key resources, and (b) resources are aligned to the CI pillars. The team's timeline for materials development will be used to track satisfactory progress on a semi-annual basis. Alignment of resources to the CI pillars will be documented on a rolling basis, as resources are created. For example, website materials will be reviewed to document whether and how the project's shared vision (Pillar 1) is articulated clearly and consistently across web-based resources. Similarly, step-by-step guides, design rubrics, and context-specific tips and lessons will be reviewed to document evidence of mutually reinforcing activities (Pillar 3) such that these resources will both capitalize on and allow for the extension of project and regional partner's assets. The shared measurement system (Pillar 4) will also be reviewed to ensure that it includes process metrics, program metrics, and success metrics that are aligned to the vision for the alliance; that the common objectives across regional partners; and that the data from the metrics are usable, timely, and transparent. Peterman will be part of leadership team meetings to observe the continuous communication (Pillar 5) across the alliance to ensure that alliance members are informed and engaged, that communications are timely, and that collaborative structures allow for two-way feedback between the project's leadership, regional pathways, and working groups. The implementation of each of the above will also inform the success of the backbone infrastructure (Pillar 2) created through the project's leadership team as they work to lead the project, align partners to the shared vision, and provide adequate guidance/support for all alliance activities. The first project audit will be scheduled for the end of the second quarter of the grant year, and audits will continue on a semi-annual basis thereafter. Peterman will share the results of each audit on a semi-annual basis to allow the leadership team to respond to any recommendations that might arise.

The second evaluation strategy will consist of annual value-creation stories that are collected in written form from all project and regional partners. Wenger et al. (2011) present value creation stories as a way to measure the value created through communities of practice and networks. Using a specific value creation matrix (p. 47), partners will reflect on the success of the collective impact alliance and the materials and support provided through the project by describing meaningful activities and resources from the project; how they have used each in their implementation of the project, with a focus on what it enabled that would not have happened otherwise; and how the activity or resource affected their success.

The value creation model includes five cycles of value: immediate, potential, applied, realized, and reframed value. Responses will be coded in relation to each of the five cycles and in relation to each CI impact area. While it is not expected that partners will have time to reach reframed value during the current grant period, it is expected that some will experience immediate, potential, and applied value. The

stories collected will provide initial data to build on in later years of the project, by continuing to chart the value of the project in relation to initial partners and/or by highlighting the specific value of the project to new members of the alliance.

SUSTAINED IMPACT

Humanity has made enormous progress in the last 200 years, progress that has helped communities become safer from hazards and allowed more people to live healthier and more rewarding lives. Geoscience has been a huge part of that process. To continue that progress, however, communities need to develop new sustainable approaches to enhancing human well-being and resilience without harming the Earth system. Moreover, all communities deserve the opportunity to live healthy, sustainable, meaningful lives.

Especially in a democratic society, that requires creating pathways for communities to access, benefit from, add to, and customize geoscience knowledge. Communities need educational pathways that engage their members, enhance their capacity, address their issues, and help ensure their seat at the table. These pathways cannot be separate from the community nor can they pull community members wholly out of their community—they need to be integrated with the culture, context, strengths, and priorities of the community. The need for these pathways in the geosciences is especially acute because of the looming challenges of sustainability and because of the historic lack of diversity in the geosciences. This proposal seeks to create those pathways in geoscience education—through three pilots and a strategy for learning from and growing outward from those initial pathways.

Increasing diversity, however, is not only about empowering new people to participate, it is also about engaging the new ideas those new people bring. We need to think differently about our relation to the planet and the nature of progress, and that new thinking has to inform the way we do geoscience. This pathways project represents an opportunity to engage new voices and new communities in rethinking geosciences. These pathways will create opportunities for new ideas, values, and cultural constructs to influence geosciences.

RESULTS OF PRIOR SUPPORT

Manduca and Egger are lead PI and co-PI on NSF DUE 1125331; $10,000,000; 12/1/11-11/30/16; *InTeGrate: Interdisciplinary Teaching of Geoscience for a Sustainable Future.* **Intellectual Merit**: InTeGrate aims to increase geoscience literacy of all undergraduates by development and dissemination of teaching materials developed and tested by interinstitutional teams of faculty and through development of model interdisciplinary programs. As of June, 2016, 12 rigorously developed, peer-reviewed modules are live on the InTeGrate website (InTeGrate, 2016) and an additional 23 are in development; 16 implementation programs are underway and 2 have published websites. The website includes over 1,200 pages of content. **Broader Impact**: More than 4,200 students have already been taught using InTeGrate materials; we have developed an interdisciplinary community of over 1,000 faculty who are committed to teaching Earth in the context of societal issues; we have robust reach beyond in the geosciences into many other disciplines in the humanities, social sciences, and other STEM disciplines. The curriculum review tool and process we developed is being used by several other projects. The project devised an interactive system for supporting simultaneous development of materials, programs, and professional development activities in service to an integrated set of program goals (Kastens and Manduca, 2016). **Publications**: Approximately 15 abstracts/year (a total of ~75), 5 peer-reviewed journal articles (see References Cited); 1 PhD thesis completed, 2 PhD theses in progress.

Charlevoix is PI of NSF ICER-1540524; $216,233; 12/2015-11/2018; *Collaborative Research: GP-EXTRA: Geo-Launchpad: Preparing Colorado Community College Students for Geoscience-Focused Careers* which provides community college students in Colorado with experiential learning opportunities in geoscience through summer internships that impart technical knowledge as well as develop students'

soft skills for advancement along a career pathway in geoscience. **Intellectual Merit***:* The project is producing new curriculum and resources accessible for other programs to adopt, and is providing community college faculty the resources and information needed to advise and guide students interested in pursuing employment or further education in geoscience. Students have the opportunity to engage in research support and fieldwork. The project informs the practice of using summer research experiences to engage and build capacity in community college students. **Broader Impacts:** This project will impact hundreds of students and faculty throughout Colorado and has the potential to influence community college programs and career paths of thousands of students across the nation. The visibility of geosciences as a career path will be raised amongst diverse students through an extensive outreach and informational campaign, and as a result of student participation in the program. **Publications**: No publications were produced under this award.

Nagle is Co-PI of NSF DRL-1418235; $1,728,035*;* 9/1/14–8/31/18; PI James Short; *Moving Next Generation Science Standards into Practice: A Middle School Ecology Unit and Teacher Professional Development Model.* Nagle leads the Lawrence Hall of Science's subaward ($767,130) for development of the curriculum and assessments that support the three-dimensional learning envisioned in the *K–12 Framework for Science* and the *Next Generation Science Standards (NGSS).* **Intellectual Merit.** This project is advancing knowledge of how curriculum materials and professional development (PD) can support teachers and students in implementing the NGSS. Analysis of expert reviews, teacher feedback, and student work samples indicate that the project has made substantial progress in the designing of curriculum and professional development to support three-dimensional teaching and learning (Nagle et al., 2016). The results also suggest next steps for revision to provide more explicit support for teachers and students. **Broader Impacts.** This project is producing instructional materials and teaching resources that align with NGSS in ecology and will serve as a model for educators of three-dimensional learning. The project is also conducting research on professional development for the NGSS and CCSS, and developing instruments to help researchers and educators to study the effects of PD on science teaching and learning. **Publications**: The project has published and field-tested a draft edition of the curriculum unit, *Disruptions in Ecosystems: Ecosystem Interactions, Energy, and Dynamics* (U.C. Regents, 2015).

Pandya: NSF GEO #1120459; $3,298,568; 08/15/11-7/31/16; *Significant Opportunities in Atmospheric Research and Science (SOARS)* [Pandya was PI of SOARS from 2004 until 2013]. SOARS is an undergraduate-to-graduate bridge program designed to broaden participation in the atmospheric and related sciences and one of the longest standing, highly successful mentoring programs for students in the atmospheric sciences. **Broader impacts:** SOARS recruits students from groups historically underrepresented in the atmospheric and related sciences, including students who are Black or African American, American Indian or Alaska Native, and Hispanic or Latino, female, first generation college students, and students with disabilities. SOARS has developed an expertise in the mentoring, career guidance, and professional development of geoscience students, and actively supports a number of other undergraduate research internship programs and professional societies, particularly in enhancing diversity and broader impact**. Intellectual merit:** The SOARS program has operated since 1996 and has achieved an excellent track record preparing students for the academic and non-academic workforce. Eighty-seven percent of SOARS protégés have gone onto graduate school, and many have entered the workforce with a MS or gone on for their PhD. Thirty-five SOARS alumni have graduated with PhD degrees, 11 of whom are now faculty members. SOARS protégés work on genuine research projects with scientist mentors from NCAR, NOAA, CU-Boulder, WHOI, and other partner organizations. **Publications**: The SOARS program has produced nearly 600 oral or poster presentations at national conferences and co-authored 25 peer reviewed publications.

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Darby, Kate J., Atchison, Christopher l. (2014) Environmental Justice: insights from an interdisciplinary instructional workshop, *Journal of Environmental Studies and Sciences*, Vol 4, Issue 4, pp 288-293.

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Biographical Sketch

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Professional Preparation

Williams College, Williamstown, MA	Geology	B.A., 1980
California Institute of Technology, Pasadena, CA	Geology	M.S., 1982
California Institute of Technology, Pasadena, CA	Geology	Ph.D., 1988

Appointments

2007- Executive Director, National Association of Geoscience Teachers
2002 - Director, Science Education Resource Center, Carleton College, Northfield, MN
1994-2000 Coordinator, Keck Geology Consortium 1999-2001 DLESE Outreach Coordinator
1995-1997 Asst. Prof. of Science, Rochester Community College
1994 Asst. Prof. of Physics, St. Olaf College
1992-2001 Research Associate in Geology, Carleton College
1989-1992 Asst. Prof. of Geology, Carleton

Products

Related to this project

Kastens, K. A., and Manduca, C. A. (2016). Using Systems Thinking to Design, Implement and Evaluate the InTeGrate Project: InTeGrate White Paper. http://serc.carleton.edu/integrate/about/pubs.html

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Synergistic Activities

1) ***Supporting inclusive excellence in undergraduate education****:* As Executive Director of the National Association of Geoscience Teachers, PI of the On the Cutting Edge professional development program for

geoscience faculty, and PI of the InTeGrate STEP Center in the Geosciences, I have developed professional development programs that allow faculty, department leaders, K-12 teachers, and others to learn from each other and from experts about research, principles, and practices that support effective inclusive education; led development of materials teaching about the Earth in a societal context; and managed pilot programs fostering improvement in success for all students by focusing on mentoring, a sense of community, and motivation to succeed. These activities produced an extensive collection of on-line resources used by more than 4 million visitors per year, and measurable impacts on teaching in the geosciences. I have worked with consortia of undergraduate liberal arts colleges to document and share effective program models and to initiate collaborations or collective action. I have overseen the evaluation of Carleton's programs to broaden participation in science.

2) ***Developing large scale communities of transformation****:* The Cutting Edge program successfully engages geoscience faculty in professional development activities with more than 850 institutions participating and with measurable impact on teaching practices. The program is now self-sustaining moving from stand alone workshops to an annual conference with multiple workshops and a travelling workshop program. The four-year old InTeGrate STEP Center now involves more than 1000 educators in teaching science in a societal context, and has produced more than 1000 pages of online content supporting this goal. Materials published by the project have been used in courses enrolling more than 9500 students to date. This community was developed using principles for design, implementation, and evaluation of complex social systems to produce a desired emergent phenomenon, in this case an increase in the number and diversity of students studying about the Earth and prepared to engage in interdisciplinary activities to address resource and environmental challenges for a sustainable global society.

3) Supporting STEM-wide transformation: I am a member of the Board on Science Education of the National Academies of Sciences, Engineering and Medicine, and former President of the AAAS Education Section. I developed the Pedagogies in Action website linking research on effective pedagogy to examples of its use across the disciplines, and have engaged in research on effective professional development practices and their impact on teaching and learning. SERC supports the For Higher Ed resource portal, the Accelerating Systemic Change Network focused on bringing DBER into use, the Network of STEM Education Centers, and the Integration of Strategies that Support Undergraduate Education in STEM (ISSUES) profiling the work of STEM professional societies in this arena.

4) ***Managing large projects with backbone infrastructure****:* I have managed large grants for national consortia since 1991. I oversaw the development of Serckit, a platform for distributed website authoring, workshop support and project management. Used by more than 100 projects to produce over 31,000 pages of content, Serckit combines digital library content management and discovery tools with wiki-like collaboration tools. As PI for InTeGrate, the NSF STEP Center for the Geosciences, I put in place a management system that scaled to support project leadership distributed across 14 institutions; authoring, collection of student data from pilots, and publication of teaching materials developed by over 40 teams involving 100 faculty; and support for 16 implementation pilots.

5) ***Participating in professional society activities****:* NAS*:* Board on Science Education (2015-2017*);* AAAS: Retiring-Chair Education Section (2013-2016) Education Section Nominating Committee (2007-2010), Fellow (2009), Education Program Review Committee (2015). American Geophysical Union: Excellence in Geophysical Education Prize (2004), Committee on Education and Human Resources (1998-2002, Chair 2004-2008), Outreach Committee (2011-2012) Council (2013-2015). American Institute of Physics: Physics Resource Center Policy Committee (2012-2014); Advisory Committee on Physics Education (2006- 2012), Chair (2008-2010). National Association of Geoscience Teachers: Executive Director (2007-), Distinguished Lecturer (2000-2001), National Officer (2001-2005), President (2003), Web master (2004-2006). National Numeracy Network: Board of Directors (2010-). Project Kaleidoscope: Networking Advisory Board (2002-2004). Sigma Xi*:* Education Committee (2004-2007), Executive Committee (2000-2001, 1997-1998), Long Range Planning Committee (1996-1999). Geological Society of America: Fellow, (2010).

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A. PROFESSIONAL PREPARATION

University of Wisconsin	Milwaukee, WI	Atmospheric Sciences	B.S. 1993
University of California	Davis, CA	Atmospheric Sciences	M.S. 1996
University of Illinois	Urbana, IL	Science Education	Ph.D. 2008

B. APPOINTMENTS

UNAVCO Boulder, Colorado	Director, Education and Community Engagement	2012 - present
University of Illinois Urbana, Illinois	Adjunct Professor, Dept. Atmos. Sciences	2009 – present
The GLOBE Program Boulder, Colorado	Director, Science & Education Division	2009 – 2012
University of Illinois Urbana, Illinois	Director of Introductory Courses Lecturer, Dept. Atmospheric Sciences	2004 – 2009 1997 – 2009
San Francisco State Univ. San Francisco, California	Lecturer, Dept. Geosciences	1996 – 1997

C. PRODUCTS

(i) Closely related

Charlevoix, D.J. & A.R. Morris. (2015). Developing Research-Ready Skills: Preparing Early Academic Students for Participation in Research Experiences. *AGU Fall Meeting*. https://agu.confex.com/agu/fm15/webprogram/Paper86108.html

Charlevoix, D. J., and A. R. Morris (2014), Increasing Diversity in Geoscience Through Research Internships, *Eos, Transactions American Geophysical Union*, *95*(8), 69-70, doi:10.1002/2014EO080001. http://onlinelibrary.wiley.com/doi/10.1002/2014EO080001/full

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Charlevoix, D.J. 2008. Improving Teaching and Learning through Classroom Research, *Bull. Amer. Meteorological Soc., 89*(6)*,* 1659-1664. http://search.proquest.com/openview/e378f8e63b010eaf814c20f75fd86d67/1?pq-origsite=gscholar&cbl=31345

(ii) Other Significant

R. Rauber, J. Walsh, and D.J. Charlevoix. (2012) (Ed 4). *Severe and Hazardous Weather: An Introduction to High Impact Meteorology*, Kendall/Hunt Pub. Dubuque, IA

Charlevoix, D.J. and Stanitski, D. 2008. A Synopsis of Academic Members of the American Meteorological Society. *Bull. Amer. Met. Soc.*, 89(6), 896-900.

Stanitski, D.M., and Charlevoix, D.J. (2008). The 2005 Membership Survey: Who Are the Student Members of the American Meteorological Society. *Bull. Amer. Met. Soc.*, 89(6), 892-895. http://journals.ametsoc.org/doi/pdf/10.1175/2008BAMS2534.1

Kahl, J. D., D. J. Charlevoix, N.A. Zaitseva, R.C. Schnell, M.C. Serreze. (1993). Absence of Evidence for Greenhouse Warming Over the Arctic Ocean in the Past Forty Years. Nature, 361(6410):335-337. https://pantherfile.uwm.edu/kahl/www/Research/Kahl_Nature_1993.pdf

D. SYNERGISTIC ACTIVITIES

Professional leadership and service. American Meteorological Society (AMS). Education Editor for Bulletin of the American Meteorological Society (BAMS) (2016-present), Co-chair and member of Symposium on Education for (AMS); responsible for leading and organizing community-focused symposium at the Annual Meeting (1999-2016; chair 2012-2016). Board member: Board on Women and Minorities (2013-present) and Awards Nominating Committee (2014-present), Board on Higher Education (2004-2009). Cool Girls Science and Art Club, non-profit, Board member, Chairwoman 2011. Colorado Cooperative for Girls in STEM, Leadership Team member (2011-2014).

Authorship. College Textbook. Co-author of introductory textbook *Severe and Hazardous Weather: An Introduction to High Impact Meteorology* currently in fourth edition and adopted by over 150 colleges and universities in the U.S. and Canada. Lead on pedagogical structure, ancillary materials, and online content; contributor to science updates including case studies of significant severe weather events and natural hazards with special emphasis to impacts on society. Policy statement co-author AMS: Earth System Science, Technology, Engineering, and Mathematics Education. Adopted by the AMS Council 19 May 2014. *https://www2.ametsoc.org/ams/index.cfm/about-ams/ams-statements/statements-of-the-ams-in-force/earth-system-science-technology-engineering-and-mathematics-education/*

Curriculum and Instruction. Developed first large-lecture (>200 students) hybrid/blended learning course at the University of Illinois serving as a model for the Provost's office and large-scale campus implementation (2007). Inaugural member of faculty of Online Global Campus Initiative, Environmental Sustainability major (now online certificate in Environmental Sustainability) and developer and instructor of Societal Impacts of Weather and Climate (2006). Creator of the Hands-On, Minds-On Meteorology curriculum integrating interactive technologies into introductory courses resulting in enrollments increasing ten-fold (2003).

International collaborations. Created GLOBE International Scientist Network, a network of scientists engaged in Earth System Science research interested in enhancing K-12 education and engaging directly with teachers and students; Within 6 months the network grew to over 55 scientists from Greece, India, The Netherlands, Tanzania, Thailand, and the United States. (2010-12). *GLOBE representative to*: WMO (World Meteorological Organization, Education and Training) International GEO (Group on Earth Observations), ACRE (Atmospheric Circulation Reconstructions Over the Earth), and ASTC (Association of Science & Technology Centers) (2009-2012).

Mentoring. Mentor and science education researcher for UCAR, SOARS and (former) H.I.R.O programs. Mentored graduate student in science education and researched effectiveness of pre-college internship programs in terms of science self-efficacy. (2010-11)

Biographical Sketch

Anne E. Egger

Geological Sciences and Science Education • Central Washington University
Ellensburg, WA 98926-7418 • 509-963-2870 • annegger@geology.cwu.edu

Professional preparation

Yale University	New Haven, CT	Geology and Geophysics	BA 1995
Stanford University	Stanford, CA	Geological & Environmental Sciences	MS 2001
Stanford University	Stanford, CA	Geological & Environmental Sciences	PhD 2010

Appointments

2011-present	Assistant Professor, *Central Washington University*
2004-2011	Undergraduate Program Coordinator, *School of Earth Sciences, Stanford University*
2004-2011	Lecturer, Geological and Environmental Sciences, *Stanford University*
2002-2004	Instructor of Geology and Geography, *San Juan College, Farmington, NM*

Products

Most relevant

Steer, D., Iverson, E., Egger, A., Kastens, K., Manduca, C., and McConnell, D., *in review*, Multi-institutional college curriculum development using a peer-to-peer auditing and coaching system: Lessons from the InTeGrate project. *Science Educator*.

Egger, A. E. and Carpi, A., 2013, Revealing data in science: Using and teaching about data-based graphics for analysis and display, in Finson, K. D. and Pederson, J., eds., Visual Data and Their Use in Science Education; Charlotte, NC: Information Age Publishing (INVITED).

Egger, A. E., 2012, Engaging Students in Earthquakes via Real-Time Data and Decisions: Science, v. 336, no. 6089, p. 1654-1655, doi: 10.1126/science.1214293 (INVITED).

Egger, A.E. and Klemperer, S.L., 2011, Recruiting Students into the Earth Sciences through Undergraduate Research: *CUR Quarterly*, v. 32, no. 2, p. 22-31.

Carpi, A. and Egger, A.E., 2011, The Process of Science. Visionlearning, Inc.: New Canaan, CT.

Additional products

Athens, N.D., Glen, J.M.G., Klemperer, S.L., Egger, A.E., and Fontiveros, V.C., 2015, Hidden intrabasin extension: Evidence for dike-fault interaction from magnetic, gravity, and seismic reflection data in Surprise Valley, NE California: *Geosphere*. doi: 10.1130/ges01173.1

Ibarra, D.E., Egger, A.E., Weaver, K.L., Harris, C.R., Maher, K., 2014, Rise and fall of late Pleistocene pluvial lakes in response to reduced evaporation and precipitation: Evidence from Lake Surprise, California. *Geological Society of America Bulletin* B31014.1, 30 p.

Egger, A.E.; Glen, J.M.G.; and McPhee, D.K., 2014, Structural controls on geothermal circulation in Surprise Valley, CA: A re-evaluation of the Lake City fault zone, *GSA Bulletin.* doi: 10.1130/B30785.1

Egger, A.E. and Miller, E.L., 2011, Evolution of the northwestern margin of the Basin and Range: The geology and extensional history of the Warner Range and environs, northeastern California: *Geosphere*, v. 7, no. 3, p. 756-773. doi: 10.1130/GES00620.1

Colgan, J.P., Egger, A.E., John, D.A., Cousens, B., Fleck, R.J., Henry, C.D., 2011, Oligocene and Miocene arc volcanism in northeastern California: Evidence for post-Eocene segmentation of the subducting Farallon plate: *Geosphere*, v. 7, no. 3, p. 733-755. doi: 10.1130/GES00650.1

Synergistic activities

1. **Leading professional development activities:** I serve in a leadership capacity in the National Association of Geoscience Teachers (NAGT), both in the presidential line and as chair of the Professional Development Planning Committee, and I am co-PI on the InTeGrate project, NSF's STEP Center in the Geosciences. Much of my work in NAGT and InTeGrate has focused on leading workshops for faculty and graduate students, including a series of workshops on teaching introductory courses. In the past two years, I've offered a full-length workshop and several webinars entirely online for the first time. I am currently one of the leaders of NAGT's Traveling Workshop program, which solicits applications for us to travel to institutions to offer a workshop on improving student learning. I am particularly interested in understanding how these workshops affect faculty in their teaching, and have developed a survey to be administered one year after the workshop.
2. **Facilitating, expanding, and supporting undergraduate participation in research:** I am the Director of the Office of Undergraduate Research (OUR) at CWU, focused on expanding the reach of the OUR and growing the program through providing more opportunities for preparation for, support during, and pathways throughout the research process. Previously, as the Undergraduate Program Coordinator in Earth Sciences at Stanford University, I grew a small, departmental undergraduate research program that funded about 6 students a year into a school-wide, interdisciplinary program that funded about 30 students a year. I served as a Geoscience Councilor on the Council on Undergraduate Research from 2011 to 2013, and am currently PI on an interdisciplinary REU Site: Hazards and Risks of Climate Change in the Pacific Northwest (EAR 1559862), which will bring students from regional community colleges to CWU to conduct research projects related to regional climate change while also working collaboratively to communicate those hazards and risks to their communities.
3. **Interdisciplinary teaching relating geoscience and societal issues:** I co-teach an interdisciplinary course in the Douglas Honors College called *Hazards, Risk, and Resilience in the Pacific Northwest*. Through this course, students conducted an earthquake risk assessment of Ellensburg through developing a survey about risk perception and screening hundreds of buildings in town with a FEMA-approved procedure. They analyzed all of their results and made a presentation to the Ellensburg city council with several recommendations for improving earthquake preparedness. I will modify this course for teaching in the REU program. This course is an ideal example of research that was (1) interdisciplinary, (2) integrated into regular classroom teaching, and (3) beneficial to the community.
4. **Developing high-quality, freely available resources for teaching and learning:** As an author, editor, and co-project director for Visionlearning (http://www.visionlearning.com), my focus is on developing peer-reviewed readings for learning about science in a way that focuses on how we know what we know, the data that support our scientific explanations, and the people behind the science. Our recent work has involved developing profiles of practicing scientists who are from under-represented groups and readings about math in science, helping students transfer what they've learned in math classes and use math in scientific applications. We also work with literacy specialists to ensure that these readings are accessible. Through InTeGrate, I've led the development of teaching materials that highlight the role of Earth literacy in societal issues in teacher preparation and interdisciplinary settings.
5. **Facilitating curricular improvement:** At CWU, I led efforts to revise three undergraduate degree programs in Geological Sciences and one in Science Education; this work followed on my experience leading curriculum revision efforts at both Stanford University and Nanyang Technical University. In Geological Sciences, I helped developed and implement programmatic assessment through use of the Geoscience Literacy Exam and a revised quantitative skills test. At the university level, I am a member of the General Education Committee, which has been in the process of fully revising the Gen Ed program.

Biographical Sketch

Barbara W. Nagle

SEPUP Director, Lawrence Hall of Science, University of California, Berkeley, CA 94720
bnagle@berkeley.edu

A. PROFESSIONAL PREPARATION

Wellesley College	Wellesley, MA	Molecular Biology	A.B., 1972
University of Pennsylvania	Philadelphia, PA	Biology	Ph.D., 1977
University of California	Berkeley, CA	Cell Biology	1977–1981
California State University	Hayward, CA	Teaching Credential	1986

B. APPOINTMENTS

1/2003–present	Director, Science Education for Public Understanding Program (SEPUP), Lawrence Hall of Science, Berkeley, CA
7/1996–12/2003	Co-Director, Science Education for Public Understanding Program (SEPUP), Lawrence Hall of Science, Berkeley, CA
9/1990–6/1996	Teacher Associate, Science Education for Public Understanding Program (SEPUP), Lawrence Hall of Science, Berkeley, CA (On loan from the Oakland Unified School District)
9/1985–8/1991	Chemistry Teacher, Science Department, Fremont High School, 4610 Foothill Boulevard, Oakland, CA
7/1981–8/1985	Assistant Research Physiologist, Department of Physiology-Anatomy, University of California, Berkeley, CA

C. PRODUCTS

Related Products

1. **Nagle, B.,** Howarth, J., Short, J., Kastel, D. Wilson, S., Willcox, M., McPherson, A. Montrosse-Moorhead, B., Holmes, J., & Hariani, M. (2016). Developing an NGSS-aligned educative middle school ecosystems curriculum unit. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Baltimore, MD. http://www.sepuplhs.org/pdfs/NARST2016.pdf
2. U.C. Regents. (2015). *Disruptions in Ecosystems: Ecosystem Interactions, Energy, & Dynamics.* Field Test Edition, Lawrence Hall of Science, University of California at Berkeley. **Nagle, B.** developed curriculum, was second author of Chapter 1 and first author of Chapter 2. Published by U.C. Regents, Oakland, CA.
3. Bellantoni, J., Hariani, M., Seaver, D., **Nagle, B.**, Cuff, K., & Dombkowski, S. (2012). *Issues and earth science. Second Edition.* The Science Education for Public Understanding Program, Lawrence Hall of Science, University of California, Berkeley. Produced by Lab-Aids, Inc., Ronkonkoma, NY. http://sepuplhs.org/middle/iaes/
4. **SEPUP.** (2011). *Science and Global Issues: Biology.* The Science Education for Public Understanding Program, Lawrence Hall of Science, University of California, Berkeley. **Nagle, B.**

developed curriculum, was first author of Cell Biology unit and second author of Evolution unit. Produced by Lab-Aids, Inc., Ronkonkoma, NY. http://www.sepuplhs.org/high/sgi/index.html

5. **Nagle, B.**, Hariani, M., & Siegel, M. (2006). Achieving a vision of inquiry: Rigorous, engaging curriculum and instruction. In R. Yager, Ed. *Exemplary science in grades 5–8: Standards-based success stories.* Arlington, Virginia: NSTA Press. http://static.nsta.org/files/PB192X2web.pdf

Other Significant Products

1. **Nagle, B.** (2015). Engineering Design in SEPUP's Middle School Issue-Oriented Science Program. In C. Sneider, Ed. *The Go-To Guide For Engineering Curricula, Grades 6–8.* Corwin Press: Thousand Oaks, CA. http://www.corwin.com/books/Book241762 - tabview=toc
2. Bellantoni, J., **Nagle, B.,** Dombkowski, S., Seaver, D., Hariani, M., Lenz, L., Markey, D., Howarth, J., Amosslee, L., & Davison, A. (2012). *Issues and physical science. Second Edition.* Commercial Edition. The Science Education for Public Understanding Program, Lawrence Hall of Science, University of California, Berkeley. Produced by Lab-Aids, Inc., Ronkonkoma, NY. http://www.sepuplhs.org/middle/iaps/index.html
3. **Nagle, B.**, Siegel, M.A., & Barter, A. (2004). Evolution of life science assessments for middle school. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Vancouver, BC. http://sepuplhs.org/pdfs/NagleSiegelBarterNARST.pdf
4. Wilson, M., Thier, H., Sloane, K., & **Nagle, B.** (1996, April). What have we learned from developing an embedded assessment system? Paper presented at the annual meeting of the American Educational Research Association, New York.

D. SYNERGISTIC ACTIVITIES

1. Contributor to science curriculum and teacher professional development for NGSS
   Is currently Co-PI for NSF-funded *Moving Next Generation Science Standards into Practice: A Middle School Ecology Unit and Teacher Professional Development Model* (NSF DRL-1418235, $1,728,035, 9/1/14–8/31/18, PI James Short, Co-PI Suzanne Wilson). For this project, Nagle leads the curriculum team, which has completed development of the first field-test edition of *Disruptions in Ecosystems: Ecosystem Interactions, Energy, and Dynamics,* a middle school curriculum unit to support the NGSS. This course was field-tested in New York City during the 2015–2016 school year, and will be revised based on feedback from teachers and an expert panel and tested again in 2016–2017. Nagle also contributed to professional development for the field test teachers.

2. Developer of SEPUP secondary science curricular materials and professional development
   Contributed to proposal development, leadership, and authoring teams for SEPUP's NSF-funded three-year issue-oriented middle school program (*Issues and Earth Science, Issues and Life Science,* and *Issues and Physical Science*) and high school courses (*Science & Sustainability* and *Science and Global Issues: Biology.* Served as the PI for NSF-funded grant that developed *Science in Global Issues* (NSF DRK-12 0352453, $2,668,188, 3/1/04–11/30/11). This project produced a yearlong high school biology curriculum. Each *Science and Global Issues* unit uses a socioscientific issue related to sustainability as the context for high school biology.
   Served as PI and co-author for U.S. Department of Energy-funded *Hydrogen Technology and Energy* (HyTEC) curriculum (DE-FG36-04-GO14277, 9/1/04–8/31/12). This project produced and disseminated a high school curriculum unit titled *Investigating Alternative Energy: Hydrogen & Fuel Cells.* Has also delivered numerous professional development sessions to support these programs and related to a variety of topics in science education, including science instructional materials, the NGSS, assessment, inquiry, differentiated instruction, and literacy in science.

Biographical Sketch Rajul E. Pandya
Thriving Earth Exchange American Geophysical Union (AGU), Washington, DC rpandya@agu.org

Professional preparation

University of Illinois	Urbana, IL	Physics	BS 1991
University of Washington	Seattle, WA	Atmospheric Sciences	PhD 1996

Appointments

2013 - Present	Program Director, Thriving Earth Exchange, American Geophysical Union
2011-2013	Director, Spark: UCAR Office of Education, University Corporation for Atmospheric Research
2004-2011	Director, Significant Opportunities in Atmospheric Research and Science, University Corporation for Atmospheric Research
2002-2004	Outreach and Community Relations Liaison, Digital Library for Earth Science Education (DLESE) Program Center
1999-2002	Assistant Professor of Meteorology, West Chester State University
1996-1998	Post-Doctoral Fellow, National Center for Atmospheric Research

Products

Most Relevant

Pandya, R., J. Galkiewicz, B. Williams, H. Furukawa, K. Berry, 2014: Using the Thriving Earth Exchange to advance community science. The Leading Edge 33, 12, 1330-1334. DOI: 10.1190/tle33121330.1

Pandya, R. E., 2014: Community-Driven Research in the Anthropocene. Future Earth--Advancing Civic Understanding of the Anthropocene, Diana Dalbotten, Ed., American Geophysical Union, 53-66.

Maldonado, J.K., Colombi, B. and Pandya, R. Eds., 2014: Climate Change and Indigenous Peoples in the United States. Springer International Publishing.

Porticella, N., Bonfield, S., DeFalco, T., Fumarolo, A., Garibay, C., Jolly, E., Huerta Migus, L., Pandya, R., Purcell, K., Rowden, J., Stevenson, F., and Switzer, A., 2013: Promising Practices for Community Partnerships: A Call to Support More Inclusive Approaches to Public Participation in Scientific Research. (Available at http://www.birds.cornell.edu/citscitoolkit/promisingpractices)

Pandya, R. E., 2012: A framework for engaging diverse communities in citizen science in the US. Frontiers in Ecology and the Environment 10: 314–317. DOI: 10.1890/120007

Additional products

Soleri, D., J. W. Long, M. Ramirez-Andreotta, R. Eitemiller, and R. Pandya, 2016: Finding Pathways to More Equitable and Productive Public-Scientist Partnerships, Citizen Science: Theory and Practice 1(1), p.9. DOI: http://doi.org/10.5334/cstp.46

Pandya, R., A. Hodgson , M. Hayden, P. Akweongo, T. Hopson, A.A. Forgor, T. Yoksas, M.A. Dalaba, V. Dukic, R. Mera, A. Dumont, K. McCormack, D. Anaseba, T. Awine, J.M. Boehnert, G. Nyaaba, A. Laing, and F. Semazzi, 2015: Using Weather Forecasts to Help Manage Meningitis in the Sahel, Bulletin of the American Meteorological Society, 96, 103–115. DOI: 10.1175/BAMS-D-13-00121.1

Charlevoix, D., R. Pandya, A. Bridger, T. Gill, E. Hampton, R. Herman, J. Knox, W.W. Lee, Diane Stanitski, 2014: New Directions for the Education Symposium, accepted for publication in the Bulletin of the American Meteorological Society. DOI: 10.1175/BAMS-D-13-00121.1

García-Pando, Carlos Pérez, M. C. Thomson, M. C. Stanton, P. J. Diggle, T. Hopson, R. Pandya, R. L. Miller, and Stéphane Hugonnet, 2014: Meningitis and climate: from science to practice. Earth Perspectives 1, 1-15. DOI: 10.1186/2194-6434-1-14

National Research Council, 2010: NOAA's Education Program: Review and Critique. J. W. Farrington and M. A. Feder, Editors, The National Academies Press, 169 pp. DOI: 10.17226/12867

Synergistic activities

1. Advancing community science. Community science is a participatory approach to science research and education that emphasizes close collaboration between scientist and community leaders in all scientific

processes -from identifying scientific questions that are community relevant through collecting and analyzing data together to applying results to produce local impact. As Program Director for AGU's Thriving Earth Exchange, Pandya uses community science to leverage geoscience, produce impact, and support AGU's mission of discovery for the benefit of humanity. Under Pandya's leadership, TEX has developed and implemented a model for launching and advancing locally-focused community science partnerships that produce impactful solutions, built partnerships with a diverse set of community-serving organizations, created and refined processes for matching scientists and community leaders, and mined knowledge from a variety of disciplines to coach and mentor community-science project teams. TEX has launched nearly 30 unique projects, which range in scope from a pilot project to help 20 residents in a diverse low-income Denver neighborhood pilot new low-cost sensors to identify harmful chemicals entering their home to an international project to work with villagers in Afghanistan to adapt their traditional agricultural calendars to a rapidly changing climate.

2. Growing a community of practice around community science. In the geosciences, community science connects with geoscience education and outreach, citizen science, actionable science, service learning, efforts to broaden participation, and environmental justice. Pandya is active participant in these communities and has held leadership positions in some of those communities. He has developed and led sessions, workshops, and symposia exploring how community science connects to these topics at professional society meetings and for smaller groups, and authored articles or given invited talks on community science. As part of TEX's long term plan, it will convene and advance a community of practice around community science, this proposal is one of several efforts toward that end.

3. Launching and leading multidisciplinary research. Pandya assembled, led, and secured funding for a multidisciplinary and multinational team that developed new tools to inform the distribution and timing of meningitis vaccines in sub-Saharan Africa. This project, funded by google.org, used community input and new data to uncover the link between meningitis transmission and relative humidity and worked with public health workers to design a straightforward tool to provide relative humidity predictions that was used to inform vaccination production. In addition, over 15 papers were published based on this research, which was also part of the graduate work of 3 students: 1 from the US and 1 from Africa. This work was also a springboard for additional work in the region, funded by NSF and other agencies.

4. Broadening participation in the geosciences. As part of DLESE, Pandya was part of several efforts to engage diverse communities as partners in developing the digital library. As director of SOARS, he expanded the program to recruit and support LBGTQ students and students with disabilities and introduced collaborative research with communities. He led the UCAR Africa Initiative, which increased scientific collaborations between African scientists and UCAR, and introduced "listening conferences" that launched several productive collaborations between UCAR scientists and educators and indigenous leaders. Working with schools in Denver and Puerto Rico, he launched a summer internship program for high-school students at NCAR. With AMS, Pandya facilitated the launch of an organization for LBGTQ members, led the team that drafted the first policy on harassment and professional conduct at meetings, and created numerous venues for people to learn about and tackle issues of disability, gender, and diversity. As a board member for the Citizen Science Association, he helped guide the establishment of the Integrity, Diversity and Equity Working Group. The Thriving Earth Exchange uses community science to advance the priorities of diverse and historically underserved communities.

5 Management experience. Pandya has managed large grants and programs since 2004 when he became the director of the SOARS Program, a multi-year REU program with comprehensive mentoring that broadens participation in the geoscience. As director of Spark, Pandya managed a staff of 20, provided strategic leadership on NCAR and UCAR's education portfolio, and led teams that produced teacher educations, student internships, and educational and curricular materials for formal and informal education. Pandya has served on the board of the "I Have a Dream Foundation of Boulder," including 5 years as chair, which helps children in underserved communities advance academically - from 2nd grade to college - through mentoring, scholarships, and academic enrichment. He is also on the board of Directors of the Citizen Science Association and serves as the Commissioner for Human Resources with the American Meteorological Society, where he manages 3 boards and numerous committees.

Mark Lee Benthien
Southern California Earthquake Center, University of Southern California,
Los Angeles, CA 90089 benthien@usc.edu

PROFESSIONAL PREPARATION

University of California, Los Angeles	Los Angeles, CA	Geophysics	BS, 1995a
University of Southern California	Los Angeles, CA	Public Policy	MPP, 2003

APPOINTMENTS

2001–present	Director for Communication, Education, and Outreach, Southern California Earthquake Center, University of Southern California, Los Angeles, CA
1999–2001	Assoc. Director for Outreach, Southern California Earthquake Center, University of Southern California, Los Angeles, CA
1996–1999	Outreach Specialist, Southern California Earthquake Center, University of Southern California, Los Angeles, CA
1995–1996	Graduate Research Assistant, California Institute of Technology, Pasadena CA

PRODUCTS

RELATED TO THIS PROJECT

Jones L.M. and Benthien, M.L. Preparing for a “Big One”: The Great Southern California ShakeOut, EERI Spectra, 27, no. 2, pp 575-595, 2011

Jones L.M. and Benthien, M.L. Putting Down Roots in Earthquake Country, Special Publication of the Southern California Earthquake Center, University of Southern California, 32 pages, 2011 (available online at www.earthquakecountry.org/roots)

Benthien, M.L. and Pearce, I., Seven Steps to an Earthquake-Resilient Business, Special Publication of the Southern California Earthquake Center, University of Southern California, 16 pages, 2008 (available online at www.earthquakecountry.org/roots)

Benthien, M.L. and L.A.’s ‘Puente Hills’ Earthquake, One Week Later, Natural Hazards Observer, 28, no. 3, p. 1-3, 2004

Benthien, M.L. and Andrews, J.H., Development and Implementation of the SCEC Communication, Education and Outreach Program, Seismological Research Letters, 74, no. 5, p. 511-515, 2003.

OTHER SIGNIFICANT PRODUCTS

Field, N., L. Jones, T. Jordan, M.L. Benthien, and L. Wald, Earthquake shaking; finding the "hotspots” USGS Fact Sheet 001-01, 2001

Henyey, T.L., G.S. Fuis, M.L. Benthien, T.R. Burdette, S.A. Christofferson, E.E. Criley, R.W. Clayton, P.M. Davis, J.W. Hendley II, M.D. Kohler, W.J. L, The "LARSE" Project– Working Toward A Safer Future For Los Angeles, USGS Fact Sheet 111-99, 1999.

Forrest, M., T. Rockwell, T. Henyey, and M.L. Benthien, Shattered Crust Series #2: The Palos Verdes Fault Guide, Edited by Jill Andrews, Southern California Earthquake Center, 1996.

Fuis, G. S., D. A. Okaya, R. W. Clayton, W. J. Lutter, T. Ryberg, T. M. Brocher, T. L. Henyey, M. L. Benthien, P. M. Davis, J. Mori, R. D. Catchings, U. S. ten Brink, M. D. Kohler, K. D. Klitgord and R. G. Bohannon, Images of Crust Beneath Southern California Will Aid Study of Earthquakes and Their Effects, EOS, Transactions of the American Geophysical Union, 77, no. 18, pp. 173-176, 1996.

Kohler, M. D., P. M. Davis, H. Liu, M. L. Benthien, S. Gao, G. S. Fuis, R. W. Clayton, D. Okaya and J. Mori, Data Report for the 1993 Los Angeles Region Seismic Experiment (LARSE93), Southern California: A Passive Study from Seal Beach Northeastward through the Mojave Desert, U. S. Geological Survey, Open- File Report, 96-85, p.82, 1996.

SYNERGISTIC ACTIVITIES

2008–present	Great ShakeOut Earthquake Drills, Global Coordinator
2003–present	Earthquake Country Alliance, California, Executive Director
2006–2007	Network for Earthquake Engineering Simulation, EOT Committee Member
2004–2010	Earthquakes and Megacities Initiative, Los Angeles Academic Representative
2004–2011	Emergency Survival Program, Coordinating Council Member

Biographical Sketch

Felicia M. Davis

a. Professional Preparation

Howard University	Washington, DC	Political Science	BA 1980
Howard University	Washington, DC	HUD Grad Fellow	1980-82

b. Appointments

2013-present	Director, Building Green Initiative at Clark Atlanta University, Atlanta, GA
2010-2013	Director, UNCF Building Green Initiative, Atlanta, GA
2006-2010	Vice President, Women Flying High LLC, Atlanta, GA
2004-2006	Director, Mothers & Others for Clean Air, Atlanta, GA
2000-2006	Director, GA Airkeepers, Atlanta, GA

c. Products

Most Closely Related

1. Davis, Felicia, Director, Building Green Initiative; Andrea Harris, President & CEO, North Carolina Institute for Minority Economic Development; Henry Lancaster, Project Manager; Kerra Bolton, Author; Maranatha Wall, Senior Research Associate; Vanessa Nicholas, Graphic Design; Edrea Davis, Media. HBCU Green Report (2014). http://buildinggreennetwork.org/wp-content/uploads/2014/08/HBCU_Green_Report_2014.pdf

2. Daley, Melissa, Editor in Chief; in collaboration with Michael Lomax, Karl W. Reid, Louis Barbash, Clarissa Myrick-Harris, Felicia Davis, Darryl Ann Lai-Fang. Sustainable Campuses Building Green at Minority-Serving Institutions (2012). Published by Kyoto Publishing Suite L200 560 Beatty Street Vancouver, BC Canada, V6B 2L3 ISBN 978-0-9813326-4-2. http://buildinggreennetwork.org/GreenReport/PDF/Sustainable_Campuses.pdf

3. Felicia M. Davis, Director; Rick Horowitz, Editor; Rebecca Caine, Editor. MSI Green Report in collaboration with Mark Orlowski & Sustainable Endowment Institute (2010). http://icb.uncf.org/LinkClick.aspx?fileticket=BAPXRJwYa8I%3D&tabid=160&mid=511

Other Significant Products

1. Martha H. Keating, Clean Air Task Force for Clear The Air, and Felicia Davis, Georgia Coalition for the Peoples' Agenda. Air of Injustice (2002). Designed by Patricia Gunn. Printed by: LaBerge Printers, Inc, Orlando, FL. http://www.energyjustice.net/files/coal/Air_of_Injustice.pdf

d. Synergistic Activities

1. As the Director of the HBCU Green Ambassador Program, I trained and supported student sustainability leaders on 27 HBCU campuses providing introduction to climate science, environmental justice, and campus stewardship. Ambassadors were nominated by faculty members that served as mentors or advisors. Students worked in teams to foster collaboration across campuses. A team effort was essential to successfully complete the training curriculum. Strong team bonds were formed and over time students increasingly turned to their colleagues for support. This was significant because teams were comprised of students from a range of majors each representing a different major. They met in person only once and communicated via Internet and conference call after the training. A collaborative

learning model was key to the success of the Green Ambassador program with enhanced student achievement based on grades, retention, and student-driven green activity on campus.

2. As Director of the Building Green Initiative I promote campus-wide sustainability (buildings and infrastructure, curriculum development, renewable energy, and student engagement for Historically Black, Hispanic Serving and Tribal colleges and universities. Since transitioning from UNCF to Clark Atlanta University the focus has narrowed to HBCUs while maintaining relationships with other MSIs. The program provided small grants to a range of institutions to implement innovative projects with an energy reduction and educational requirement. The Initiative is credited with increasing and supporting environmental sustainability on diverse MSI campuses and building a vibrant network of faculty and administrators committed to sustainability goals. We conducted the first MSI campus sustainability surveys with participation from more than 50 institutions, provided training for faculty to advance interdisciplinary environmental studies, and coordinated sustainability conferences targeting minority-serving institutions.

3. As a national director of Project Preserve designed to rescue engineering and computer science students performing poorly in the most competitive universities (collaboration between CUNY, CSUN and Xavier-New Orleans), I identified and recruited Black and Latino engineering and computer science students that were failing in the nation's most competitive engineering and computer science programs. These students had comparatively strong backgrounds for the new campus environments and quickly began to thrive. Two additional student success factors were "time on task" and collaborative learning. Mandatory active study sessions and competitive team projects with faculty sponsors helped to transform the culture changing faculty expectations for minority students. It was determined that institutional fit is a critical factor in STEM student success. The program also provided financial aid and we introduced multi-cultural studies in summer bridge programs involving several of the Preserve students as tutors.

Biographical Sketch

Katherine Kelly Ellins

The University of Texas Jackson School of Geosciences Phone: 512-471-0347
10100 Burnet Rd., Bldg. 196, Austin, TX 78759-4445 U.S.A. E-mail: kellins@jsg.utexas.edu

Professional Preparation

- Skidmore College, Saratoga Springs, NY, Geology, B.A. 1973.
- New York University School of Education, New York, NY, Science Education, M.A. 1976.
- Columbia University, New York, NY, Geography, M.A., January 1982.
- Columbia University, New York, NY, Geography, Ph.D. 1988.

Appointments

- 01/2016 – 07/2016. Fulbright CORE Scholar. Visiting Faculty, Department of Geography and Geology, University of the West Indies, Mona, Jamaica.
- 09/2014 – present. Program Director. Jackson School of Geosciences, University of Texas Austin.
- 10/1998 – 09/2014. Program Manager, Institute for Geophysics, University of Texas Austin.
- 10/1994 – 09/1998. IODPJOIDES Office (University of Wales, Cardiff, UK and Woods Hole Oceanographic Institution).
- 08/1988 – 05/1994. Assistant Professor, Dept. of Geology, University of Florida, Gainesville.

Products

Five Significant Scholarly Products Related to this Project

Ellins, K.K., T.S. Ledley, N. Haddad, K. McNeal, A. Gold, S. Lynds, and J. Libarkin, 2014, EarthLabs: Supporting Teacher Professional Development to Facilitate Effective Teaching of Climate Science, Journal of Geoscience Education, v. 62, no. 3, p. 330-342.

McNeal, K., J. Libarkin, T.S. Ledley, K. K. Ellins, and S. Dutta, 2014, The Role of Research in On-line Curriculum Development: The Case of the EarthLabs Climate Change Curriculum, Journal of Geoscience Education, v. 62, no. 4; p.560-577.

Ellins, K.K., E. Snow, H. C. Olson, E. Stocks, M. Willis, J. Olson, and M. R. Odell, 2013, The Texas Earth And Space Science (TXESS) Revolution: A Model For The Delivery of Earth Science Professional Development To Minority-Serving Teachers, Journal of Geoscience Education, v. 61, no. 2, pp.187-201; doi: 10.5408/12-348.1.

Ledley, T.S., N. Haddad, E. Bardar, K. Ellins, K. McNeal, J. Libarkin, 2012, EarthLabs – An Earth System Science Laboratory Module to Facilitate Teaching About Climate Change: The Earth Scientist, v. 28, n. 3, p. 19-24.

Ellins, K. K., H.C. Olson, 2012, Enhancing Geoscience Education within a Minority-Serving Teacher Population, Journal of Geoscience Education, v. 60, no. 1, p. 21-33.

Five Additional Scholarly Products

Ellins, Katherine K., Tamara S. Ledley, Karen McNeal, Nick Haddad, Julie Libarkin, Erin Bardar, Betsy Youngman, Candace Dunlap, Jeff Lockwood, and Alison Mote, 2015. Supporting Students' Understanding of Change Over Time and Space: The EarthLabs Climate Series, Paper No. 183-4, presented at the 2015 GSA Annual Meeting in Baltimore,

Maryland, 1-4 November.

Ellins, Katherine, Elaine Bohls-Graham, Eric. M. Riggs, Laura Serpa, Belinda Jacobs, Sean Fox, Molly Kent, E. Stocks, Deana Pennington, Diversity and Innovation for Geoscience (DIG) Texas Earth and Space Science Instructional Blueprints, Abstract ED51C-3448, presented at 2014 Fall Meeting, AGU, San Francisco, Calif., 15-19 Dec.

Ellins, K.K., A.S. Mote, J. Lockwood, N. Haddad, T. S. Ledley, K. McNeal, S. Lynds, J. C. Libarkin, A. Gold, 2014, EarthLabs Climate Detectives: Curriculum Based on IODP Expedition 341 on the JOIDES Resolution, Paper No. 245-7, presented at the 2014 GSA Annual Meeting in Vancouver, British Columbia, 19–22 October.

Hornbach, Matthew J., Paul Mann, Cliff Frohlich, and Kathy Ellins, 2011, Assessing geohazards near Kingston, Jamaica: Initial results from chirp profiling, The Leading Edge, v. 30; no. 4; p. 410-413; DOI: 10.1190/1.3575287.

Goehring, Liz, Véronique Robigou and Kathy Ellins, 2012, Bringing Mid-Ocean Ridge Discoveries to Audiences Far and Wide – Emerging Trends for the Next Generation, Oceanography v. 25, no. 1, p. 287-298.

Synergistic Activities (Five Examples)

1. Fulbright CORE Scholar. 2015 – 2016. University of the West Indies (UWI), Jamaica, Dept. of Geography and Geology (GGEO). Established the Jamaica Educational Seismic Network (JAESN) to promote geoscience knowledge, hazard awareness, and community resilience to Jamaica's seismic risk among pre-college and undergraduate students; organized and delivered geoscience professional development for JAESN educators; team-taught a course on geohazards and disaster management; and advised UWI GGEO faculty on geoscience curriculum development.
2. Innovations in Teaching. 2014 – 2015. Developed and taught 2 courses for pre-service STEM teachers and geology majors, Jackson School of Geosciences based on content from 3 projects: NSF-GEO-1203021, NSF-DRL-1019815 and NSF-OEDG-0703687. I received a University of Texas Collaborative Teaching Grant from Center for Teaching and Learning at The University of Texas to create and teach an undergraduate course, GEO 271T: Geoscience Through the Lens of Art (offered fall 2015), which connects geoscience with the visual arts and computational sciences. The DIG Texas Instructional Blueprints for Teaching Earth Science represent an example of online K-12 curriculum.
3. Leadership: Member EarthScope Steering Committee and Chair, EarthScope Education and Outreach Subcommittee, May 2013 – Dec. 2015; co-leader of Diversity and Innovation in Geosciences (DIG) Texas.
4. Recent Professional Service / Earth Science Education: Co-convener of 9 AGU and GSA sessions (2003-present).
5. Mentoring: I mentored 6 Education Interns (minority-serving secondary teachers) during summer 2014 and 2015 as part of NSF-GEO-1203021, Collaborative Research: Diversity and Innovation for Geosciences in Texas (DIG TEXAS) - an Alliance for Earth Science Literacy.

Biographical Sketch

Garry A Harris

Professional Preparation

University of Virginia, Charlottesville, VA	Nuclear Engineering	BS	1981
Georgia Institute of Technology, Atlanta, GA	Technology Management	MS	1993
Georgia Institute of Technology, Atlanta, GA	Quality Systems Engineering	MS	2004
Georgia Institute of Technology, Atlanta, GA	Energy and Environmental Policy	PhD	to be completed in 2019

Appointments

Dec 1998-present	President/CEO, Sustainability Solutions Group (SSG) with 2 divisions: HTS Enterprises & the Center for Sustainable Communities (CSC)
Jul 2013-2014	Executive Director-Atlanta, Emerald Cites Collaborative
May 1990-Dec 1998	Senior Resident Inspector, Nuclear Regulatory Commission
Jun 1987-Sep 1990	Senior Nuclear Plant Evaluator, Institute for Nuclear Power Operations
Sep 1981-May 1987	Senior Nuclear Reactor Service Supervisor, Westinghouse Electric Corporation

Products

None

Synergistic Activities

1. Manager of operations of a consulting firm that provides diverse energy engineering and power generation technical services, sustainable communities planning and implementation, workforce force development, clean energy solutions, and industrial and reliability engineering including research, policy and education services. The firm's division of HTS Enterprises provides design, engineering, procurement, construction, quality and maintenance services for comprehensive energy engineering to a host of government and private industry clients; the nonprofit Center for Sustainable Communities (CSC) provides communities, particularly at risk and disadvantaged communities, the resources to make their communities greener, cleaner, healthier and safer – through specialized programing, research, analysis, evaluations and engineering approaches which focus on maximizing community input and participation and result in real world applications and solutions.

2.Advocate for and educator in community sustainability and environment: both locally and regionally he teaches about clean and renewable energy, energy efficiency, climate change, policy, environmental justice, healthy homes, recycling, affordable housing, building climate resilient (Weather Ready Nation) and sustainable communities, local and regional food systems, workforce development, efficient transportation systems, and STEM education. He is the creator and co-founder of the Advance Atmospheric Research and Monitoring Station (ARMS).

3. Participant in several civic and advocacy organizations and sustainability initiatives: including the Atlanta Regional Commission Education Committee; Just Energy Circle (community based energy equity), Georgia Environmental Justice Alliance, Sierra Club SMART Energy (solar, wind, energy efficiency) and Transportation Committees; and the Advancing

Equities and Opportunities Initiative in the Southeast Collaborative (energy and environmental equity). He is a graduate of the Inaugural Class of the EPA's National Environmental Justice Leadership Academy. He has served on municipal boards including the Tax Allocation District Advisory Committee for the Atlanta Beltline project ($3 billion, 25 year project) and the Atlanta Beltline Community Health Initiative Advisory Board. He was recently cited as a signifcant contributor to the City of Atlanta, named a "100 Resilient City" by the Rockefeller Foundation. Mr. Harris has worked to establish the following energy and sustainability initiatives and organizations including the Georgia Energy and Industrial Construction Consortium, Emerald Cities Collaborative Atlanta, Atlanta Better Building Challenge, City of Atlanta Energy Plan, Climate and Resiliency Action Plan, ECO Districts Target Cities, and Georgia Energy Services Coalition. He currently serves on the local energy utilities Demand Side Management Working Group, Integrated Response Plan, and Clean Power Plan Working Group. He has worked successfully to established significant energy policy in the state of Georgia including the EPA and State of Georgia Clean Power Plan, State of Georgia Energy Performance Contracting Implementing Policy (energy efficiency). He has been recognized nationally by NOAA, FEMA and the National Weather Service on severe weather preparedness and climate adaptation and mitigation by establishing and advancing the Weather Ready Nation initiative.

4. Member of and leader for professional societies: past chairman of the American Nuclear Society section in Atlanta where he helped form the Georgia Section of the society; nominee for the American Nuclear Society's National Board of Directors; senior member of the American Society for Quality (ASQ); past Chairperson for the American Society for Quality Construction and Design Division and a member of the society's energy and environmental division.

5. Recipient of professional awards: Westinghouse Engineering Achievement Award, NRC High Quality and Special Act Awards, Westinghouse Award of Excellence, Westinghouse Engineering Achievement Award, Presidential Citation for Leadership and the Landis Award for Public Education from the American Nuclear Society (ANS). He has been recognized by a member of Congress and nominated as a White House Champion of Charge for his work in STEM Education and received a nomination for Climate Resilience and Equity. He was also nominated as Clinton Presidential Leadership Scholar.

Biographical Sketch

Ellen Roscoe Iverson

Science Education Resource Center, Carleton College, Northfield, MN 55057
Phone 507-222-5749 eiverson@carleton.edu

Professional Preparation

University of Minnesota, Twin Cities, MN	Scientific and Technical Communications	B.S. 1989
University of Minnesota, Twin Cities, MN	College of Architecture, Environmental Design	B.S. 1989
University of Minnesota, Twin Cities, MN	Scientific and Technical Communications	M.S. 1993
University of Minnesota, Twin Cities, MN	Post-graduate Program Evaluation Certificate	2012
University of Minnesota, Twin Cities, MN	Organizational Leadership, Policy, and Development: Evaluation Studies	Ph.D. 2016

Appointments

November 2008-present: Evaluation Director, Science Education Resource Center, Carleton College
March 2003-November 2008: Web Development and Evaluation, Science Education Resource Center, Carleton College
June 1996-April 2003: Technology Manager, Marathon Multimedia, Learner's Digest International
August 1989-June 1996: Technical Assistant to 3rd line Manager and Staff Programmer, IBM

Products

Most Related

Gregg-Jolly, L., Swartz, J., Iverson, E., Stern, J., Brown, N., Lopatto D. (accepted). Situating Second-Year Success: Understanding Second-Year STEM Experiences at a Liberal Arts College. CBE-LSE.

Condon, W., Iverson, E. R., Manduca, C. A., Rutz, C., & Willett, G. (2015). Faculty Development and Student Learning: Assessing the Connections. Bloomington, Indiana: Indiana University Press. ISBN: 978-0-253-01878-6

Gross, D. S., Iverson, E. R.; Willett, G. A., Manduca, C. A. (2015). Broadening Access to Science With Support for the Whole Student in a Residential Liberal Arts College Environment. Journal of College Science Teaching, 44(4), 99-107.

Willett, G., Iverson, E. R., Rutz, C., & Manduca, C. A. (2014). Measures Matter: Evidence of faculty development effects on faculty and student learning. Assessing Writing Vol. 20. April. p. 19-36.

Iverson, E. R. (2012). Measurement using Faculty Surveys. Commissioned White Paper presented at the AAAS Measurement of Teaching Practices Meeting. Washington DC.

Other Significant

Singer, S., Schwarz, J., Manduca, C. A., Fox S. P., Iverson, E. R., Taylor, B.J., Cannon, S. B., May, G.D., Maki, S. L., Farmer, A. D. & Doyle, J.J. (2013). IBI Series Winner: Keeping an Eye on Biology. Science 25 January 2013: 339 (6118), 408-409. [DOI:10.1126/science.1229848]

Rutz, C., Condon, W., Iverson, E. R., Manduca, C.A., and Willett, G. (2012). Faculty development and student learning: What is the relationship? Change, May/June 2012, 42-49.

Manduca, C. A., Mogk, D. M.,Tewksbury, B. Macdonald, R. H., Fox, S. P., Iverson, E. R., Kirk, K. K., McDaris, J., Ormand, C. & Bruckner, M. (2010). SPORE: Science Prize for Online Resources in Education: On the Cutting Edge: Teaching Help For Geoscience Faculty: Science, v. 327, no. 5969, pp. 1095-1096.

Manduca, C.A., Iverson, E.R., Fox, S.P., McMartin, F. (2005). Influencing User Behavior through Digital Library Design: An Example from the Geosciences, D-Lib, vol 11(5). (Recipient of the Geoscience Information Society's Best Paper Award for 2006)

Synergistic Activities

*Evaluator/Assessor:

Assessment Co-Lead for InTeGrate NSF STEP Center project (Grant DUE-1125331); Internal Evaluator for "Supporting and Advancing Geoscience Education in Two-Year Colleges (Grant DUE 1525593, 1524605, 1524623, and 1524800 Faculty as Change Agents); Evaluator for "On the Cutting Edge Professional Development program" (Grant DUE-1022844); Assessment Lead for Bringing NSF MARGINS/GeoPRISMS Continental Margins Research into the Undergraduate Curriculum (Grant DUE-1141056); External Evaluator for Geodesy curriculum for the 21st century – innovative science for addressing societally critical issues (Grant DUE-1245025); External Evaluator for CBE-Life Science Education funded by HHMI; External Evaluator for Grinnell HHMI Undergraduate Science Education 2012 competition; Co-Evaluator for "Carleton Interdisciplinary Science & Math Initiative" funded by HHMI.

*Memberships:

STEM Exchange Evaluation working group; American Evaluation Association and the Qualitative Methods TIG; American Geophysical Union; Geological Society of America.

*Vice Chair, Board of Education for Minnesota Independent School District 659.

*Council of Champions and Data team member, Northfield Promise Collective Impact Initiative.

*Presenter of scholarly work:

Iverson, E. (2015) Theory of change as a guide post: Engaging stakeholders in and through the value and use of evaluation American Evaluation Association Annual Meeting. Chicago, IL; Iverson, E. (2015). Logic Models for Smarties. Minnesota Evaluation Studies Institute. St. Paul, MN; Swartz, J., Gregg-Jolly, L., Stern, J., Iverson, E. (2015) Promoting equity and success in STEM: Addressing the second year. The centennial annual meeting of the Association of American Colleges and Universities (AAC&U); Iverson, E., Kastens, K., Baldassari, C., Steer, D. (2014) Fostering a systems approach to collaboration on curriculum and assessment: Research across institutional and disciplinary boundaries. Geological Society of America Abstracts with Programs, Vol. 46, No. 6, p.646; Iverson, E. (2012) When a Website is Part of Program Evaluation: A Three Staged Approach. Evaluation 2012: American Evaluation Association Annual Meeting. Minneapolis, MN; Willett, G., E. Iverson, M. Huber, W. Condon (2011) Faculty Development within Cross-Curricular Initiatives: What Are the Effects on Student Learning? Presented at 2011 The Association of American Colleges and Universities (AAC&U) Annual Meeting. San Francisco, CA; Iverson, Ellen A., Sabra Lee, Carol J. Ormand, P.G. Feiss, Heather Macdonald, Cathryn A. Manduca, Randall M. Richardson (2011) Building Strong Geoscience Departments: Case Studies and Findings from Six Years of Programming, Abstract ED23A-0616 Poster presented at 2011 Fall Meeting, AGU, San Francisco, Calif., 5-9 Dec.

Biographical Sketch—Sally F. McGill

Professional Preparation:

Harvard and Radcliffe Colleges, Cambridge, MA	Geology (geophysics option)	A.B.	1985
California Institute of Technology, Pasadena, CA	Geology	M.S.	1989
California Institute of Technology, Pasadena, CA	Geology	Ph.D.	1992

Professional Appointments:

Department of Geological Sciences, California State University, San Bernardino

Interim/Acting Department Chair	January 2015 to present, Fall 2006 and 1998-2000
Professor	September 2000 to present
Associate Professor	September 1996 to August 2000
Assistant Professor	September 1991 to August 1996

Products:

Five most closely related publications: (* denotes student co-author; †indicates K-12 educator co-author)

†Vargas, B.E., W.B. Banerdt, E. Burkett, E. Cochran, E. Durst†, A. Foutz†, R.M. de Groot, M. P. Golombek, L.Gomez*, M. Hubenthal, T.L. Hudson, J.H. Jones, T. Jordan, D. Keck†, R.S. Kirkwood†, K. Kocaya†, H. Lopez*, S. McGill, M. Moya†, A. Padilla†, Y. Seebert†, L. Secord†, D. Sumy, A. Trebi-Ollennu, M. Vinci, S. Wallace†, A. Wessen, R. Zimmerman-Brachman, 2015, Vital Signs of the Planet: A Professional Development Program for High School and Middle School Science Educators Provides Authentic Experiences In Scientific Inquiry and Encourages Instructional Improvement in Schools Through Lesson Study, Southern California Earthquake Center Proceedings, v. XXV, (Poster 312).

†Keck, D., McGill, S., *Bocanegra, C., de Groot, R., †Durst, E., †Foutz, A., †French, J., *Gomez, L., Kirkwood, K., Kocaya, K., Ladefoged, D., *Lopez, H., Padilla, A., †Seebert, Y., †Secord, L., †Vargas, B., and †Wallace S., 2015, Vital Signs of the Planet: Southern California Educators Contribute to Crustal Deformation Studies Within San Bernardino and Riverside Counties, Southern California Earthquake Center Proceedings, v. XXV, (Poster 311).

de Groot, R.M., and S.F. McGill, 2011, Teachers Using Continuous GPS Data to Learn About Earthquakes - Sharing Research Results in the Classroom Through Lesson Study, EOS, Transactions of the American Geophysical Union, Fall 2011 Meeting, Absrtract--ED33C-04.

McGill, S., R. deGroot, J. Spinler*, and R. Bennett, 2009, High School Science Teachers Contribute to Improved Understanding of the Slip Rate Distribution Across the Pacific-North America Transform Plate Boundary, Geological Society of America, Abstract with Programs, v. 41, no. 7, abstract 235-3

McGill, S. F., J. E. Fryxell, A. L. Smith, W. B. Leatham and B. J. Brunkhorst, Earth Science Pipeline: Diversity in the geosciences through outreach and research, EOS: Trans. Am. Geophys. Union, v. 85, p. F518, 2004.

Five other publications: (* denotes student co-author)

McGill, S. F., J. C. Spinler, J. D. McGill, R. A. Bennett, M. Floyd, J. E. Fryxell, G. J. Funning, 2015, Kinematic modeling of fault slip rates using new geodetic velocities from a transect across the Pacific-North America plate boundary through the San Bernardino Mountains, California, Journal of Geophysical Research, v. 120, p. 2772–2793, 10.1002/2014JB011459.

Onderdonk, N. S. McGill and T. Rockwell, 2015, Short-term variations in slip rate and size of pre-historic earthquakes during the past 2000 years on the northern San Jacinto fault zone, a

major plate boundary structure in southern California, Lithosphere, v. 7.3, p. 211-234, doi:10.1130/L393.1.
McGill, S., Owen, L., Weldon, R. J., Kendrick, K., 2013, Latest Pleistocene and Holocene slip rate for the San Bernardino strand of the San Andreas fault, Plunge Creek, Southern California: Implications for strain partitioning within the southern San Andreas fault system for the last ~35 k.y., Geological Society of America Bulletin, v. 125, no. 1/2, p. 48-72, doi: 10.1130/B30647.1.
McGill, S. F., S. G. Wells, S. K. Fortner, H. A. Kuzma, and J. D. McGill, 2009, Slip rate of the Western Garlock fault, at Clark Wash, near Lone Tree Canyon, Mojave Desert, California, Geological Society of America Bulletin, v. 121, p. 536-554.
McGill, S., *S. Dergham, *K. Barton, *T. Berney-Ficklin, *D. Grant, *C. Hartling, *K. Hobart, J. McGill, R. Minnich, *M. Rodriguez, *J. Russell, *K. Schmoker, *M. Stumfall, *J. Townsend, J. Williams, 2002, Paleoseismology of the San Andreas fault at Plunge Creek, near San Bernardino, southern California, Bulletin of the Seismological Society of America, v. 92, pp. 2803-2840.

Synergistic Activities:

1. McGill is a member of the Communications, Education and Outreach Planning Committee for the Southern California Earthquake Center (SCEC) (June 2015-January 2017).

2. McGill has served as a mentor to 31 summer interns (from 1999 to 2015) supported through SCEC's Summer Undergraduate Research Experience, UNAVCO's RESESS program, and NSF EarthScope grant. In addition to the above 8-week internships, McGill has mentored another 28 students over the past 5 years in a 3-week summer research program funded by an NSF grant from the Division of Mathematical Sciences for Proactive Recruitment in Introductory Science and Mathematics. Through these summer research programs, as well as through CSUSB's required senior research project, McGill has mentored 36 conference presentations by undergraduate students at SCEC, GSA, AGU, IRIS and EarthScope. Since 2002, McGill's summer interns have conducted an annual summer GPS data collection campaign across the San Andreas and San Jacinto faults near San Bernardino. In many years the undergraduate interns have been joined in this effort by ~10 high school and middle school science teachers (supported by an NSF EarthScope grant 2009-2012 and by a NASA InSight grant 2013-2016). McGill has mentored 12 conference presentations by teachers.

3. McGill developed a high school-level lesson plan on using GPS to monitor motion across the San Andreas fault and has taught it 3 times as a guest lecturer at Oak Hills High School, California. The lesson entitled "Science Lab: Using GPS to Monitor Tectonic Plate Motions" is also available on the EarthScope website at: http://earthscope.org/resources/educators. Upon request, as part of a project to highlight educational aspects of the Plate Boundary Observatory continuous GPS stations, she developed text and figures highlighting the station located on the CSUSB campus (P612) and the scientific results related to the San Andreas fault obtained from this and other southern California stations. See:
http://xenon.colorado.edu/spotlight/index.php?product=spotlight&station=p612

4. McGill regularly gives several presentations per year on earthquakes and active faults of southern California to local community groups (e.g., Sierra Club, United Methodist Church of Redlands, Morongo Valley Historical Society, Rancho Mirage Public Library).

5. In addition to teaching Introductory Geology, McGill developed and taught for many years a general education course on earthquakes. Enrollments have expanded to over 200 students per quarter, split into two sections, which are now often taught by part-time faculty who would benefit from the teaching training planned in this proposal.

Biographical Sketch

Norma J. Neely, Ed.D.
Director, American Indian Institute

Professional Preparation

Central Missouri State University, Warrensburg, MO	Education	B.S.	1968
Central Missouri State University, Warrensburg, MO	Education, Science emphasis	M.S.	1973
University of Texas, Austin, TX	Educational Administration	Ed.D.	2001

Appointments

June, 2012 – Present	Director, American Indian Institute; University of Oklahoma; Norman, OK
September, 2011—May, 2012	Assistant Professor; Oklahoma State University; Stillwater, OK
August, 2006 – August, 2011	Regional Instructional Facilitator for Science; Truman State University; Kirksville, MO
November, 2005 – July, 2006	Science Specialist, Austin ISD; Austin, TX
June, 2004 – October, 2005	Educational Consultant; Designing Success for Educators; Austin, TX
June 1999 – June 2004	Associate Director for Regional Projects; Texas Rural Systemic Initiative; Texas A&M University; Canyon, TX
June 1996 – May 1999	Texas Coordinator of Building a Presence for Science; National Science Teachers Association; University of Texas; Austin, TX
June 1994 – May 1996	Graduate Student/Research Associate; Educational Administration; The University of Texas; Austin, TX
September 1993 – May 1994	District Resource Teacher/Department of Instruction K-12; Kansas City, MO; The School District of Kansas City, MO
September 1992 – May 1993	K-5 Animal Resource teacher; Three Trails Science/Math Magnet School; Kansas City, MO; The School District of Kansas City, MO
September 1991 – May 1992	K-12 District Science Resource Teacher; Kansas City, MO; The School District of Kansas City, MO
September 1988 – May 1991	K-5 Environmental Science Resource Teacher; Academy of Environmental Science; Kansas City, MO; The School District of Kansas City, MO
September, 1987 – May 1988	Language Arts Resource Teacher; Southwest Middle Magnet School; Kansas City, MO; The School District of Kansas City, MO
September 1986 – May 1987	Coordinator of College for Kids and Teens; Longview Community College; Lee's Summit, MO; Longview Community College
September 1968 – May 1973	Fourth Grade Teacher; Lee's Summit Elementary, Lee's Summit, MO; The School District of Lee's Summit, MO

c. Products

Most Closely Related

Neely, Norma, co-author of a chapter of the National Science Teachers Association's (NSTA) Pathways to the Science Standards: Guidelines for Moving the Vision into Practice (Elementary School Edition). (2000). ISBN: 978-0-87355-161-8.
https://www.nsta.org/store/product_detail.aspx?id=10.2505/PKEB124X

d. Synergistic Activities

1. Educator and service provider to groups underrepresented in STEM. As a member of the Citizen Potawatomi Nation and Director of the American Indian Institute within the division of Public and Community Services at the University of Oklahoma (OU), Dr. Neely oversees the Institute's goals to support training and research, along with health promotion/disease prevention, art/culture/language preservation, and tribal leadership and organizational development. Prior to coming to OU, Dr. Neely served as Coordinator of "Building a Presence for Science" at the National Science Teachers Association, Associate Director of the NSF-funded Texas Rural Systemic Initiative, Science Instructional Facilitator for the Northeast Regional Professional Development Center at Truman State University. Additionally, she taught science to pre-service teachers at Oklahoma State University. She served as Professional Development Director on the board of the National Science Teachers Association, Education Committee Chair on the Board of SACNAS (Society for the Advancement of Chicanos and Native Americans in Science); and on numerous boards and advisory committees including Science Teachers of MO, American Royal Advisory Committee, MO Governor's Task Force on Environmental Education, Scholastic's Magic School Bus Advisory Council, and EarthScope's Education and Outreach Committee. Previously, Dr. Neely authored a grant to take teachers to the Peruvian Amazon in order to develop curriculum materials. She has also participated in several other grants, including an NSF-funded research expedition to Antarctica, a state-funded learning experience in the Galapagos, and archaeological digs in various locations in the United States and in Zaire. She began her career as an elementary teacher and in 1990 received a Presidential Award for Excellence in Science Teaching.

2. Leader in organizations addressing education needs and education research. Currently Dr. Neely is the district director for Region 13 (TX, OK, NM) of the National Science Teachers Association (NSTA), and chair of the advisory board for AIR's (American Institutes for Research) REL Southwest (Regional Educational Laboratory Southwest).

3. Creator of learning activities and curriculum, including contributions to these publications: "Project Zoo"- a third grade curriculum guide for using the Kansas City Zoo; "Rain Forest Rendezvous"- K-6 Lessons/Activities on tropical rain forests; "Ecosystems Made Elementary"- K-6 Lessons/Activities comparing /contrasting the ecosystems of Missouri and the Galapagos Islands; "Belize Curriculum" for the JASON Project; "Measurement" section of the Math/Science Connection of Summer Interface 1992; Mentoring Handbook for Austin Independent School District. She also wrote copy for two science-related video games produced by Sega/Genesis.

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DR. J. JOHN TABER
IRIS
1200 New York Ave., NW, Suite 400
Washington, DC 20005

Biographical Sketch

PH: 202-682-2220
FAX: 202-682-0633
E-mail: taber@iris.edu

Professional Preparation

Swarthmore College	Swarthmore, PA	Physics	B.A. 1977
University of Washington	Seattle, WA	Geophysics	Ph.D. 1983

Appointments

2010 – Present	Director, IRIS Education and Public Outreach program
2001 – 2010	IRIS Education and Outreach Program Manager
1994 – 2001	Earthquake Commission Fellow in Seismology, Victoria University of Wellington
1991 – 1994	Research Fellow, Victoria University of Wellington
1989 – 1991	Post-doctoral Fellow, Victoria University of Wellington
1984 – 1989	Associate Research Scientist, Lamont-Doherty Geological Observatory of Columbia University

Five Products Related to the Proposal

Taber, J., M. Hubenthal, T. Bravo, P. Dorr, J. Johnson, P. McQuillian, D. F. Sumy, R. Welti, 2015, Seismology Education and Public Outreach Resources For a Spectrum of Audiences, as Provided by the IRIS Consortium, The Leading Edge, 34(10), 1178-1184.

Taber, J, M. Hubenthal, and M. Benoit, 2014, Opportunities for Undergraduates to Engage in Research Using Seismic Data and Data Products, AGU Annual Meeting Paper No. ED21D-3478.

Wysession, M.E., N. LaDue, D.A. Budd, K. Campbell, M. Conklin, E. Kappel, G. Lewis, R. Raynolds, R.W. Ridky, R.M. Ross, J. Taber, B. Tewksbury and P. Tuddenham, 2012, Developing and Applying a Set of Earth Science Literacy Principles, Journal of Geoscience Education, 60(2), 95-99.

Hubenthal, M., Stein, S., Taber, J., 2011, A Big Squeeze: Examining and modeling causes of intraplate earthquakes in the earth science classroom, The Earth Scientist. 27(1), 33-39.

Wysession, M., M. Hubenthal, J. Taber, 2008, Using SeisMac to Turn Your Laptop into a Seismograph for Teaching, Seismological Research Letters, 79(5), 723.

Five other Significant Products

Duggan-Haas, D., J. Taber, 2015, Basic Fracking Math, In the Trenches, 5(3), 10-12.

Hubenthal, M., O'Brien, T., Taber J., 2011, Posters that foster cognition in the classroom: Multimedia theory applied to educational posters, Educational Media International, 48(3), 193-207.

Hubenthal, M., L. Braile, J. Taber, 2008, Redefining earthquakes & the earthquake machine, The Science Teacher, 75(1), 32-36.

Smith, M., J. Taber and M. Hubenthal, 2006, Real-Time seismic displays in museums appeal to the public, EOS, Trans. AGU, 87, no. 8, 85.
Ansell, R., and J.J. Taber, 1996, Caught in the Crunch: Earthquakes and Volcanoes in New Zealand, HarperCollins, Auckland, 188pp.

Five Synergistic Activities

Earth Science Literacy and workforce development

As Co-PI of the Earth Science Literacy Initiative (2008-2009), helped develop and disseminate a set of Earth science literacy principles that have become widely referenced in Earth science education and outreach and that helped form the basis for the Earth science elements of the Next Generation Science Standards. Co-PI for distributed summer undergraduate research program reaching over 155 students (2002-), Co-PI on workshop to encourage collaboration between early career geoscientists and geoscience education researchers (2015).

Development of educational tools that highlight the use of data

Leadership of software engineers and educational specialists in the development of a range of tools designed to allow students and the general public to explore and interpret seismic data (2002-). Products include software for streaming real-time seismic data into the classroom (jAmaseis), Web applications reaching millions of users (Seismic Monitor, IRIS Earthquake Browser and 3D Viewer, Seismic Waves) and public displays in museums with millions of visitors (Earthquake Channel and its predecessors, Active Earth Monitor).

InTeGrate Leadership team

Led undergraduate curriculum workshop on Engineering, Sustainability and the Geosciences (2013), Led teams of undergraduate faculty to develop intro and upper level interdisciplinary classroom modules using geoscience to address societal issues (2013-), Organizing committee for workshop on Teaching about Risk and Resilience: Sea Level Rise, Flooding, and Earthquakes (2014).

National and international collaborations

UNAVCO Education and Community Engagement Advisory Committee (2005-), EarthScope Education and Outreach Steering Committee (2005-), Development of international seismographs in schools community (2005-), Deep Earth Academy review panel (2011), E&O program plan creation team for NEES Consortium, (2004).

Professional society activities

National Association of Geoscience Teachers Executive Committee (2013-), Seismological Society of America Communications Committee (2013- 2016), Society of Exploration Geophysicists Youth Education Committee (2014-), Co-chair, IASPEI Commission on Education and Outreach (2003-), American Geophysical Union Committee on Education and Human Resources, IRIS Liaison (2004-2010), Past president: New Zealand Geophysical Society, Quake Trackers advisory board (2007-2009), Management Committee, New Zealand Society for Earthquake Engineering (1999-2001).

Facilities, Equipment & Other Resources

SERC at Carleton College

The project site will be hosted on web infrastructure run by the Science Education Resource Center (SERC) at Carleton College. This infrastructure, based on Amazon's web services, provides robust, high-speed service through a geographically distributed set of servers in multiple data centers and Amazon's world-wide content delivery network. It uses proven technologies (e.g. Nginx, Apache, PHP, MySQL, Solr) within a professionally managed environment that includes multiple layers of remote backup, custom configured security infrastructure and automated performance monitoring. Carleton College guarantees access to the website for the life of the content, which is estimated at 10 years.

The site will be constructed using Serckit (http://serc.carleton.edu/101542), SERC's web publishing platform, which supports distributed online authoring of websites for over 70 science education programs including: the InTeGrate STEP Center, the National Numeracy Network, On the Cutting Edge Professional Development for Geoscience Faculty and the National Association of Geoscience Teachers.

Serckit provides a proven suite of web-based tools for developing and disseminating online curricular materials. Serckit's online authoring environment has been continuously tested and refined for use by STEM faculty over the last decade with over 1200 geoscience faculty using its tools to publish their teaching materials. Serckit includes standardized templates and processes that embody the curricular publishing experiences of programs such as On the Cutting Edge and the InTeGrate STEP Center. Multiple modes of review of curricular materials are also directly supported via a review system framework that facilitates multiple independent online review processes, each with its own criteria, workflow and management.

Serckit also provides email lists, discussion boards, and private online group workspaces that have been successfully used by many projects to coordinate their work. Project leadership can use these tools to share project documents and track project progress. They can be used to facilitate sharing of information and as a platform for group authoring by participants in working groups, workshops, and meetings.

Serckit's authoring and collaboration tools form a strong foundation for facilitating cross-institutional networks. In addition to explicit support for face-to-face and virtual events participants can join groups, collaborate around shared work and learn about other community members with shared interest through Serckit's profile system that automatically documents individuals' contributions and participation. Serckit can facilitate project data collection including online participant reporting summarized via dashboards and student data collection through tools that support secure collection, management, and scoring of both online and paper student assessments.

The system has successfully supported the work of over 4,000 authors from over 800 institutions in creating over 30,000 pages of original content, including community contribution of more than 5,000 teaching activities. The system has also proven to be highly scalable and reliable,

comfortably handling traffic in excess of 30,000 visitors per day while maintaining an 'uptime' of over 99.9 percent. In aggregate more than 4.5 million unique users visited these sites in 2015.

"Other Personnel" Biographical Information

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Professional Preparation

Oxford College of Emory University, Oxford, GA	Psychology	A.A., 1994
Emory University, Atlanta, GA	Psychology	B.A., 1996
Duke University, Durham, NC	Developmental Psychology	Ph.D., 2002

Appointments

2010-present	President, Karen Peterman Consulting, Co., Durham, NC
2008-2010	Independent External Evaluation Consultant, Durham, NC
2009-present	Senior Consultant, Goodman Research Group, Inc., Cambridge, MA
2005-2009	Senior Research Associate, Goodman Research Group, Inc., Cambridge, MA
2002-2005	Research Associate, Goodman Research Group, Inc., Cambridge, MA
2002	Consultant, Insight Research Group, New York, NY
Summers 2000-2002	Instructor, Developmental Psychology, Duke University
1999-2001	Instructing Assistant, Developmental Psychology, Cognitive Psychology, Duke University
1997-2000	Teaching Assistant, Developmental Psychobiology, Introduction to Human Memory, Developmental Methods, Duke University

Products

Most related

Bevc, C., Young, D.L., & Peterman, K. (submitted). Using Social Network Analysis to Document Science Festival Partnerships. Journal of Science Communication.

Peterman, K., Kermish-Allen, R., Knezek, G., Christensen, R. & Tyler-Wood, T. (in press). Measuring Student Career Interest within the Context of Technology-Enhanced STEM Projects: A Cross-Project Comparison Study based on the Career Interest Questionnaire. Journal of Science Education and Technology.

Peterman, K., Cranston, K., Pryor, M. & Kermish-Allen, R. (2015). Measuring Primary Students' Graphical Interpretation Skills via a Performance Assessment: A Case Study in Methodology. International Journal of Science Education, 31(17), 2787-2808.

Peterman, K. & Young, D.L. (2015). Mystery shopping: An innovative method for observing scientist interactions during public science events. Visitor Studies, 18(1), 83-102.

Kermish-Allen, R. Peterman, K., MacDonald, S., Thompson, R. & Winner, B. (2015). Energy for ME: A model for 21st century education. Journal of Sustainability Education.

Other Significant

Peterman, K, Pan, Y., Robertson, J. & Glenn Lee, S. (2014). Self-report and academic factors in relation to high school students' success in an innovative biotechnology program. Journal of Technology Education 25(2), 35-51.

Kermish-Allen, R. & Peterman, K. (2013, October). Using participatory action research methodologies to develop an online learning community. A presentation at the annual meeting of the North American Association for Environmental Education in Baltimore, MD.

Synergistic Activities

- Since 1998 has designed and conducted basic and applied research projects, almost all of which focus on STEM education.
- Began working as an independent consultant in 2008 which led to the creation of Karen Peterman Consulting, Co. in 2010.
- Evaluations have included formative, process, and summative components, and have used a range of assessment designs and measurement tools, including a focus on using embedded and performance assessments.
- Served as a co-PI on a research and development grant awarded to the University of California, San Diego by the United States Department of Education (2008-2011) and a NSF Cyberlearning and EAGER grant awarded to the Island Institute (2012-2014, 2014-2015); currently serves as a co-PI on three research grants, two from NSF AISL and one NSF Cyberlearning.

Collaborators and Other Affiliates

Collaborators:
Rachel Becker-Klein, Ph.D., Peer Associates; Christine Bevc, Ph.D., University of North Carolina, Chapel Hill; Cynthia Char, Ed.D, Char Associates; Rhonda Christensen, University of North Texas; Kayla Cranston, M.A., Antioch University; Heather Deese, Ph.D., Island Institute; Ginger Fitzhugh, Ph.D., Evaluation and Research Associates; Amy Grack Nelson, M.A., Science Museum of Minnesota; Leslie Goodyear, Ph.D., Education Development Center; Leanne Jacobson Teiper, M.A., Karen Peterman Consulting, Co.; Pat Jessup, Ph.D., Insites; Kimberle Kelley, Ph.D., University of Southern California; Gerald Knezek, Ph.D., University of North Texas; Ruth Kermish-Allen, Maine Math & Science Alliance; Marrah Moore, i2i Institute; Alyssa Naim, Education Development Center; Suzanne Macdonald, Ph.D., Island Institute; Tina Phillips, Ph.D., Cornell Lab or Ornithology; Marie Pryor, University of Central Florida; David Reider, Education Design; Jane Robertson, Ph.D., Virginia Polytechnic Institute and State University; Veronica Thomas, Ph.D., Howard University; Tandra Tyler-Wood, University of North Texas; Brooks Winner, Island Institute; Denise Young, Ph.D., Morehead Planetarium.

Graduate Advisor:
Dr. Carol O. Eckerman, Ph.D., Duke University (retired)