Informal STEM Learning in Rural Places

Panelists' Backgrounds & Perspectives

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MMSA
Maine Mathematics and Science Alliance

NSF

Sue Allen

Virtual Coaching in STEM Facilitation Skills for Afterschool Educators

Summary of rural work:

Over the last 3 years our team has created an instructional coaching program for afterschool educators who are increasingly being asked to facilitate STEM learning experiences with youth, but who may have little or no formal training as teachers. The project's main thrust is now to make this model work entirely virtually, so that isolated educators in rural settings don't have to travel long distances to have access to high-quality professional development. We are also adapting the program to work for library staff interested in running STEM programs in their rural libraries. The heart of the virtual model is to bring together educators who don't know each other, and create an online cohort of learners who feel committed to learning together to improve their practices. They learn by video-recording their own interactions with youth, sharing them online, and discussing their use of the various facilitation skills covered in the course.

Three things that worked and why:

- Surprisingly, cohort bonding was very achievable, even for cohorts who were total strangers at first. Contributing factors were probably the warm and supportive coaches, the use of break-out rooms to encourage smaller conversations, the small cohorts (typically 3-6) and the strong desire of rural educators to hear "what others are doing."
- Technology glitches tended to resolved not only by the coach, but by members of the cohort who helped each other and also brought in help from their own communities (e.g. tech gurus from school, older youth or colleagues in their programs, other trusted adults).
- Recruitment was most successful through personal contacts and word of mouth, even if the goal was to leverage existing networks. Sometimes the trust-building and planning took a year or more, but it worked because we had the time to build continuity and the community networks tended to have stable leadership.

Three things that didn't work and why:

- Online bandwidth in rural settings has been a frequent struggle, affecting the quality of the communication (e.g., participants' links getting choppy or dropping) and making it particularly difficult to live-stream the videos of educators working with youth.
- Recruitment has been very challenging, even though the program is high-quality and the coaching support is provided free of charge. We have learned that in the rural communities, only relatively well-resourced programs (e.g., 21st CCLC programs) with leaders who are very committed to PD for their staff have the capacity to participate in this kind of extended (10-30 hour) PD. Very few rural afterschool educators have the capacity to volunteer their time for in-depth PD, and volunteerism is declining nationally, including in rural settings.
- Specialized training proved to be relatively unappealing to generalists who have many areas to cover in addition to STEM. In rural areas this is particularly challenging because almost everyone is a generalist due to small sizes of communities and staff.

What's Needed

- Rural citizens absolutely need better high-speed internet: faster and broader, for equitable access to highly interactive online PD, cohorts of peer professionals, and the ability to live-stream videos.
- In the out-of-school-time (OST) world, there is very little incentive for increasing one's credentials or qualifications. This is particularly challenging in low-income rural communities where the budgets of schools and towns may already be stretched extremely thin.

Links to our work:

- Project website: www.mmsa.org/ACRES
- Allen, S., Brasili, A., Byrd, S. Chick, P.C., Ouelette, K., & Lobley, J. (2018, March). *Adapting video-based reflections to afterschool settings.* Paper presented at the annual meeting of the National Association for Research in Science Teaching, Atlanta, GA.
- Allen, S. & Ouelette, K. (2016). Building coaching relationships over the internet. *AfterSchool Today, 7(3),* (pp.12-13).

My relevant background experiences:

- Informal STEM education
- Professional development for afterschool and out-of-school educators
- STEM ecosystems
- Badging, credentialing, & assessment of learning

Susan Assouline

Eliminating Barriers and Enhancing STEM Excellence through Informal Learning

Summary of rural work:

For more than 20 years, the research team from the UI Belin-Blank Center for Gifted Education and Talent Development has investigated various aspects of rural programming for high-potential students. More recently, we have provided an extracurricular STEM intervention through the STEM Excellence and Leadership (SEAL) program to high-achieving middle-school students in 10 rural districts across Iowa. The aims of SEAL are to enhance middle-school students' STEM achievement and aspirations for advanced coursework in high school and beyond. An underlying assumption for our work in rural schools is that talent cuts across all demographics, including zip code. However, zip code does seem to matter with respect to who attends – and graduates – from 4-year colleges or universities because smaller percentages of students from rural schools receive a bachelor's degree compared to their urban and suburban counterparts. College degree attainment is correlated with career and life satisfaction. The purpose of our work is to eliminate barriers to the kinds of advanced learning opportunities that support both academic achievement and aspirations of high-potential students from middle school through college.

Three things that worked and why:

- A primary research question concerned the extent to which an expanded talent discovery model would identify greater numbers of high-potential students than the typical 3 to 5% identified for typical gifted education programming. The method we used, based upon an above-level testing model, was highly effective at differentiating among high-achieving students from under-resourced rural schools. The method was not only effective in finding greater percentages of students who would benefit from the SEAL program, but the simple, preliminary intervention of above-level testing had a positive impact on all students who were part of the talent pool, regardless of program participation.
- **A s**econdary research question concerned overall satisfaction of the students and the teachers with respect to the program. Not surprisingly, there was great satisfaction. We also found that both students and teachers believed that they thought more creatively and critically about their work.
- Finally, the talent discovery model included a measure of psychosocial factors (e.g., motivation, student engagement, and self-regulation). Teachers used the data from that instrument to learn more about their students. When teachers are supported in their efforts to provide a sufficient dosage of advanced, extracurricular STEM learning, student achievement and aspirations improve.

Three things that didn't work and why:

We had no failures because we self-corrected any issues as they became evident. However, we do have a few primary lessons that we learned.

- First, the psychosocial measure, which we thought would enhance our identification procedures, had little impact on program identification. Nevertheless, teachers still believed the data were useful and continue to request it.
- Second, without funding, this extracurricular program will be very hard to sustain. We believe that the state or local schools should take on the program once the deferral funding is complete; however, it is challenging to have facilitators roll this into their responsibilities because they are not trained to "market" their programs. To be effective, extracurricular programming requires a minimal dosage; however, rural students are all very busy and it is challenging to find the time for the extracurricular, informal learning activities.
- Finally, we anticipated that the program facilitators would have some gaps in their STEM knowledge; nevertheless, the gaps in math were larger than we had anticipated.

What is needed:

- Because this is an extracurricular program, it would benefit from the type of local support that other extracurricular rural school programs receive, i.e., booster clubs.
- Treat the SEAL participants similarly to the sports teams. Make time for them after school; pay the facilitators similarly to the way coaches are paid. Pay to have the facilitators go to additional training throughout the year.
- Finally, send some – or all – of the students to a one-week advanced academic summer program on a university setting so that they see what they can do.

Links to our work:

- Project Website: www2.education.uiowa.edu/belinblank/about/excellence/Default.aspx
- Assouline, S. G. Ihrig, L. M., Lane, E., Mahatmya, D. (2017). Closing the Excellence Gap: An Investigation of an Expanded Talent Search Model for Student Selection into an Extracurricular STEM Program in Rural Middle Schools. *Gifted Chile Quarterly, 61,* 250-261. journals.sagepub.com/doi/10.1177/0016986217701833
- Ihrig, L. M., Lane, E., Mahatmya, D. & Assouline, S.G. (2018). STEM Excellence and Leadership Program: Increasing the Level of STEM Challenges and Engagement for High-Achieving Students in Economically Disadvantaged Rural Communities. *Journal for Education of the Gifted, 41*(1), 24-42. journals.sagepub.com/doi/abs/10.1177/0162353217745158

Relevant Background Experiences:

- Middle-school science educator for six years.
- Expertise (30+) years in gifted education and talent development, including academic acceleration and talent identification in the area of math.
- Expertise in the area of twice-exceptionality.

Steven D.K. Brown

STEM Guides in Rural South Carolina

Summary of rural work:

Founded in 2013, Dreams Imagination & Gift Development Program (DIG) organization has been inspiring youth in rural South Carolina to excel in all endeavors by enabling them to unlock their full potential and build upon their natural gifts and talents. DIG aims to create a cultural and interactive environment where children and youth learn through educational instruction, social development, mentoring, leadership, and community service. DIG's programs offer developmental opportunities for all school age students from 1st-12th grades through a holistic approach of involving education, recreation, community service, and mentoring to ignite the entire community. Since beginning its programs, DIG has served 507 youth in its After-School and Summer STE(A)M enrichment programs, 17 youth in its virtual mentoring and development program with nine of which have graduated high school graduates and enrolled in college, 104 participants in our recreation programs, and approximately 4,000 participants annually in its DIG STEM Festival. Through all of our efforts, we have been able to attract over 100 volunteers annually from the local community. DIG builds its STE(A)M curriculum in house with a focus on real life application in hopes to make the connection between education and the workforce at an early age.

Three things that worked and why:

- Identifying a local community resident to serve as the face of the organization. Small communities find it hard to trust outsiders. It was important to identify someone with ties to the community to be the face of the initiative to increase local support and enrollment of programs. Trust is a big factor in rural communities.
- Use nontraditional methods like sports and community events to showcase STEM. In small communities sports serve as a strong community pillar and public platform. We used

recreational and community events as a platform to market our educational programs to gain supporters.
- Initially 70% of our staff were volunteers. This allowed the local community to feel vested in the success of the youth and the program. This helped reduce the budget and increase community involvement.
- Leveraged faith based organizations and local community groups. Small communities typically have strong faith based organizations. By leveraging the churches as volunteers and for facility usage we were able to identify our biggest supporters and volunteers. This also made it easier to communicate to the community about events and program offerings.

Things that didn't work and why:

- It was assumed that local industries were had an existing culture of supporting educational programs that served as a pipeline to their industry. It was learned that smaller local industries are not accustomed to supporting organizations at the same financial level as larger corporations, and the culture is often not community focused. Small industries often have to be educated on the importance of STEM focused programs to the workforce.
- Assumed that local governments and school districts would support our STEM initiatives because of positive metrics, proposals, program offerings and successes. We learned that at first the entities are afraid that something new may expose areas of improvement in the school system and this is seen as a negative thing. It was more work to partner with the school district than the community and faith based organizations.
- The word Mentoring has a negative connotation to rural parents. Most people see the word mentoring as a child who is struggling and need help. We found that we had to market the word mentoring as an asset for both gifted kids and at-risk kids.
- Staff recruitment and retention.

What's needed:

- We need more support of the school districts to market the out of school programs to kids and parents. We need the schools to see the programs as complimentary to the classroom work.
- We need local industry leaders to become full supporters of the program to strengthen the school to career pipeline.

Links to our work:

- Facebook: facebook.com/digdp
- augustachronicle.com/news/20180425/stem-festival-attracts-4000-people-to-downtown-williston
- wave3.com/story/28168662/a-south-carolina-man-reaches-out-to-his-community-in-a-big-way
- augustachronicle.com/thepeoplesentinel/news/2018-01-11/dig-partnership-expands-stem-impact

My relevant background experiences:

- Bachelors in Electrical Engineering
- Outdoor STEM Festival in Rural South Carolina
- STEM After-School Program in Rural South Carolina

- STEM Summer Camps in Rural South Carolina
- STEM Curriculum for rural. STEM programs
- Mentoring program in Rural South Carolina

Christina Cid

Expert Storytelling and Family STEM Meaning Making in a Rural Community

Summary of rural work:

In 2016 the High Desert Museum, Deschutes Public Library and Oregon State University-Cascades received funding from the Institute of Museum and Library Services' STEMeX initiative to explore the impact of experts' use of storytelling and object-based inquiry on rural families in Central Oregon. Our conceptualization of "story" includes both expert personal stories and the scientific process as modeled in the How Science Works flowchart (Understanding Science, 2018). Through this work, our goal is to explore how might experts' use of storytelling impact rural families' STEM learning talk, understanding of the nature of science, engagement and attitudes.

To investigate our research questions, over the course of two rounds, fourteen rural families with children ages 7-10 years old participated in a series of six, day-long workshops led by museum staff, librarians and other experts (the "eX" part of STEMeX). During the workshops families investigated the carnivores living in our region, learning how to identify animals in the wild, how to track their movements, how to collect DNA samples and more. Families then wrote and published books about their experience in the project. These books are now available to be checked out to the public at our local library.

Three things that worked and why:

- We conducted 2, multi-day professional development workshops for the project staff on how to integrate the use of storytelling, how science works and object-based inquiry into the workshop series. Based on these workshops, the project staff then developed a story arc that was used throughout each workshop. The arc began with the STEM experts telling personal stories about how they got to their current career, then moved to families conducting real-world STEM investigations and ended with families continuing the investigations at home using the actual tools and equipment used during the workshops. The STEM experts use of personal narrative had a positive impact on families' STEM identity and engagement. The families gained significant insight from getting to know the STEM experts, hearing their "how I got here" stories, hearing funny work or personal life stories, and building trust and relationships with them. They felt connected to them and also related to them. This was true for both children and caregivers.
- Families conducted take-home STEM activities, which helped to build upon the activities done during the workshop. Families gained a lot from being able to use authentic tools in their own environments. Many also reported seeing their own surroundings in new ways and gained experience engaging in the scientific and engineering design processes on their own. They also reported involving family members and friends not affiliated with the project into the take home activities.

- Family programming, in which an adult caregiver attended with at least one child, was a unique and successful part of the program. Families learned together both inside and outside of the classroom. Several caregivers reported feeling more knowledgeable about how to help their child pursue STEM activities and careers. Other adults reported having a better understanding of challenges the children were having in school because they experienced a learning environment together.

Three things that didn't work and why:

- While we provided training for project staff on the use of narrative and storytelling, some STEM experts needed additional support in planning and delivering stories, as opposed to presenting a traditional scientific talk. It's important to get experts out of their "head" and not to focus on all of the details. Rather, how can we support experts in connecting to the families and make visible what is often overlooked in the experts' lives and work?
- The time commitment required of families was high. Families committed to six, day long workshops on Saturdays, completed activities at home and wrote a book. There were times when it was evident that the adult caregivers were tired, which impacted their engagement.
- Some of the books the families wrote and published contained inaccurate scientific information. These books are now available for check out at the local library. Based on the timing, we didn't have the capacity to read and give feedback about the accuracy of the content in each book.

What's needed:

- Additional research on the generalizability of our project; drilling down to core components of what aspects of the project most impacts families' STEM learning (for example, is writing the book critical to the project's success?); how can we reach families that aren't self-selecting into the project?

Links to our work:

- Spurr, K. (2017, August 28). Capturing wildlife on camera. *The Bend Bulletin*, p. A1. Retrieved from https://www.bendbulletin.com/localstate/5539621-151/local-families-conduct-citizen-science-with-wildlife-cams
- 2018 AERA Conference paper summary: https://convention2.allacademic.com/one/aera/aera18/index.php?cmd=Online+Program+View+Paper&selected_paper_id=1311469&PHPSESSID=u36bdq1tmrkdnvvu1u1jsq87a6

My relevant background experiences:

- Emphasis on place-based learning that integrates STEM, social studies and the arts
- STEM learning in school and out of school settings
- Conducts STEM professional development for teachers of grades K-12
- Previous elementary and middle school teacher
- Teaches science/social studies methods course for pre-service elementary teachers
- Research on the impact of museum resources (scientists, educators, collections, objects, etc.) on teachers' knowledge of science and confidence in teaching it

Marta Civil

Out-of-school and In-school Mathematics; Funds of Knowledge

Summary of work:

While my work is not located in rural areas, I think that the ideas behind a) funds of knowledge and b) parents (or other significant adults) as intellectual resources can be of relevance to projects in rural areas. I have worked with teachers, children, and parents with my focus bring on Mexican immigrant mothers and children (primarily ages 7-14) of Mexican origin. A main idea is to learn from families about their experiences in everyday life and then build on those to develop mathematical learning activities. Much of my work has been around learning about the funds of knowledge (resources, experiences, knowledge) that all families and communities have and making connections to "school" mathematics. I have also been involved in after-school projects where we sought to engage children in explorations that show how mathematics is used in community settings. But most of my work has focused on mathematical activities with mothers, learning from their experiences with both, school mathematics and out-of-school mathematics.

Three things that are working:

- My work with mothers (most of whom are of Mexican origin) reveals a genuine interest in engaging in mathematical explorations. They enjoy sharing their experiences as well as learning more about what their children may be learning in school. The workshops are quite informal with a lot of dialogue and casual conversations. I think that this approach could work in other settings since it is about listening to and learning from the participants.
- Having parents (in my case it has always been mothers) as co-facilitators of workshops. They often connect much better to the other parents / families in the audience than teachers or university personnel. They often know some of the families attending and even if they do not, they have things in common (e.g., cultural background; language; children attending the schools in the area).
- Having a community connection. Certainly, for my work having principals' buy-in is important. But I would say that the most successful work we did with parents was at a school where a mother who had been a participant in one of my prior projects took it upon herself to start a series of mathematics workshops for recent immigrant parents. We joined that effort. Her connection to these parents was instrumental in the recruitment and continued success of the project.

Three things that didn't work and why:

- This is a recurrent issue for me: to uncover the mathematics in out-of-school / informal settings. While I firmly believe that families engage in mathematically rich activities, our limited view of mathematics (as being "school mathematics") may not let us see the mathematical potential in these other settings.
- Recruitment. My work is mostly tied to schools and to a certain level some parents come because they want to help their children with school mathematics (we then expand this to discussions beyond school mathematics). But even with that first motivation, families do not tend to rush to schools to do math!

- The development of activities that are mathematically rich and allow participants to be themselves, to engage in those activities like they do in other everyday activities (participation; enjoying the challenge). This is not so much something that "is not working for me" but more a call for how to better connect to the participants so that they and we see them as doers of mathematics.

What's needed:

- Better understanding of how diverse communities engage with mathematics in their everyday life.
- Schools' and out-of-school programs' appreciation for the mathematical funds of knowledge that families bring to the setting.

Links to our work:

- My webpage (math.arizona.edu/~civil) is very outdated, unfortunately. But it still has some relevant information (I have started a new one… but at the rate I am going it will not be ready for the September meeting!). In particular, the gender equity informal STEM project, while it was many years ago may be relevant to this conference (math.arizona.edu/~gistem). Also an old project, Project Bridge focuses on funds of knowledge (math.arizona.edu/~bridge)
- A current project: sites.google.com/a/math.arizona.edu/hablemosdematematicas
- Civil, M. (2016). STEM learning research through a funds of knowledge lens. *Cultural Studies of Science Education*, *11*(1), 41-59. DOI 10.1007/s11422-014-9648-2
- Civil, M. (2018). Intersections of culture, language, and mathematics education: Looking back and looking ahead. In G. Kaiser, H. Forgasz, M. Graven, A. Kuzniak, E. Simmt, & B. Xu (Eds.), *Invited Lectures from the 13th International Congress on Mathematical Education* (pp. 31-47). New York: Springer. https://doi.org/10.1007/978-3-319-72170-5_3

My relevant background experiences:

- Mathematics Education
- Equity (particularly issues of culture and language (English Learners))
- Working with parents / families; community knowledge
- Bridging the formal / informal worlds in mathematics education

Jeff Cole

Facilitating locally relevant STEM learning in ELO programs serving K-8 Youth

Beyond School Bells (BSB) directly engages Nebraska's rural ELO programs in three ways: state and local partnership development, support for a Coalition of established school-based programs, and facilitation of new ELO programs in underserved rural communities. We work with school-based and community-supported afterschool and summer programs serving primarily K-5th, but also 6-8th grade youth. A key component of our approach is that high quality ELO programs include STEM experiences, and that locally relevant STEM experiences are the most impactful for participating youth. Finally, we believe that there is STEM talent in every Nebraska community

that wants to be involved in supporting the next generation and ELO programs can be a platform to harness that energy.

Three things that worked and why:

- **Mini-grants to local communities** to develop locally relevant program strands - BSB provides $5,000 - $10,000 STEM mini-grants to rural communities to facilitate the development of sustainable STEM and Career Awareness programs and partnerships.
- Launching ***Think Make Create* (TMC) mobile STEM learning / tinkering trailers in** rural communities - the development and field testing of these low cost, custom built, 7 by 12 trailers have been a key feature of recent BSB work. TMCs are designed to provide staff with access to a rich variety of resources promoting hands-on, project-based STEM learning; to bring attention to new ELO programs and to meet important storage needs for school-based ELO programs.
- Utilizing a *minimally viable product* approach to developing new programming - as part of our ***ELO Design Challenge***, we are supporting a partnership approach (working closely with Nebraska 4H Extension) to rapidly prototype new programming strands in rural communities. This has led to new programming and staffing innovations.

Three things that didn't work and why:

- **Frequent staff turnover** challenges stability and makes professional development difficult; lack of adequate staffing, reduces opportunities for new programming and partnerships
- **Prioritization** - key rural leaders are over capacity and don't yet understand the value of ELO STEM in meeting larger community, education and youth development goals
- **Full utilization of TMC trailers** in pilot programs. While some communities using TMCs in innovative ways, others are underutilizing these tools.

Links to our work:

- Beyond School Bells - beyondschoolbells.org
- Think Make Create Labs - beyondschoolbells.org/mobile-maker-space
- beyondschoolbells-org.presencehost.net/videos/stem-videos
- STEM Ready America Compendium - *The Nebraska Way: Building STEM Learning Systems from the Ground Up,* stemreadyamerica.org/article-nebraska-way

Relevant Experiences:

- ELO Experiences - Taught in and managed school-based ELO programs, developed frameworks for city-wide ELO systems and 12 years as Network lead of NE's statewide Network.
- Worked briefly in urban development and understand city / state elected leaders (not federal)
- Partnership and fund development

Lynn D. Dierking

Leap into Science Leap: Cultivating a National Network for Informal Science and Literacy

Summary of rural work:

The four-year *Leap into Science: Cultivating a National Network for Informal Science and Literacy* project builds upon two prior NSF-funded initiatives: *Leap Pilot* (DRL#0714658) and *Leap Full-Scale Development* (DRL#1223730). These projects engaged children and families in science and literacy learning by integrating children's books with hands-on science learning by working through informal education partners (primarily libraries, museums. The goal of the National Network project is to broaden access to this program, and build knowledge about how to cultivate a national network supporting children and families' science and literacy learning through state and regional-level informal education partnerships. The focus of previous work has been in urban areas. This effort will expand into rural communities, adding additional partners such as Head Start and other day care settings, afterschool programs, public health organizations, etc., as well as museums and libraries. Embedded in the project is a research effort, conducted by the Institute for Learning Innovation (I am a co-PI on the project), to complement the evaluation and inform understandings of project impacts and scale-up efforts (particularly from the perspective of participating families, in both urban and rural areas). The pilot state/regional networks we are working with include: Arizona, New Jersey, Oregon; Tennessee; Washington; and, West Virginia.

Three things that worked and why:

- We are completing Year one of the project, but what is working thus far includes: Enthusiasm for the opportunity to be a part of the project by leaders in the rural states/regions within states; they communicate that often they are not included in projects of this scale, particularly efforts that are STEM-related;
- The strength and innovative nature of the networks created in rural states/regions; these include the less usual suspects and demonstrate a "whole" child *and family* approach; we hope to probe why this might be the case with families and providers in the community through the evaluation and research; and
- Successful National Leadership Institute for state/regional leaders that provided bonding opportunities; confidence-building for providers not as familiar with STEM; and, possibilities for reaching new educators who have not always partnered with museums or libraries.

Three things that didn't worked and why:

- Again we are at the beginning of this work but challenges include: Recruiting, recruiting, recruiting!!; the "right" strategic state partners to support implementation in the rural states/regions; then recruiting the "right' staff in the rural states/regions to participate and implement the program; and, (3) ultimately recruiting families.
- Ensuring that work in both in urban and rural areas is asset-based since it is so easy to look at what communities do not have. The research is looking at interest development within the family and how Leap into Science connects to other resources/opportunities in the rural and urban communities in which Leap into Science is being implemented.

- Responding to diversity and inclusion issues that the selected rural states/regions are grappling with (views on learning, systemic oppression, undocumented families, etc.)

My relevant background experiences:

- Long history of work with various hats (conducting evaluation, research, programming, etc.) in rural areas for history projects in rural PA, the Science Carnival Consortium which worked with small science centers around the country, Girls at the Center, Cascading Influences, etc. and early in my career outreach in rural areas in southern Florida.
- Deep interest in the notion of ecosystems and ecologies of learning and thinking about how those play out in urban and rural areas
- Deep commitment to asset-based approaches to learning
- Lived experience in rural areas in Florida and Maryland; lots of time spent in the rural south.

Paul Dusenbery

Providing Informal STEM Experiences to Small and Rural Libraries through the STAR Library Network

Summary of rural work:

Over the last 8 years our team has created a variety of informal STEM experiences for public libraries in every region of the country, including many rural communities. The centerpiece of our library engagement program is called the STAR Library Network (*STAR Net*), a community of practice (CoP) that includes in-person and online components. *STAR Net* focuses on helping library professionals build their STEM skills by providing "science-technology activities and resources" (STAR) and training to use those resources. Nearly 8,000 library and STEM professionals have joined *STAR Net* to access webinar trainings, monthly newsletters, professional blogs, partnership opportunities, facilitation guides, book recommendations, and *STAR Net*'s *STEM Activity Clearinghouse*. The latter resource packages each activity along with tips on use in the library setting, links to related content and online video clips, and suggested books. It's a direct response to librarians finding inaccurate materials across the Web and is seen as a trusted resource for activities that have been proven to work in libraries. In the last year, the site has logged more than 125,000 pageviews from almost 70,000 visitors.

STAR Net's series of traveling exhibitions were developed with a specific aim to reach rural regions of the country. While it is often difficult to know who is accessing the virtual parts of *STAR Net* (and from where), that is not true of the national traveling exhibitions. Nearly one million patrons from rural communities have experienced these exhibits and more than 61,000 patrons have attended a STEM program tied to the exhibit. On average, libraries host 25 events related to exhibit themes during its 3-month stay (and many sites far exceed this number!). The exhibitions have attracted considerable media attention and have aided libraries in establishing strong partnerships in their region. The exhibitions, new partnerships, and multiple programs have helped many rural communities recognize the important role that their library plays in nurturing a vital STEM ecosystem of formal and informal STEM learning organizations working together on important community needs.

Three things that worked and why:

- **Traveling STEM exhibitions** come in two sizes, large "Discover-class" exhibits and small "Explore-class" exhibits. The *STAR Net Phase 1* summative evaluation report confirmed that library patrons were deeply engaged in the content of the exhibits (Fitzhugh et al., 2013). Dwell times were extremely favorable when compared to museum exhibits, suggesting that the exhibits were an effective way to engage library patrons. Many rural libraries have asked when they can get another STEM exhibit, and often are able to receive exhibits and other offerings from *STAR Net* partners, through the *STAR Net* online community.
- ***STAR Net* professional development programs** using active learning principles have by far the greatest impacts on library staff. The *STAR Net* training model pairs proven informal STEM facilitation techniques with actual hands-on activities, like those found in the *Clearinghouse* described above. Previously, many libraries used simple activities found on Pinterest or other internet sites that did not necessarily have accurate science content. *STAR Net* also has an active webinar series to provide online training support for activities and STEM events that we support (e.g. the 2017 Solar Eclipse).
- **Community Dialogues.** All the selected exhibit host sites had to demonstrate that they had established several community partnerships and were willing to recruit more to assist with facilitating programs, increase needed resources, and help with promotion campaigns specially targeted to engage underrepresented groups. Long-term, successful partnership building was a key component of all the in-person workshops associated with the exhibitions. Recently, we have used this foundation to develop a *Community Dialogue* framework. *Dialogues* provide libraries with meaningful feedback from the community on who visits the library and why, and ideas about how the library can better serve ethnically, economically, and geographically underserved and underrepresented audiences. It is an excellent way for libraries to build durable, long-lasting partnerships within their community.

Three things that didn't work and why:

- **Building an effective CoP** proved to be a serious challenge in Phase 1 of *STAR Net*; even defining who should be in the community was not a consensus decision by the development team. The online tools we had chosen were not easy to navigate and so libraries did not feel part of a real STEM community. While our CoP is now firing on all cylinders (nearing 8,000 members), it was certainly more touch-and-go in the beginning.
- Library staff's STEM identity and self-efficacy have been and continue to be a challenge for broad adoption of STEM throughout the library community. The scales are enormous: our country is VERY large, and many rural communities feel isolated, with very disparate access to resources and partners. For all the successes that STAR Net has achieved, I feel that hands-on STEM programs, while nice to have in a library setting, are still considered a low priority when compared to the necessary, traditional library duties focused on reading literacy.
- The timing of an exhibition program has also been a problem, with libraries being trained on an exhibition they sometimes won't see for another 2-3 years! Many libraries experienced staff or facility changes in that time and had to be retrained remotely.

What's needed:

- Critical Mass. I deeply believe that once there is a critical mass of library staff who know how to implement STEM programs and who are respected by their peers, then STEM literacy

throughout the library community has a chance to really take root. It won't be me, my team members, or even STEM experts who will cause this transformation to take place. It will come from within the library community. Such a change will likely be quite uneven as rural libraries adopt this change at a slower rate than urban libraries. That is not a given, of course, and we may be quite surprised where the needed change is coming from.

- Professional Development. Library staff rarely have training in STEM and are most comfortable in the humanities. STEM is also rarely considered a topic in the professional training of librarians (MLIS degrees). Looking at the big picture, the key lever of change will have to focus on professional development. There is nothing else that comes close. The great challenge we all have working with rural communities is how can we offer PD in STEM when STEM itself is so vast that it is practically impossible for anyone to master. I have a Ph.D. in space physics; but, I'm a novice when it comes to genetic engineering. One possible tactic is to train library staff to be good facilitators of STEM learning, a "guide on the side" approach, rather than a content expert. Our STEM Activity Clearinghouse is another possible support system for libraries that can provide an accessible STEM watering hole that is far more effective than attempting to implement a broad STEM program.

Links to our work:

- Project websites: starnetlibraries.org
  starnetlibraries.org/resources/community-dialogues
  facebook.com/STARLibraries;
- Baek, J. (2013a). *The accidental STEM librarian: An exploratory interview study with eight librarians*. Boulder, CO. nc4il.org/images/papers…
- Baek, J. (2013b). *Public libraries as places for STEM learning: An exploratory interview study with eight librarians*. Boulder, CO. nc4il.org/images/papers/Baek_Public…
- Datum Advisors. (2015). *STEM equity in informal learning settings: The role of libraries*. National Center for Interactive Learning Report, Denver, CO. starnetlibraries.org/stem-in-libraries/diversity/
- Dusenbery, P.B. (2014a). *The STEM Education Movement in Public Libraries*. Informal Learning Review, No. 124, Informal Learning Experiences, Denver, CO. nc4il.org/images/papers/Dusenbery-ILR-124-2014.pdf
- Dusenbery, P.B. (2014b). *STAR Library Education Network*. Informal Learning Review, No. 125, Informal Learning Experiences, Denver, CO. nc4il.org/images/papers/Dusenbery-ILR-125-2014.pdf
- Fitzhugh, G., Coulon, V., & Elworth, J. (2013). *STAR_Net summative evaluation report*. Report for the National Science Foundation. Evaluation & Research Associates, Lynnwood, WA. nc4il.org/images/papers…

My relevant background experiences:

- Informal STEM education with a focus on exhibitions and programs
- Professional development for informal educators
- STEM ecosystems
- Communities of practice and networks

Michelle K. Hall (and Michael Mayhew)

Teen Science Cafés and The Teen Science Café Network

Summary of our rural work:

Teen Science Cafés (TSC) were born in 2008 out of a desire to infuse STEM and an introduction to STEM careers in the mostly small, rural, minority communities in northern New Mexico. In 2012 with a national dissemination grant, we started the Teen Science Café Network to train ISE educators to launch programs in their community. Today we have programs in 43 states. Nationwide there are about 20% of the 120 TSC's that serve rural or underserved communities. 30% serve people of color and in general, the adult leaders reflect the ethnicity of the audience. The monthly programs held during the academic year are led by high school age teens, with the guidance of an adult mentor local to the community. Teens and scientists come together to explore a big idea in science that is relevant to teen lives. A short presentation with lively conversation is followed by a hands-on experience. Mindful Eating, Science of Love, The Nuclear Deterrent, the Zombie Brain, Bugs in Your Belly Button, & Drone Technology in Hurricane Emergency Response are a few of the many recent topics presented across the Network.

STEM experts share their pathway to STEM from age 14-30, including all the detours, twists, and turns. Teens often remark, "I think I could do that!" after hearing the adults' stories. The social atmosphere and highly interactive presentations allow teens to realize that STEM experts love their work. The programs are social, build a sense of community for teens interested in STEM, and develop teen leaders who manage the majority of the planning, organizing, and implementing of the programs. The program impacts are consistent across socio-economic demographics. Teens see science everywhere, find STEM experts to be interesting, have increased interest in STEM, gain confidence talking about STEM, learn to consider multiple perspectives of an issue, and discover a myriad of STEM careers at all professional levels. Coaching of presenters is essential, and teens help with that. The format allows a scientist to develop a program with the help of informal educators and deliver it in multiple locations over time.

Three things that worked and why:

- Teen leadership gives teens ownership of planning, marketing, implementing, and reflecting on their program to ensure it stays relevant to them and their peers. They are actors rather than passive receptors. Teen leadership also reduces cost by using less staff time.
- Vetting and training presenters, including a required a dry run with teen leaders, is essential to a successful program. These are best in person, but can be virtual, which is a valuable option for rural programs. The presenter gets vital feedback about what the teens find interesting and when they are stumped or bored. It gives scientists, who can be off standish/anxious with teens, a chance to become comfortable with this formidable audience.
- The low overall program cost (free to teens) and a flexible program model that can be implemented in most any size community increases program sustainability.

Three things that didn't work and why:

- Hosting programs in school settings and/or with teacher leadership tends to result in a highly controlled school environment, rather than teens making free choices in their learning and social development. TSCN programs are strictly out-of-school.
- Selection of the adult leader can make or break the program. While the adult leader does not need to be STEM trained, they are more successful when STEM enthused, and have leadership and mentoring skills. When adult leaders begin to direct the teen leaders rather than ask questions and explore ideas to guide them, the teen leaders will often shut down and do no work.
- Teachers who want to support the program may give teens extra credit to attend. This can result in a large group of teens attending with no motivation or commitment to participate beyond the extra credit. It can change the dynamic of the program from free choice to coerced.

What's needed:

- We would like to implement an element of mentoring for the teens by scientists outside of the café program events. The challenge is distance and busy scientists. The #1 thing teens like about the program is meeting a "real" scientist. How can we extend that relationship?
- More opportunities for training adult leaders in rural communities, who may be relatively isolated and lacking in support.

Links to our work

- TeenScienceCafe.org
- Hall, Michelle, Susan Foutz, and Michael Mayhew. 2012. "Design and Impacts of a Youth Directed Café Scientifique Program." International Journal of Science Education, Part B: Communication and Public Engagement. cafenm.org/documents...
- Video: Inaugural UVM Extension 4-H Science Pathways Café on Across the Fence
- teensciencecafe.org/resources/engaging-teens
- Mayhew, Michael and Michelle Hall. 2012. "Science Communication in a Café Scientifique for High School Teens." Science Communication 34 (4). pp. 547-555. cafenm.org/documents/Mayhew_Hall_Science%20Communication_article.pdf.
- Theoretical Framework and Model for Implementing the Teen Café Scientifique

Relevant Background Experience:

- Experience working in industry, federal agencies, academia, and now lead a small business.
- Professional experience in science education including standards, curriculum, assessment, instruction, and professional development.
- 11 years leading Teen Science Cafes in New Mexico. Informal science education, science communication, evaluation, and GIS / geophysics curriculum development.

Tom Keller

Building Capacity for CS Teaching in a Rural State

Summary of rural work:

According to a recent US Census, Maine was the most rural state, covering some 30,000 square miles. Our 710 public schools serve 200,000 K-12 students including 14 unbridged island communities. Our 'Building Capacity' project was designed to introduce computer science (CS) education to teachers and students across the entire state, in three years. Working with curriculum leaders, lead teachers, and school administrators, we completed a professional development program consisting of a 5-day summer institute and 4 follow up Saturday workshops for 3 cohorts of teachers. We reached all corners of the state and focused on rural schools. In addition, we created the first in the state computer science methods course and built and continue to support a professional learning community of educators doing computer science.

Three things that worked and why:

- The curriculum and professional development package (Exploring Computer Science) were exemplary. The thoughtful development of the curriculum and the pedagogy of both the curriculum and pd provided comfort for teachers who were initially reluctant to engage in computer science.
- We created short video-based lessons that tied CS principles with local STEM employers and employees. These were found to be valuable for several reasons; they are short and engaging, they are placed based, they put a real face on especially middle tier STEM jobs in local communities, and they show CS being applied virtually everywhere.
- CS is being integrated in schools across the state by local policy and state support. Students in many small and under resourced schools have the opportunity to learn about CS and that decision was made at the local level. The state has not determined a CS policy yet, that is, there are no standards, no teacher certification, and no high school graduation requirement. In essence, the state has not gotten in the way of CS.

Three things that didn't work and why:

- Saturday workshops were problematic when teachers had to drive an hour or two (or three) or had to take a ferry to the mainland to attend the 9 am to 4 pm sessions. Then weather was an additional complication for winter workshops. Certainly, these workshops were necessary but the most effective way to conduct them (and we tried a few variations) has not yet been found.
- School culture and changes led to less implementation than expected. In some cases, teachers learned during the summer institute that they were no longer scheduled to teach this course despite the principals agreeing to offer it. Plus, teachers moved between schools and their teaching assignments differed in the new school and principals changed positions as well. Rural teachers need to be 'Jill/Jacks of all trades' since there are relatively few in the school. Their teaching assignments vary according to student needs and numbers.
- While the some 60 teachers we ran through the program had generally good experiences, it is now extremely difficult to find new teachers to train. We think that we have reached the pioneers, or the pioneering districts, and others will not join in until or unless it is mandated.

What's needed

- We need research on the few, core concepts in computer science that keeps the door open to students. In our small and rural schools, there is not excess capacity or time to implement a whole, separate computer science curriculum.
- We need models of instruction for how teachers can incorporate CS principles into math, science and other content areas.
- We need better models for conducting professional development for very small cohorts of educators, (say, 2 or 3). There is value in the 'teacher talk' that goes on at these sessions as they make sense of the content and discuss methods of implementation. But when there are very few teachers present, that crosspollination is lost.
- Our research focused on enticing Maine youth into computer science study and careers by showing how computers are used in businesses and agencies. Our first attempt highlighted such uses in major Maine institutions like LL Bean and the Jackson Lab. Even though these are based in Maine, they did not connect with rural kids sufficiently. We shifted the model to more local settings such as dentist offices and machine shops. This may mean that pathways into CS are different in rural areas than in urban ones.

Links to our work:

- Keller, T.E. (2017, May). Exploring Computer Science in Maine: 2014-2017. Retrieved from mmsa.org/resources/publications/white-papers/
- Keller, T.E. (2018, January). Computer Science Education in Maine in 2017. Retrieved from mmsa.org/resources/publications/white-papers/.

My relevant background experiences:

- Science education including standards, curriculum, assessment, instruction and professional development (largely formal)
- Education policy
- Computer science education

Stephen (Steve) Krak

STEM Learning Ecosystems sponsored by the STEM Funders Network

Summary of rural work:

"STEM Learning Ecosystems provide the architecture for cross-sector learning, offering all young people access to STEM-rich learning environments so they can develop important skills and engagement in science, technology, engineering and math throughout preK-16. Strong STEM Learning Ecosystems feature dynamic collaborations among schools, out-of-school time programs, STEM expert institutions (such as museums, science centers, institutions of higher education and STEM professional associations), the private sector, community-based organizations, youth and families." (from stemecosystems.org).

The theory of action behind the STEM Learning Ecosystems project is that better partnerships in a community lead to better outcomes for students. This national (and recently international)

network of 68 STEM Learning Ecosystems include several communities that contain either an entirely rural footprint or a mixture of urban and rural constituents. Specifically, I worked with rural communities in Maine, Pennsylvania, North Carolina, and Ohio, and mixed communities in Wisconsin, California and others. Each community is given access to a technical assistance consultant and access to the network of other communities. Rural communities meet up at biannual national convenings of the ecosystems, meet virtually to find others trying new solutions, and organize online in "Communities of Practice" around topics of interest such as advocacy, communications plan, and family engagement. The types of participants vary by community but typically include school districts, STEM-rich institutions, out-of-school STEM providers, local business, government, post secondary education, and other community organizations (Eg. Rotary, Kiwanis, etc.).

Three things that are working:

- Keep the focus local. While many communities target abstract aspirations for their youth, I have found several times that rural communities do not respond to the same aspirations. Instead, we have found success focusing on preparing youth for jobs in the region. This resonates with stakeholders and provides a scaffold for those who want to go beyond.
- Focus on relationships, build on strengths. In larger communities where social capital is very different, formulaic solutions can be successful. But in rural communities it seems that relationships are rich, multi-faceted, and critical. People put their reputations on the line with their critical relationships (remember that rural leaders wear many hats). Focusing on those relationships as the channels to getting things done and modifying behavior appears to yield the best results.
- Do it with them, not to them. This is true with any community to a greater or lesser degree. But with rural communities I have found a much stronger sense of belonging or not belonging, being a local vs. not being a local. Even when you build trust, it is critical to help them own their own solutions while playing the role of assistant in the process, never the lead.

Three things that are not working:

- Mirroring efforts in big cities is not working. It seems obvious to say that "one size does not fit all," but the distinction between what can work in a large urban or even an urban/rural mix and a substantially rural community is stark. When some specific interventions have worked (E.g. the basics of a design studio) even these interventions need to be tailored. We have at times assumed that what has worked in a non-rural will work in a rural community. We found out quickly that we were wrong.
- Focusing on bigger, abstract aspirations may not work. Conjuring aspirational images of what their children might become (world-changing scientists or engineers, for example) does not gain traction in many rural communities for many reasons. What resonates is aiming for regional jobs. There is nothing wrong with opening the door to 4+ year college career paths, but the majority of opportunities will involve community college associate degrees, certifications and apprenticeship programs that allow students to start their careers closer to home and their families. When we have assumed that what motivates large urban communities will motivate rural communities, we have fallen on our face.

- Injecting external experts (the wrong way) is not working. Being an outsider is strike one. Being associated with a large urban is strike two. And if you dare position yourself as the subject matter expert that will "fix them", be ready to hear strike three, and pack your bags. I have learned from each of these experiences. Go slow and earn your invitation to participate, even if you are introducing a proven program.

What's needed:

Leveraging the patterns we have seen in our communities, I recommend to our network of rural communities:

- Pay attention to the interfaces between partners, formal and informal. Rather than being another 'random act of STEM', pay close attention to how this fits into the bigger picture. What is it connected to? Who can refer students to you? To whom can you refer students? How are you complementing in-school STEM offerings, families and teachers explicitly? How are you connecting to or integrating what are traditionally seen as non-STEM activities? This systemic approach will improve our outcomes, but more importantly it will improve the impact of each informal STEM program/organization on the community.
- Share vocabulary. Being part of the larger whole means striving with our community partners to focus on a common language around STEM and STEM experiences. What if our students heard the same terms and phrases that connected activities in and out of school, and even from our local business and industry?
- Create local ownership. Even if we're bringing a proven solution from the outside, consider how we might create a real sense of local ownership. Re-branding? Using the locally-adopted vocabulary? Building training capacity locally? Giving total ownership of the celebrations to the community? There are many ways to accomplish this sense of ownership that builds pride and reduces the resistance to solutions that come from outside their community.

Links to the work:

- Program: stemecosystems.org
- Sponsors: http://stemecosystems.org/about-the-stem-funders-network/
- TIES (lead technical organization in this work): tiesteach.org

My relevant background experiences:

- Proficiency and experience with facilitation of several design processes (design studios, design thinking, engineering design processes, hybrids)
- 25 years of R&D engineering with Battelle, a major R&D and philanthropic organization
- 4 years Program Manager during the development of the Ohio STEM Learning Network
- 4 years helping to design and stand up the first public STEM schools in Egypt
- 1 year leading a Design Thinking lab and resource for students at Denison University
- 3 years as a community Technical Assistance Lead for the STEM Learning Ecosystems project for 13 communities

Amber Lange

Emerging Scholars Program at Clemson University

Summary of rural work:

Since 2007 I have been the director of Emerging Scholars, a rural college access program that works with students of color from seven rural high schools on the I-95 corridor in South Carolina. We work with 10th, 11th and 12th graders by bringing them to campus every summer to take classes, provide an after school program in each school and offer college trips and workshops throughout the academic year. Suring the summer classes students take a variety of STEM related classes and in the after school program we provide STEM activities for the teachers and offer tutoring in math and science courses. We take the students to a STEM festival that is hosted in a nearby town so they get to have hands on experiences. 97% of our students are African American, 1% are Latinx, 1% are Bi-racial and 1% are White. All of our high schools are under resourced and classified as Title 1.

Three things that worked and why:

- Emerging Scholars has been working with students since 2002 and there have been over 900 students in the program. We have a 100% high school graduation rate and 90% of our students are in college or the military the year after they graduate from high school. I think we have had so much success because we have been patient. Changing a culture in a school or a community takes time. We used to have to recruit students to be in the program and our three-year retention rate was under 70%. Over time parents and students saw the importance of the program and our retention shows that. We now have 90% of our students finish the program. Some families thought we were there short term or just fulfilling a grant obligation. After 16 years it is clear we are not going anywhere.
- Our after school program just finished its first full year. We are working on inputting the data to see what type of impact it had on the students. However, the feedback has been positive from students, parents and teachers. This has helped us continue our work from the summer so the students are retaining the information we give them. Unlike the school system our students were losing valuable information during the academic year. We are 4 hours away from our schools so it is hard to see them every week. Hiring teachers in the school that support the program has helped us reiterate things we teach in the summer. We are also able to do more activities based on what individual schools need.
- This upcoming fall will be the third year that Clemson is offering full scholarships to any of our students who get accepted. Before this scholarship we averaged two students enrolling every year. This upcoming fall we will have 45 students at Clemson that graduated from the program. We have created a support program for them because they are not prepared for their STEM classes. They even come three weeks early and take STEM related courses to help prepare them for their first year at Clemson. One of the largest barriers for our students is money for college. They would come to Clemson three summers and get accepted but when they received their financial aid package, Clemson was out of reach. Clemson's financial commitment to our students has made it possible for them to get a Clemson degree. I hope other institutions use us as an example!

Three things that didn't work and why:

- We do great when it comes to working with students but the school districts themselves have not made a lot of progress in the 16 years we have been working in them. We had a grant many years ago that brought the teachers up for training in math and I believe we need to do more things like this. There are a lot of students who do not get to participate in ES but if you have more prepared teachers, they can reach more students.
- We need to do more with our families. We do host a Parent Awareness Weekend (PAW) for the parents of our new students every summer but we don't do a lot with them during the academic year.
- We need to have a staff member who is in the area. Clemson is 4 hours from our schools and it is hard to be there all the time. If we hired someone who lived in the community, they could take care of more things for us on a daily basis.

What's needed:

- Better teacher training
- Technology needs/infrastructure
- More family programming
- Get local industries involved

Links to our work:

- clemsonemergingscholars.org
- newsstand.clemson.edu/mediarelations/clemson-emerging-scholars-program-expanding-route-to-higher-education
- newsstand.clemson.edu/mediarelations/richardson-1-million-challenge-gift-to-benefit-emerging-scholars-attending-clemson

My relevant background experiences:

- I am working on my PhD in Educational Leadership and my research will concentrate on rural students of color and state takeovers of rural, Black districts. I will be done with classes this fall.
- My own K-12 experience is in a rural district in Illinois so I constantly see the differences between the rural area I grew up in and the ones I see in South Carolina. Race and poverty seem to be the biggest differences.
- I am a co-author of a paper presented at the 2018 American Educational Research Association (AERA) conference titled "Experiences and Expectations of Rural Black and Latinx Incoming Freshman."
- Even though I am still directing the Emerging Scholars program I am now the Executive Director of College Preparation and Outreach at Clemson. I oversee another college access program and help bring more K-12 students on Clemson's campus.

Kalman Mannis

Rural Activation and Innovation Network

Summary of rural work:

RAIN is looking into STEM identity in four (4) rural regions of Arizona. The regions, include three county wide sites, one multi county area, and the smallest is a river valley. Included in three of the regions are tribal nations, one has a military base, and one shares a border with Sonora, Mexico. The populations are diverse in ethnicity, age, and socio-economics. Research outreaches began in the Fall of 2017 and concluded the first set of data collection in the early months of 2018. In addition to the landscape research the project developed regional innovation councils (RICs) to engage place based decision making to the development of STEM experiences. RICs have been provided with $50,000 per year for each of the four grant years to strategically support the development of informal and non-formal STEM. Each RIC has developed a mini-grant process and began grant cycles in the Fall of 2017. In addition to the mini-grants the RICs have been actively doing outreach to social groups (Rotary, Kiwanis, Lion's), K12 and Community colleges, at regional events, and with strategic partners.

Three things that have worked:

- We strategically pulled together local teams and champions in each of our research regions. The foundational idea was to have folks who shared an interest in STEM but had non-overlapping professional networks. We used a Council model derived from Arizona First Things First (early childhood health and education board). Each seat on the Rural Innovation Councils (RICs) was designated. We included: First Things First Regional Director, Executive Director of a chamber of commerce or regional economic development team, K12 teacher or administrator, county school executive, community college representative (no universities in our regions), healthcare representative, county library district director, business owners, city representative, county representative, and at-large seats for anyone interested in the project. We have about 12 seats and typically 8-10 show up to meetings.
- Spent the first year creating the RICs and coaching participants into cohesive groups through a set of tasks including: Strategic Planning, Media and Outreach Planning, and Budget alignment to plans. RICs met monthly and had a 2 day retreat where they were given coaching on how to polish their plans. Once the plans were ready the teams put them into action. This was done so that time, efforts, and money from the grant were not wasted, and to provide coaching on the standards for these documents.
- One of the most interesting and unexpected successes was a pilot project done with a rural library (Huachuca City), the cooperative extension STEM division (Cochise County), and the girl scouts. Each needed something the other could provide. Our efforts brought the three together and helped with some seed funding. This has been in place for 10 months and all parties are happy with the results.

Three Barriers or Challengers:

- This is no surprise to anyone – 1. Funding, 2. Distances, 3. Perception of value, 4. Media or processes available for dissemination of information on the various programs.

- 1 & 2 are issues in all the communities we work in as well as those that we collaborate with. It is #3 that has risen to the top in impacting RAIN's work. Perception is not just from the student population, but is multigenerational and multiethnic. We have not seen many programs that can get people off the couch and outside. Especially if it requires an investment in money or driving. This is not universal. There are subpopulations that are happy to drive and engage in STEM activities, but they trend to more educated and older.
- The last one, how to accurately reach target populations with information, has been and continues to be an unresolved discussion. This is true both for the towns and in the more remote regions. We have tried social media, but don't' have the right combination yet.

What's needed:

- Local government support has been lacking. Typically, there is verbal support for programs, but when implementation support is requested there is little follow through. The usual comment is that there are not enough people/money/time to help.
- Grant writing and grant managements are skills that are needed. There are groups doing wonderful work in rural areas that would benefit from a quality grant development program delivered by someone local.
- Natural Resource managers working with regional social groups, afterschool clubs, and libraries to engage the public in active participation of resource management (local problems, local solutions). These groups could also be tapped to support afterschool programing, and adult learning at libraries.

Links to our work:

- Website: 4azrain.org

My relevant background experiences:

- Use of cognitive coaching to stimulate conversation
- Creative grouping to bring in multiple voices
- Data Synthesis
- Needs assessments
- Systems Thinker (Scope and Sequence)
- Grant management

Daniela Marghitu

Attracting to STEM Majors and Careers Underserved Children from Rural Alabama

Summary of rural work:

According to a recent US Census, in Alabama almost 50% of the population is living in rural areas. Alabama is among the 13 states where rural education is most important to the overall educational performance of the state (Johnson & Strange, 2007), yet it is among the four states least conducive to rural educational achievement. In Alabama, minority students in rural schools are predominantly African-American. In their national study, Farmer, Leung, Banks, Schaefer, Andrews, and Murray

(2006) found that in over 40% of the rural schools serving poor, minority youth, a disproportionate percentage of African-American students did not pass the end-of-year exams and were in danger of dropping out. These schools are concentrated in the Southwest and South, and include Alabama's schools.

Our K12 outreach project was designed to introduce computer science (CS) education to teachers and students across the entire state. Working with teachers, school administrators, and STEM Education nonprofit organizations, we completed professional development programs consisting of two 2-day workshops and reached out over 2,000 K12 students with our informal K12 Saturday academies and summer camps an. In addition, we created the first in the state computer science formal course for middles school that was taught for three years.

Three things that worked and why:

- The curriculum and professional development package we developed were very successful. The thoughtful development of the curriculum and the pedagogy of both the curriculum and professional motivated for teachers who were initially reluctant to engage in computer science education. We provided many video tutorials that were very appreciated by students and teachers. We also developed projects that reflected the needs and culture of the local communities. We also provided for teachers instructions on accommodating students with disabilities.
- CS is now being integrated in schools across the state by local policy and state support. Students in many small and under resourced schools have the opportunity to learn about CS and that decision was made at the local and state level. The state has determined a CS policy, there are standards, teacher certification, and high school graduation requirement. In essence, the state is encouraging CS education.
- Raised awareness on the students with disabilities capability to pursue STE academic majors and careers

Three things that didn't work and why:

- Lack of state wide coordination of all K 12 formal and informal K12 outreach programs to avoid overlapping efforts
- Not all school districts were always interested in engaging in our project
- Not all school districts have trained personnel to insure inclusion of students with disabilities

What's needed:

- In small and rural schools, there is not a solid infrastructure or time to implement informal and formal CS education
- We need models of instruction for how teachers can incorporate CS principles into math, science and other content areas.
- More trained teachers and counselors that can assure the inclusion of students with disabilities

Links to our work:

- Computer Science for All: http://cs4all.eng.auburn.edu
- Computer Science for All Girls: http://cs4allg.eng.auburn.edu
- Computer Science for All Bulldogs: http://cs4allb.eng.auburn.edu

- Mentoring Alabama Girls in Computing (MAGIC): http://magic.eng.auburn.edu
- For related publications see: http://eng.auburn.edu/~daniela/publications.html

My relevant background experiences:

- K 20 Computer Science education including standards, curriculum, assessment, instruction and professional development (formal and informal)
- Maximizing the inclusiveness of underrepresented (e.g. minorities, girls and people with disability) in STEM majors and careers

James Riley McGirt

Project Learning Tree's Green Schools Program

Summary of rural work:

Project Learning Tree's GreenSchools (GS) Program combines environmental education, service learning, and leadership skill building to empower educators and students to reduce the ecological footprint of their schools and their communities. Students develop leadership skills and apply 21st Century (STEM) science, technology, engineering, and math to make a difference in the real world. The program was designed to work with 20 urban and rural middle and high schools across the nation, reaching 4,000 students annually for a total of 60 schools and 12,000 youth over the three-year grant period. As a result, 63 schools in 13 states (WA, IA, CO, KS, OK, TX, MO, WV, SC, VA, MD, NJ & RI) and Wash., DC were awarded grants totaling $439,000 to implement student conceived, driven and implemented GreenSchools environmental improvement projects. These 63 schools were the initial pilots for the PLT GreenSchools program which now engages over 5,300 schools nationwide.

Three things that worked and why:

- Critical to the GreenSchools Program is the utilization of service learning as a teaching model. Through the practice of service learning, students were able to experience working in and leading teams that consisted of students, teachers, school administrators, and community members.
- The GreenSchool workshop model afforded students the opportunity to participate in two full days of GreenSchools training with their teachers and community members to learn how to conduct the GS investigations. This gave students the confidence to take leadership roles during the completion of the GS investigations and the development of student driven action projects.
- Connecting students to Green careers was of paramount importance. Two-thirds of the students who participated in the GS evaluation indicated that their experience with the GS program encouraged them to consider pursuing a career in STEM Sciences

Three things that didn't work and why:

- The most pressing challenge that GS educators faced conducting their environmental action projects involved time constraints. While students faced time constraints because of their

involvement in extracurricular activities, educators had difficulty setting work times when all Green Team members could participate.
- Green Team students were sometimes frustrated by the difficulty of getting other students, non-Green Team members, to commit their time to the project and delays imposed by administration.
- Students were so inspired to become environmental change agents after their GS training, they sometimes did things without the necessary school permission first. This includes accessing the school dumpster (to weigh solid waste) or taking light covers off in a classroom to discover the type and wattage of light bulbs.

What's needed:

- More rural education- based research – Between 2004-2015 the top 5 ranked education research journals published 64 urban-oriented articles, and only 5 rural oriented articles.
- Address rural poverty - Child poverty is higher in rural districts. 47% percent of urban counties have high rates of child poverty compared with 64 percent of rural counties. A higher percentage of rural students face extreme poverty compared with urban students.
- Close the rural achievement gap – Although the vast majority (75%) of rural students are white, the Latino population has been steadily growing in rural areas. Similar to urban districts, white rural students out perform African -American and Latino students in reading and math.

Links to our work:

- PLT GreenSchools program: **plt.org/greenschools**
- North American Association of Environmental Educators (NAAEE) eePro Green Schools Group (I serve as moderator and provide blog content for this group): naaee.org/eepro/people/james-mcgirt

My relevant background experiences:

- Classroom Teacher – elementary, middle and high school
- Middle School Principal
- Kauffman Scholars, Inc. Director of Mathematics Curriculum & Instruction
- Manager of Project Learning Tree GreenSchools Program

Jan Mokros

STEM Guides in Rural Maine

Summary of rural work:

Five years ago, we started a major NSF-funded project on connecting rural students with STEM opportunities in their small (population of 5,000 or less) and often geographically remote communities in Maine. We speculated that there were many OST STEM opportunities, including library programs, 4-H activities, land trust initiatives, and others. Our job was to first uncover them, and then connect 10-18 year old kids and their families to them. Calling attention to the opportunities was not enough: We invented a new job of "STEM Guides", who work to connect kids with STEM in their communities. STEM Guides are catalysts and brokers. They point to and

connect youth with existing programs, rather than inventing new programs. They support and serve both families and youth.

Three things that worked and why:

- Finding a solid institutional partner (including a school or 4-H chapter) helped jump-start the work and made the work of STEM Guides more immediately successful. It was important to partner with schools, as they are the center of many rural communities.
- Existing, vetted "STEM Gift Packages" (often NSF-funded) were used for the program, which avoided re-inventing the wheel. One of the more effective ones was Teen Science Cafes. We chose a theme of "technology in emergency management" for some of these cafes, because 1) rural areas have an EM infrastructure and need to grow this workforce; 2) the jobs involve a great deal of emerging technology that was too new to be taught at school; and 3) kids are attracted to this technology.
- There were many existing social connections in the 5 rural communities that we could leverage. For example, in one community a STEM Guide directed the musical for middle school kids, had been a teacher, and was a parent herself. Her "multiple identities" made it easier to make connections with families and youth.

Three things that didn't work and why:

- Sometimes STEM is hidden even to rural STEM workers themselves. A game warden who uses GPS doesn't necessarily think about or articulate the STEM embedded in his/her work. In turn, that makes it hard to communicate to others about the importance of STEM jobs. How do we make the STEM more visible in "lower-case" stem jobs---the ones you'd most likely see in rural communities?
- We employed local residents, sometimes educators, to be STEM Guides in our rural areas. It was hard work to develop and retain Guides. When the Guides lacked a natural physical venue for connecting with kids, they remained less visible. Our vision of having parents and kids run into a STEM Guide in the grocery store and ask about STEM events was fulfilled on occasion, but not enough.
- Within struggling community organizations, everyone's job is to make **their own** STEM program more visible, but no one's job is to make **everyone's** STEM programs more visible. This makes the work of "connecting" more difficult, and makes us wonder about the successful mechanisms employed by other rural STEM ecosystems to work across institutional boundaries.

What's Needed

- More "buzz" in schools about STEM outside of school, more knowledge on the part of teachers about OST STEM, and more effort from schools to connect kids with out-of-school programs. (Rural kids participate in these OST programs far less likely than urban youth.)

Links to our work:

- Jan Mokros, "Drone Technology in Hurricane Emergency Response" Teen Science Café Network, teensciencecafe.org/cool-cafes/drone-technology-in-hurricane-emergency-response/

- Jan Mokros, Jennifer Atkinson, Sue Allen, Alyson Saunders, and Kate Kastelein, "Facilitating Formal-Informal Connections in Rural STEM Ecosystems, Connected Science Learning, June 13, 2017. csl.nsta.org/2017/06/rural-stem-ecosystems
- *STEM Guides: Connecting Rural Youth to Informal STEM.* 2018. Maine Mathematics and Science Alliance [Producer]. (STEM for All Video Showcase, Web, May 14,2018) Available at: stemforall2018.videohall.com/presentations/1189
- Project Website: mmsa.org/projects/stem_guides

My relevant background experiences:

- STEM ecosystems in rural Maine
- Science fairs for high school students in rural settings
- Data science education in informal rural settings (clubs, camps)
- Math in informal settings, including museums, zoos, farmers markets
- "Community-based" STEM that focuses on technology and emergency management

Dan Rockmore

Pushing the Limits/Rural Gateways

Summary of rural work:

Pushing the Limits (PTL) was an NSF-funded program designed to build capacity of rural and small libraries to provide programming to enhance public understanding of science and math. PTL provided professional support, technical assistance, specially produced video segments paired to specific books of fiction or historical non-fiction, along with funding for library professionals and local science partners to co-facilitate a series of science café-style public discussions with adult patrons. Close to 100 libraries around the country participated in PTL. Librarians were linked via an online Community of Practice that helped share lessons learned and in a supportive environment.

Rural Gateways: Fostering the Development of Rural Librarians as Informal Science Facilitators is intended to research and develop rural librarians' self-efficacy as community-embedded ISL facilitators. The goals of *Rural Gateways* are based on the data gathered via an earlier project *Pushing the Limits and used some of the materials, methods, and processes developed in PTL*. *Rural Gateways* uses a scaffolded process that begins with professional development and a fully supported library program "in-a-box" for librarians to share with adults in their community. It progresses through the use of an online Community of Practice, additional professional learning, and gradually reduced support, as librarians are first encouraged to develop components of ISL programs for adults, and then in subsequent instantiations, their own full ISL programs for adults. This project ultimately will involve around 180 libraries and librarians and science partners. This project is still in progress.

Three things that worked and why:

- Librarians are eager – Librarians are inquisitive and eager to find opportunities to expand their reach (in terms of expertise, abilities, and patron base) and programming, especially if it comes with resources.

- Media produced is engaging – designed to introduce science in the context of human and relatable experiences ("real people using and talking about real science")
- Audience is engaged – Folks in rural areas are curious and keen to engage with their neighbors in a safe and friendly environment: the library. Libraries in rural communities are already a social and generally "objective" hub.

Three things that didn't work and why:

- Librarians are generally under-resourced in terms of time and money (so always concerns about sustaining the energy post-funding)
- Participation in the communities, while generally good (and in some places great) could always be greater.

Links to our work:

- pushingthelimits.org (unfortunately, I can't open up access to the site as we need it password protected at present to complete our project. I will see if in time for the meeting I can arrange for some subset of materials to put elsewhere.)

My relevant background experiences:

- Broad science interests (current Associate Dean for Sciences at Dartmouth College)
- Have co-produced/written 4 documentaries related to mathematics and computing
- Experience bringing science and math to public

Dennis Schatz

A Couple Rural Initiatives of Pacific Science Center

Summary of rural work:

Washington State LASER (Leadership and Assistance for Science Education Reform) is a statewide initiative, with 10 regional LASER Alliances across the state that provide professional development to K-8 teachers/administrators and support delivering classroom-based curriculum materials to teachers' classrooms. While this focuses on supporting the formal science-learning environment, there is much to learn regarding the challenges and opportunities for serving rural communities – either inside or outside the formal classroom.

Science on Wheels (SOW) consists of eight 13-passenger vans loaded with tabletop exhibits, demonstration equipment for large audiences, and inquiry-based small group experiences. The vans travel across the state, primarily to rural locations, to provide science center-like experiences at schools, county and other local fairs, science festivals and family nights at schools.

Three things that worked and why:

- **It has been critical to partner with local people and organizations.** These individuals know the needs of their communities and constituencies, and either tailor the programs – or ask us to tailor the programs – to local needs.
- We developed a **Shared Vision and Distributed Leadership** as a key principle of the Washington State LASER effort. Similar to item 1, this allows for focusing on the mission and

goals of the effort, but empowering local leaders to determine the best way to implement the effort in the most effective way for their constituencies.
- Pacific Science Center has **statewide recognition** as a leader in science learning and represents a "neutral" resource and advocate across the state for science learning. It is not seen as political in nature, such as our state office of education, or as inappropriately imposing on "others' territories."

Three things that didn't work and why:

- **Funding (so what's new).** Until 2008, both programs had significant funding from the state legislature. With the Great Recession, funding was reduced by more than 90%. For SOW, we had to abruptly move to a much higher fee-for-service model, which was a difficult adjustment for external organizations after so many years of partial underwriting. This was especially hard on rural organizations, because they typically have less discretionary funds and had to pay for travel costs of the program from Seattle to their sites. For Washington State LASER, we had to cut back resources to the Alliances and provide few programs, typically funded by private foundations. With fewer financial resources for the Alliances, this added challenges to maintaining the Shared Vision, and Distributed Leadership.
- **Lack of Priority by Leadership** – Both programs originally had strong support from the leadership at Pacific Science Center and from the State Superintendent of Public Instruction (name of our state education director). In 2008, Terry Bergeson, the State Superintendent from 1996 to 2008, lost her bid for reelection. The new Superintendent was less supportive our activities, so it was hard to encourage increased support once the state budget recovered from the recession. More recently, our relatively new CEO at Pacific Science Center has decided that the highest priority is to fund activities that happen at our building in Seattle. Consequently, he gave up the co-leadership of Washington State LASER, and lowered the priority (but did not eliminate) our efforts at statewide program outreach.
- **The shift from Science to STEM.** For more than 50 years the Science Center has been associated with science, and Washington State LASER in now in its 18th year. STEM was not a known term when both of these efforts started. Even as both efforts shifted to include STEM learning, our history presented barriers for people to understand our efforts were also shifting to include STEM.

What's needed:

- We need leadership that considers services to rural communities a high priority.
- We need to deepen our relationship with other organizations across the state, so we develop better collaborative programs and funding efforts for programs.

Links to our work:

- Washington State LASER - wastatelaser.org
- Science on Wheels - pacificsciencecenter.org/science-on-wheels/local-community-events

My relevant background experiences:

- Professional Development for in-school and out-of-school educators
- Connecting in-school and out-of-school STEM learning experiences
- Science communication training for science-based professionals (scientists, engineers, etc.)

Rhonda Struminger

El Centro de Investigaciones Científicas de las Huastecas "Aguazarca" (CICHAZ)

Summary of rural work:

I co-direct the CICHAZ field station in rural Mexico and run outreach programs to bring informal STEM learning experiences to the general public. These programs vary annually, but all connect enthusiastic scientists to the community, generating interest in research at the field station and in science more generally. In collaboration with a local non-profit, we are now bringing summer camp programming to more rural communities and in the next year plan to start a new NSF-funded project, a mobile learning laboratory, that will enable year-round programs.

In 2017 I became part of an NSF-funded project to document informal STEM outreach programming based at some 400 U.S. field stations (establishments that call themselves such and support scientists conducting research in or near its premises) – an estimated 26% of which are located in a rural setting. We have surveyed rural field station personnel online to capture key aspects of their outreach programs. Most rural programming targets adults (69%), followed by university students (55%), youth under 14 (53%) and professionals (52%) – high school students and families were less of a focus at 49%. Lectures (46%) and field trips (45%) are most popular. Only 24% of programs focus on data collection and sharing by the community (e.g., citizen science activities or BioBlitz events). The majority (85%) of field stations target under-represented groups: of these, 36% pursue members of the rural/low income community, 34% target Hispanic or Latinx, and 22% target African Americans. Next steps include evaluating the demographics of the communities near field stations as well as evaluating urban versus rural programming in detail to identify if there are any key differences and similarities. In addition, we will be exploring which approaches to participant engagement and strands of science are incorporated into different program types, and how the programs are evaluated for success.

Three things that worked and why:

- Partnering with a local NGO has helped CICHAZ engage with community leaders who have expertise directly related to community engagement and local STEM topics. In the U.S., rural field stations have partnered with groups such as Upward Bound, university college-prep programs, and local schools; it is not yet clear how successful this has been for these stations.
- At CICHAZ, we hosted an NSF-funded conference to bring the local community together with scientists who are strong communicators and who are interested in the community. The discussions focused on topics and activities of interest to the community and this helped us get buy-in for future programs.
- At the annual Organization of Biological Field Stations conference, we have brought together field station personnel to discuss informal STEM learning. This effort has created a community of enthusiastic and informed field stations that want to work together to improve outreach and access.

Three things that didn't work and why:

- Scientists who are not good at communicating with the general public or those outside their area of expertise can undermine a program's success. The same program (e.g., open houses) can have different success levels depending on the scientists and field station personnel involved with the implementation.
- We do not have a good way to gauge how much of an impact the CICHAZ outreach program has on participants. About 40% of participants return each year which is indicative of interest, and in 2018 we did video interviews of participants which was helpful but we do not know if or how their behavior was impacted in any way. In general, assessment remains a challenge.
- Similarly, with the survey work, we will have a good picture of what field stations provide but do not yet know how participants are impacted in terms of knowledge gained, behavior modification, or interest. We would need to do longitudinal research on program implementations and participants' responses.

What's needed:

- Insight into what drives field station leadership to prioritize outreach.
- How to better train and motivate scientists to do effective outreach and help them achieve research/outreach balance (there are potential synergies especially with citizen science programs but scientists often are not motivated or incentivized professionally to work with or interact with non-scientists).
- Better understanding of how to recruit and engage rural populations in field station activities, and if this is different from urban populations.
- Best practices for assessing the impact of programs.

Links to my work:

- cichaz.org
- fieldstationoutreach.info/
- **R. Struminger,** J. Zarestky, R. A. Short, and A. M. Lawing. in press. "A Framework for STEM Educational Outreach at Field Stations." *BioScience*.

Other relevant background experiences:

- Researching how exposure to science and scientists may impact attitudes towards scientific findings and scientific literacy.
- Masters in Technology in Education –integrating pedagogy into K-12 settings as well as developing a collaborative learning lab between two universities (CICESE in Mexico and M.I.T. in the U.S.).
- Developing a web-based geography and social studies curriculum for K-12 students.
- Managing and developing online companion pieces for textbooks and coordinating state standard alignments for a major textbook publisher.

Mara Casey Tieken

Research on Educational Equity in Rural Communities

Summary of rural work:

My research focuses on racial and educational equity in rural schools and communities. My book *Why rural schools matter* (University of North Carolina Press, 2014), an ethnographic study of two rural southern communities, examines how rural schools define and sustain their surrounding communities. I am currently working on a multi-year project, supported by a grant from the Spencer Foundation, that explores the college aspirations, transitions, and persistence of rural, first-generation students. I am starting a second research project on the racial, political, and community impacts of school closures in African American communities in the rural Arkansas Delta. I also study community organizing for education reform and work with the Center for Youth & Community Leadership in Education, where I support organizing efforts in rural New England. I began my career in education as a third grade teacher in rural Tennessee.

Three things that are working and why:

- Greater support for rural college access: Many rural communities are recognizing that their future depends the skills and leadership that come with higher education, and they're trying new approaches to support rural college-going, like bridge programs, dual enrollment, or flexible programs for older students or those with families.
- High school graduation rates: Rural high school graduation rates are, on the whole, higher than the national average, and many people credit the personal attention that rural schools can provide. However, we still see gaps between racial groups and between poor and wealthier students, and there are some schools with absolutely abysmal graduate rates—so there's still lots of work to do here!
- Close school/community relationship in many rural communities: Rural schools can support rural communities in all sorts of ways (in addition to educating a community's youth): supporting rural economies, serving as community centers, sustaining rural cultures, and building political power. Despite a rise in state and federal accountability policies and a narrowing of what "education" means (i.e., test scores), many rural schools continue to be responsive to their communities and nurture and sustain them. This can take many forms, from involving youth and parents in school decision-making to opening a medical clinic in the school to providing adult English tutoring at night.

Three things that aren't working and why:

- Ignoring changing rural demographics and growing rural inequality: Media, researchers, and policymakers often talk and operate as if rural America is entirely white; this marginalizes rural communities of color and also makes invisible rural racial inequality. We see this racial inequality in rural schools, too, across a variety of indicators: racial gaps in college access, racial segregation in schools, lacking supports for rural ELL students, etc. We need to address this racial inequality in our schools and communities, particularly as rural America grows less and less white.
- Rural school closures: In the past decade, 35 states considered or adopted legislation leading to school closure. Closures hit rural communities particularly hard; closing rural schools

appears to undermine rural sustainability. These closures disproportionately impact poor communities and communities of color, further undermining their growth and wellbeing.
- The stay-or-go approach to rural college going: Sometimes we present rural youth with a choice: leave your community for college and spend an adult life away from your rural community OR stay in your community but forgo the degree and its benefits. We need to make sure our students have other options (e.g., get a degree and then return to your community to use it there, return to your community later in life, pursue college while staying in your rural community or another)—and that they know about them.

What's needed:

- Disrupting the "rural America as white America" myth and addressing rural racial inequality through responsive education policy and strong school/community relationships (along with other methods, policies, and tools)
- Recognizing that rural communities need immigration and growth in rural communities of color to offset population decline in rural white communities
- Abandoning the stay-or-go approach to rural college going and finding ways to support rural youth to get a degree and then put that degree to use in rural communities
- Involving rural families in the college process
- Developing education policy in coordination with other policies—economic, health, immigration, development—to support rural community vitality and sustainability
- School funding equity

Links to my work:

- Why rural schools matter: uncpress.org/book/9781469618487/why-rural-schools-matter
- Interview: ruralmatters.libsyn.com/why-rural-schools-mattermara-casey-tieken
- "There's a big part of rural America that everyone's ignoring": washingtonpost.com/opinions/theres-a-big-part-of-rural-america…
- "Close a school, hurt rural community": dailyyonder.com/close-rural-school-hurt-rural-community/2017/08/14/20474/
- "College talk and the rural economy: Shaping the educational aspirations of rural, first-generation students" in the Peabody Journal of Education: tandfonline.com/doi/abs…

Other areas of research and interest:

- Community organizing for education reform
- Spatial inequality
- Race and racial inequality in rural places, rural changing demographics
- College access and experiences
- Place-based education

Dr. Shelly Valdez

Native Pathways & Yakanal: Indigenous Youth Cultural Exchange

Summary of rural work:

Sowing Synergy project- project evaluator; documenting the story of the SUNY-ESF, Sowing Synergy graduate program. Following the academic pathway of NA students as they develop their MS research thesis, which focus on service to their perspective tribal communities. The thrust of the program is centered on creating a graduate program that is designed to incorporate traditional ecological knowledge (TEK), with tools of western science, into environmental science programs within higher education environments.

Native Pathways-Native Science Fellows program-project evaluator; documenting the story of the Fellows as they move through their undergraduate and graduate programs. The project supports Native American and Latino undergraduate students' diverse pathways to geosciences careers. The program works with students who are enrolled in tribal colleges and western academic institutions, focusing on providing support systems, such as mentors and creating research opportunities with non-profit organizations and tribal programs that will allow students to conduct research that is influenced with community-based research environments. Additionally, to some degree influence the student research to incorporate TEK and worldviews of understand science.

Haaku Community Academy (HCA) – Curriculum team member; working with 3 team members to create a framework (more so, a process) to collectively bring together Acoma's culture & language, umbrellaed with STEAM from a community-based lens, and incorporating the more 'western academic content' areas that amplify a holistic process of student centered curricula. Community-based learning, within a school campus that bridges learning within and among the community.

Yakanal: Indigenous Youth Cultural Exchange – Co-coordinator. The mission of Yakanal is to strengthen cultural identity and leadership capacity in indigenous youth, preparing them to engage with other cultures while preserving their own. The Cultural Exchange Program provides immersive experiences to re-engage indigenous youth and elders within their homelands through traditional knowledge and ceremonial practice, and to re-connect the Pueblo and Mesoamerican indigenous cultures that have been historically linked through trade routes and migration stories. ***Learning from the land-Science of Place***.

Past collaborations: Native Universe, Cosmic Serpent, Roots of Wisdom, Ways of Knowing

Three Things That Work & Why:

- Relationship Building drives the work. Creating a deep sense of relationship will drive the work. This means that prior to the project, partners should spend time to learn about one another, and the communities you will bring into the environment (including the partner's community). From an indigenous perspective, relationship is essential for building trust and relationship is continuous (is not aligned to funding cycles- rather its life-long).
- Working & partnering alongside allies is key. Unfortunately, there is still a notion that Science is understood best when a person has a TITLE at the back of their name of they come from a European background.

- Creating opportunities for shared leadership- walking alongside one another, as opposed to one person leading the charge. This amplifies the balance in knowledge.

Three Things That Don't work and why:

- Funding cycles – this type of work does not necessarily lend themselves to funder's funding cycles for two reasons: (a) Creating relationships takes time, and because it should be intentional, there are times when face-to-face is more important than other communication systems. Travel can be impacted. (b) For the area of evaluation – the processes are emergent and are also amplified with creating relationships and participatory environments. Funders/program leads sometimes don't consider this type of process when funding is available.
- Evaluation using standard western constructs- There is a historical fear of evaluation and research among indigenous communities, that are notions of the historical traumas that follow indigenous communities; lessons of the past are still very real within indigenous communities. We must begin taking looking at how we internalize our own understanding of evaluation practices and open our minds-eye to worldviews of evaluation practices. You also need evaluators that are willing to immerse themselves in these emergent environments and are open to worldviews.
- Western Academia- these are foreign systems that have perpetuated failed goals of successfully graduating Native community members through educational institutions. They are based on a colonizers sense of what constitutes 'education' without including those individual communities that these educational systems target. We need to begin decolonizing these western systems and allow Native communities to build their own landscapes of what education means for them. We also need to get funders to realize this in a more deeper sense, through partnering with indigenous people and allies who see the potential of community-based practices, that in so many ways incorporate the informal learning spaces, that are also tied to indigenous worldviews of education.

What's needed:

- More indigenous people involved in NSF systems.
- Indigenous evaluators.
- More training and orientation for funders around authentic collaboration with indigenous communities, evaluation/assessments and community-based education that is driven from Native worldviews.
- Rethinking funding streams
- NSF partners and other funding agencies need to reach out to Native communities that is reflective of indigenous community's core values (come to visit these communities and share these various funding streams, show them in a common space as opposed to sending out narrative transcripts).
- Pull together like-minded projects that validate this type of work; share with communities that are interested; and,
- Create support systems for authentic collaborations.
- Funding K-P21systems that are aligned to indigenous epistemologies.
- Creating a movement that is surrounded with indigenous partners and allies to come together for shared knowledge (inclusive of a yearly conference).

Links to our work:

- nativepathways-edu.net/
- yakanal.org
- Facebook pages: Yakanal Indigenous Youth Cultural Exchange, Mayan-Pueblo Youth Cultural Exchange.

My relevant background experiences:

- Indigenous Ways of Knowing through the lens of Science
- Indigenous Evaluation processes
- Collaborative Partnerships
- Storyteller
- Facilitation

Julie Vastine

Shale Gas Stream Monitoring

Summary of rural work:

In 2010, when Pennsylvania was transitioning into a period of most intense hydraulic fracturing of shale gas, Dickinson College's Alliance for Aquatic Resource Monitoring (ALLARM) developed a pollution reporting stream monitoring protocol. Founded in 1986, ALLARM's aquatic citizen science mission, is focused on leveraging the power of science and the power of communities to assess stream health and use data for local change. When hydraulic fracturing (fracking) took off in Pennsylvania, ALLARM was repeatedly asked by community partners and individuals if there was a role stream monitoring could play in detecting potential forms of pollution. In response to community demand, ALLARM developed a red flag pollution reporting protocol based on chemical and visual monitoring techniques. Since 2010, ALLARM has trained over 2,500 people at 80 workshops, which resulted in 300 sites where volunteers collected data.

In the early fracking days in Pennsylvania, it was common for rural communities to approached for leasing their land. As a result, when ALLARM developed its program there were a few considerations we had to take into account when working with affected communities, 1) the level of community collective trauma (in some locations); 2) working with diverse audiences that we had before (e.g. farmers, church patrons); and 3) minimizing the economic cost of program participation in communities that were already taxed emotionally and financially.

Three things that worked and why:

- Offsetting the equipment & lab analysis cost: repeatedly we heard from participants how much they appreciated not having to pay for equipment and lab analysis. As it was, the time commitment was a significant investment.
- Conducting workshops where the interested community is located: To help minimize the burden of participation in workshops, we always travel to the community demand.

- Great educational experience: While not everyone who attended workshops went on to monitoring, we were able to provide an objective scientific background on shale gas, another story line to be considered in with the mixed messages.
- Robust quality control program: For those participants who went on to monitor, being able to participate in our external verification check (quality control) we were able to certify that monitors were using their equipment correctly and collecting credible data.

Three things that didn't work and why:

- Challenge of long distance relationships: ALLARM is located 3-6 hours away from community partners. We are still challenged by maintaining the right level of contact and support. Individual phone calls are preferred by volunteers but time consuming. Not all volunteers are interested in electronic communication avenues. ALLARM does 2 in person visits to a community/year. 6 conference calls/year. Monthly newsletter.
- Delayed development of a central database: If I could do it all over again, I would have had a database in place before we started to train people to monitor. We have one now and it is amazing but wish we had it from the beginning.
- Intrinsic versus extrinsic motivation & volunteer burn out: In relationship to ALLARM's other volunteer monitors, we found that our shale gas volunteers burnt out at faster rates (after1-3 years versus 3-8 years).

What's needed:

- Balance of community contact with ALLARM support. Avenues to minimize travel time (not realistic but we would see our partners more frequently if travel wasn't a factor).

Links to our work:

- Project website: allarmwater.org

My relevant background experiences:

- I have worked in the field of aquatic citizen science/volunteer monitoring for 16 years
- I represent the national field of volunteer monitoring on the National Water Quality Monitoring Council
- I was recently elected to the board of the Citizen Science Association

Appendix

Topics Participants Hope to Discuss

Definitions: Rural and STEM

- How do different informal learning strategies correspond with different conceptions or definitions of rural?
- How do we define "rural" so that we all have a common language to compare our various interventions? Clearly defining key terms we use in our specific programs will help all participants have a common framework to have meaningful conversations.

Diversity and Equity

- How do research agencies help to create a discourse on decolonizing mainstream education for indigenous communities/rural communities? How does this impact funding?
- How place intersects with gender, SES, and race to shape STEM access and participation
- I would like to learn more about work in rural areas with diverse populations. If I could do some work in rural Arizona, for example, it would most likely have Latina/o and Native American participants.
- Impact of growing minority populations in rural areas on rural & STEM education.
- The needs and experiences of rural Students of Color
- How do rural populations differ from urban populations so that we can better customize messages or resources?
- How to bring expertise and opportunities from outside without the pushback of "you're from away."

Community Building

- I'd like to learn how others have overcome barriers as they created STEM ecosystems---or perhaps more modestly, "STEM villages" in rural areas.
- How to increase the public's understanding and awareness of STEM topics so that they can better apply that knowledge in their everyday life.
- I'd like to learn about a variety of incentives to help rural educators become and stay involved. Certainly, stipends are one, but money is limited. How do we get and keep good people to do this important work of preparing our kids? How do we make it easy or even attractive for people to attend professional development, to travel long distances, to step forward, to implement with fidelity, and to add to their already busy lives?
- How do you attract and retain teachers to run STEM programs.
- I am always interested in strategies for recruitment. What characteristics are likely to make participants to want to come and engage in informal mathematics (in a sustained way)?
- How might we create coherence in our many informal and formal STEM education endeavors in rural communities?
- Processes (not just platforms) to 'spread the word'
- I would like us to be brave and discuss the difficult challenges of impacting rural communities, confronting the enormous scale issues, access issues, and how we can more effectively "work with communities and not for communities."

Research Outcomes and Measuring Impact

- Assessing & evaluating programs
- How we can better measure impact of ELO STEM programming in rural settings
- Good indicators of impact – how to assess the impact of informal STEM learning engagement on participants.
- What are great metrics that capture the overall impact of a STEM program in rural areas?
- What are reasonable indicators for impact when working with small rural areas? –We can't reach thousands of youth, because of population size. What are substitute measures?
- What are effective ways to demonstrate the value of rural programs, given the lower numbers and higher costs?
- How to think about return in investment (ROI) when everything has smaller numbers (PD, youth).
- What are the most pressing needs for researchers to tackle in rural STEM OST work?
- What pressing research needs are there in the field that we could possible help to address?

Formal and Informal STEM

- Are the goals of informal STEM learning different from formal STEM learning and if so, how and why?
- How might we leverage informal STEM to help formal STEM education goals in rural communities?
- How should informal, extracurricular learning merge with learning that is more formal?
- How to bring formal and informal STEM learning together with each other and the core community concerns of economic survival and career options: who is funding this, and what are good models?
- I am intrigued by potential connections between work in informal STEM in rural contexts and my own work even though it is not in a rural setting. I think that some of the dilemmas of navigating the formal – informal are going to be similar.
- How to get rural schools more involved with STEM education
- Place-based approaches to teacher professional development
- What are other barriers to effectively working with rural students and their teachers?
- What is the role of teachers / schools in this work?
- Approaches to developing rich conversations that stimulate the free flow and curiosity of the teen mind on STEM issues without formal structures (e.g. small group discussions with provided questions)

Workforce Connections

- Development of a STEM workforce in rural areas: How is it different? How are solid pathways into the community STEM workforce in rural areas established?
- How to connect rural students to the growing green job industry?
- Partnership development with atypical groupings – auto mechanics, hair salons, chiropractors, landscapers, welders, fitness centers, town/county engineers, water reclamation, etc.
- How to get local industries more involved with rural school districts

Scaling Up: Effective Practices

- Develop best practices and suggested standards for working with rural communities
- Proven methodologies to make rural students "STEM Ready."
- Great lessons learned and methods for successful programs in rural areas.
- I want to learn from others what is working and what is not working and why. I hope that we can share promising practices that one day could grow into real models that can be adopted and/or modified by other development and research teams.
- How might we better help rural communities learn from each other?
- How might we enable a system of informal STEM R&D for rural communities with pathways for dissemination to other rural communities?

Scaling Up: Funding and Sustainability

- Funding (non-traditional funding cycles)
- How do you identify grants and sponsors for rural programs?
- Sustainable funding for projects
- How do funders continue to support partnerships that are based on authentic relationships and are driven to continue the work (the funding doesn't align with the values of the partnerships).
- Board/Council best practices for sustainability
- How can programming be sustained once funding is ended?
- Is there a life cycle to an effort, or succinctly, is sustainability possible? It seems that when a champion moves on or a new shiny object appears, that the old is discarded. Is this just the way it is?