

# The Rural Informal STEM Conference

Alexandria, VA  
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## Executive Summary

The Rural Informal STEM Conference (RISC), sponsored by the National Science Foundation (NSF) and held at its headquarters on September 13–14, 2018, was the first of its kind to bring together key innovators and experts in rural STEM learning outside of school. People who live in rural settings are a frequently overlooked and significantly under-represented STEM audience, who number roughly [60 million Americans](#).

The conference addressed questions about the overall status of informal (out of school) STEM learning in rural places, including the following: How do we define rural places? What are promising practices in diversity, equity, and inclusion in these places? How can STEM programs build community support for their work? How can such programs assess their impacts appropriately?

Key findings, as interpreted by the conference leaders, included:

- 1) There are myriad definitions of rural places, even within a single state or federal agency. This reflects a vast diversity of characteristics; rural places are not all the same. Rural residents are likewise very diverse, and self-identify in a variety of ways in relation to the term “rural”; for some people the term carries negative connotations as an imposed construct.
- 2) Promising practices in equity and inclusion include: expecting that people in rural places will self-identify in multiple ways so that a “community” may not be as simple as a geographical town or municipality; seeing STEM knowledge and learning opportunities in everyday activities and occupations within communities; avoiding a “savior mentality” by listening to what communities want and are already doing; and ceding a significant degree of control to communities as programs unfurl. Also, it is important to know how a community may view people “from away,” and to recognize that a STEM-based career may involve a wrenching move away from a rural home community.
- 3) Building community support is likely to be a multi-year process of trust-building and co-design. STEM programs are likely to gain more community support if they involve not just youth but families, community members, schools, and industry in STEM programs. Helping communities and local businesses to see the STEM already in their work can make STEM career opportunities and pathways be seen as attractive and achievable.
- 4) Assessing impacts is an ongoing challenge, especially given that numbers of people reached can never be competitive with urban areas, no matter how effective a program is. Qualitative methods and storytelling hold particular promise for assessing impacts in rural places.



# The Conference

## Conference background and goals

For this report, we take the phrase “informal STEM education (ISE)” to mean “lifelong learning in science, technology, engineering, and math (STEM) that takes place across a multitude of designed settings and experiences *outside* of the formal classroom” (Center for Advancement of Informal Science Education [CAISE], 2017).

The 2018 Rural Informal STEM Conference (RISC) was a two-day event funded by the National Science Foundation (NSF). The conference was the first of its kind to bring together key innovators and experts in rural STEM education outside formal school. Organized by the Maine Mathematics and Science Alliance (MMSA), the conference aimed to address the main question, **“What can we learn from recent work in rural informal STEM education that will help us to create more, as well as more effective, scalable pathways for the future?”**

The conference brought together experts working in rural out-of-school-time STEM programs, adult and community education, family outreach, citizen science, out of school/afterschool, and educational programs offered by field stations, universities, research institutes, and science centers. In addition, a small group of interested researchers, funders, and policy-makers contributed their perspectives. The AISL (Advancing Informal Science Learning) program at NSF has funded a number of projects in these areas over the past decade, and for project leaders, this was a rare opportunity to discuss their work, share lessons learned, and propose some next steps to advance STEM learning in rural settings.

More specifically, the goals of the conference were to address the following:

- Characteristics of rural learners, stakeholders, and networks  
What is uniquely important about STEM learning in rural settings? What assets and needs are important to know about?
- The identities and roles of informal STEM educators in rural areas (family members, community STEM experts, librarians, 4-H leaders, etc.)  
Who are the people who facilitate STEM learning in a rural community? How can we identify and encourage them, as well as others who previously have not been involved, to take a more active role?
- Successes and failures of experimental programs  
What are some of the essential “secret sauces” of successful programs that use a particular kind of ISE medium or deliverable to engage learners in STEM (e.g., afterschool programs, broadcast media, citizen science, STEM festivals, etc.)? What approaches are less successful?
- Connecting and cross-pollinating  
How can STEM partners work together in rural communities? How can isolation and competition be reduced in the service of a larger common goal? How can the key members of a rural STEM ecosystem become motivated to work together more effectively?

- Anchor institutions: schools, field stations, libraries, and more  
In rural communities that lack science centers or other dedicated informal STEM institutions, which institutions can support informal STEM education? Where are the synergies and tensions in their missions and expectations? How can informal educators collaborate with schools, while retaining their essential commitments to social, low-stakes, interest-driven learning?
- Next steps to broaden involvement  
What are appropriate next steps to support equity of opportunities for rural populations in STEM education? How can isolated efforts be coordinated to foster more frequent cross-pollination? What are some next steps toward a more equitable STEM ecosystem that includes informal learning resources?

## Who participated

The conference included two types of participants: panelists and observers, each of whom was personally invited by conference organizers with input from the project's cognizant Program Officer. The list of participants, along with photos and short bios, may be found at <https://www.mmsa.org/projects/RuralConference2018>.



*Panelists*, including rural informal STEM project leaders, researchers in rural STEM education, and practitioners, spoke on panels as well as in all discussions. These experts shared their extensive experience working in rural settings, and were the core participants throughout the conference. Most attended in person, while a few were unable to travel and attended via videoconference.

*Observers* included stakeholders interested in learning more about rural STEM education, including staff from various federal departments and agencies, the National Research Council, and the American Association for the Advancement of Science. While they did not have an official speaking role, observers were encouraged to ask questions, engage in discussions, and share their expertise. In addition to the eight observers who attended the entire conference, many others joined parts of the meeting, including a large number of NSF program officers.

While conference organizers attempted to assemble a wide array of diverse voices, this could only be accomplished to a limited degree in such a small gathering, and therefore this report cannot be considered comprehensive or even representative of all possible perspectives, viewpoints, or regions. For example, one of our goals was to engage experts at the intersection of rural STEM economic development and education, but despite considerable effort we were unable to identify someone active in this area.



## Dates, places, and structure

Prior to the conference, all panelists were asked to reflect on their own experience and insights and to share these in a two-page format. Specifically, each provided a brief summary of a current educational project or research study that related to the conference topic and described what they considered successful versus unsuccessful approaches to the work. They also shared topics of ongoing interest that informed the conference agenda. These reflections can be read in full on the [conference website](#).

The conference was held September 13-14, 2018, at the NSF headquarters in Alexandria, VA. Seventeen panelists attended in person, and an additional six joined the conference virtually via videoconferencing. Each day included panels and design tasks.

*Panels* lasted one hour and began with several three-minute micro-presentations by selected panelists to seed the discussions. The four panel topics were: What do we mean by “rural” places; Diversity and equity in rural informal STEM education; Community building; and Research outcomes and measuring impact.

*Design challenges* allowed small groups of participants to apply their expertise to hypothetical yet plausible situations, thereby surfacing more of their tacit knowledge. Participants engaged in two design challenges: Designing a new rural informal STEM program; and Scaling up or Working with schools.

In addition, participants were welcomed by senior NSF staff: Dr. Sylvia James, Dr. Evan Heit, and Dr. Paul (Wyn) Jennings. Attendees were also invited to a working dinner with Dr. Jeff Weld from the White House’s Office of Science and Technology Policy. Prior to the conference conclusion participants discussed the components of the final report and listened to final words of encouragement from Dr. Jennings.

The conference structure was quite informal, based on principles drawn from Allen et al. (2018), including:

- Have individual participants give a three-minute presentation, preferably without PowerPoint slides, on some related aspect of their own work so that everyone can glimpse the assets they bring to the project. Follow this up with a large chunk of open discussion so participants can really talk together.
- Split participants into groups and ask them to undertake a few authentic design tasks that the team is actually struggling with.
- Never ask one person from each small group to present all their discussed points. Instead, keep the reporting time quite short and ask the whole group: “Who would like to share one interesting thing you heard or thought of during your discussions?”
- Build in plenty of time for informal discussions.



## Report writing process

The principal audience for this report is the peers of those who attended: researchers, informal STEM educators, and program developers who work in rural settings. However, we hope it will also be of interest to policy-makers, funders, and educators more broadly defined. The report avoids academic jargon in an attempt to be easily readable and useful to all such groups.

The report was compiled using materials provided by participants and organizers as well as notes from three experienced documenters over the course of the conference: Corrine Kaczmarek, Sam Theriault, and Asia Williams. Kate Kastelein of MMSA was responsible for synthesis of the documentation and writing of the report, with assistance from conference leaders Dr. Sue Allen and Dr. Tom Keller. An earlier preliminary report was written by conference leader Dr. Jan Mokros. The recommendations and questions in each section were written by the conference leaders and should not be taken to represent the views of the conference participants more generally or NSF specifically.

All panelists agreed to share their written and verbal contributions in the final report. In the case of the short presentations, we have named the individual speakers, but for the quotes and descriptions of the discussions we chose to leave these unnamed for readability and also to allow the participants extra freedom to speak their minds. In some instances, direct quotes from attendees have been lightly edited to aid comprehension or to compensate for the lack of surrounding context. There is a list of attendees and biographical information available on the [conference website](#).

## Map of participants' work places

During the conference, participants were asked to locate their work on a map of the U.S. to give a sense of the overall geographical spread of the projects represented. The final map is duplicated below.



## Issues and Discussions

Below are highlights of the discussions on four major topics, drawn from conversations throughout the conference (during micro-presentations, panels, design challenges, and informal conversations between sessions).

### Issue 1: What do we mean by “rural” places?

**Panelists: Dr. Alex Marré, Dr. Mara Casey Tieken**

**Facilitated by Dr. Tom Keller**

#### **Dr. Alex Marré**

Dr. Marré, a research economist, started off by clarifying that he was presenting his own views and not those of the United States Department of Agriculture (USDA). He then kicked off the panel by pointing out both the challenges and necessities of defining “rural” places. Dr. Marré said that, while each rural area is unique, defining an area as rural is often of great importance when securing federal funding. He presented two examples of definitions he uses regularly, the first more often in research and the second more often in federal policy:

First, he described how the Office of Management and Budget (OMB) uses a county-based system, focusing on shared economic or social characteristics. Basically:

- Metropolitan areas (urban) are broad labor-markets that include:
  - Counties with one or more urbanized areas; urbanized areas are densely-settled urban entities with 50,000 or more people; and
  - Outlying counties that are *economically tied* to a central urbanized county as measured by labor-force commuting.

Outlying counties are included if 25% or more of workers living in the county commute to the central counties, or if 25% or more of the employment in the county consists of workers coming out from the central counties.



- Nonmetropolitan (rural) areas are counties outside the boundaries of metropolitan areas and are further subdivided into two types:
  - Micropolitan areas, which are nonmetropolitan labor-market areas centered on urban clusters of 10,000-49,999 persons and defined with the same criteria used to define metro areas; and



- All remaining counties, often labeled "non-core" counties because they are not part of "core-based" metropolitan or micropolitan areas.

Dr. Marré explained that one weakness of this method is that an entire county is the basis of the model. One end of a county could have a large city, while the other end could be quite remote, and the county would be considered urban. However, this model is popular with researchers because they can easily tie in economic data and national trends.

Second, Dr. Marré presented a definition from the U.S. Census Bureau:

- Urbanized areas, urban clusters, and rural areas:
  - Urbanized areas are those where there is an urban nucleus of 50,000 or more people; these must have a core with a population density of 1,000 persons per square mile and may include adjoining territory with at least 500 persons per square mile.
  - Urban clusters have at least 2,500 but less than 50,000 persons.
  - Rural areas include open country and settlements with fewer than 2,500 persons; or areas with a population density of less than 500 persons per square mile.

Dr. Marré said that a problem with the Census data is that although it is more precise than the county data described in the OMB model, it is still possible to have densely populated settlements in rural areas and rural settlements in areas defined as urban.

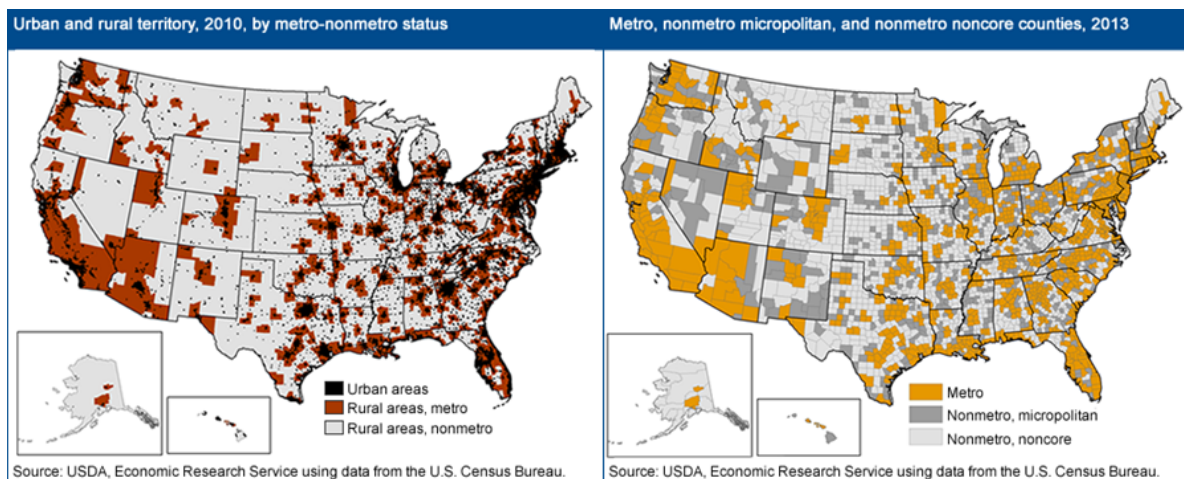


Figure 1: USDA Map

Figure 2: US Census Map

### Dr. Mara Casey Tieken

Dr. Tieken, a researcher who studies education in rural communities, gave a presentation focused on how rural residents understand the places where they live. For example, one person may identify “rural” as living on a farm, and someone else may associate it with a geographic location such as The Plains. She argued that residents’ own self-definition of rural may matter more than official designations, as people make sense of their lives outside such imposed definitions. Respecting these

identities and definitions as valid means that “rural” does not have an easily operationalized definition, which many would argue is the whole point.

Dr. Tieken acknowledged that this nuanced approach isn’t feasible for quantitative researchers or policy-makers who affect funding decisions. She said that another challenge of defining rural in this individualized way is that it opens the door for researchers or policy-makers to take a “know it when you see it” approach, which can lead to definitions based on their own ideas about rural people and places rather than characteristics defined by the people who live there. Dr. Tieken explained that an individual’s definitions can come with assumptions and bias—for instance, after the 2016 election many people are talking more about rural voters, but in some problematic ways. For example, some common assumptions are:

- Rural America is white America.
- Rural places are in economic decline.
- Rural is the opposite of urban.
- Rural people won Trump the election.
- Rural places are all the same.

Dr. Tieken pointed out that rural realities are a lot more complicated:

- People of color make up 20% of the rural population, and this proportion is growing.
- While some rural economies are struggling, others—like tourism, organic farming, and clean energy—are flourishing.
- Rural and urban places share many commonalities (and many places are classified as rural by some definitions, but urban by others).
- While rural areas, on the whole, lean red politically, there are also significant blue-leaning rural places (and, by many accounts, it was metro votes for Trump that won the election).
- Rural places, therefore, are NOT all the same.

Following the presentations, participants shared other definitional resources, including maps of rural versus urban libraries created by the Institute of Museum and Library Services; the Department of Agriculture’s Rural-Urban Continuum Codes; Health Resources and Services Administration guidelines; or the National Center for Educational Statistics classifications of schools. It was noted



that there are over 25 different federal definitions of rural, and the state of Texas alone has over 200, but that Dr. Marré had captured the two major ones, on which many others are based.

One participant said, “I live in a small town and it’s a weird small town, it’s rural by demographic standards, but it’s not rural by other standards.” Such

“weirdness” turned out to be fairly common. The standards by which rural is defined are not clear or consistent across agencies, organizations, or even residents. Also, rural communities often have communities within communities, much the same way that urban areas do, but rural populations are lumped under the category ‘rural’ and these embedded communities are often missed.

One attendee pointed out that rural communities in fact had many common concerns with urban areas that left them both on the losing end in terms of policy and resource allocation: fragmentation based on class and race, food deserts, gerrymandering, water quality, transportation constraints, and many others.

## Themes emerging from discussion

### Rural areas are often grouped together simply in opposition to urban areas:

- *In Nebraska, we call Lincoln or Omaha urban areas, and everywhere else is rural. It corresponds to our congressional districts. In terms of self-identification, our rural communities also identify as not Omaha or Lincoln.*
- *In Arizona, the cities have such a vast population, everyone considers the city as the same thing as the state. That’s pejorative, without consideration of the realities of what’s going on in the tribal communities or the rural communities.*

### Such definitions may carry negative connotations for both residents and nonresidents:

- *Rural communities are often defined in terms of what they don't have. People may push back on being defined as rural because they know those assumptions are attached, and they may not fit into the meaning they make for themselves. So, think about the historic legacy of what rural means and what it does and doesn't capture.*
- *Some of the areas we'd define as rural are next door to larger industries where they benefit from the industry and those resources, and they don't want that definition. There are some who are 100 miles away and take pride in their community, but still don't want that definition [of rural]. So, it's hard for them to trust you, if you're coming in, because they don't want to be called small, or rural, or country. We need to be careful and aware when we make those definitions.*
- *The Native indigenous communities I'm working with currently are pushing the paradigm and not wanting to use that (rural) definition that's in a lot of the literature, because those are not necessarily friendly terms that they want to be associated with. Instead, you'll see a lot of defining their place as it pertains to their understanding and connection to that place.*

### Frequently mentioned characteristics of some rural places:

- Low population density
- Limited transportation options
- More small businesses than large businesses
- Unequal distribution of resources
- Community members who wear many hats (one person may be parent, school board member, fire chief, and nonprofit organizer)
- Strong connection to place
- Mistrust of outsiders
- Few organized afterschool STEM opportunities
- Limited access to technology and technology infrastructure
- Long community memory

There was also lively discussion on what, if any, commonalities exist across the vast array of rural communities. Despite the lack of a common definition, some characteristics were frequently mentioned by participants over the course of the conference (see box on page 10).

### Conference leaders' recommendations

- Notice that there are *many* different definitions of “rural” even among state and federal agencies.
- Remember that people may self-identify in a variety of ways in relation to the term “rural,” including rejection of the term entirely as an imposed construct.
- Be aware that terms such as “rural,” “small-town,” “reservation,” and the like, may be loaded with connotations that can set the stage (positively or negatively) for relationships between communities and well-meaning people “from the city.”
- Avoid simply grouping rural communities together as areas that are not major cities.
- Ask yourself whether a broad definition is needed at all, and if it is (e.g., for equity in funding), try to use those that are most aligned with the goals of your particular program (e.g., economic, geographical, political, or historical).

### Questions to consider

If we accept that definitions are local and individual, are we doing rural residents a disservice because funders won't recognize their common needs and inequities?

How do we define “rural” in our own work? Do we use self-identification by residents or some form of regulatory definition – and what are the implications of these?

## Issue 2: Diversity and equity in rural informal STEM education

Panelists: Dr. Marta Civil, Dr. Shelly Valdez

Facilitated by Dr. Jan Mokros

### Dr. Marta Civil

Dr. Civil, an expert in community-based mathematics, began by explaining that she does not consider herself a rural educator as such, although she works with families of Mexican origin who often do come from rural backgrounds.



Dr. Civil's approach rejects deficit models of education, and instead uses a Funds of Knowledge framework which focuses on the capacities and knowledge that communities already have (Civil, 1994).

Dr. Civil explained that a key component to her approach is home visits. At home the youth are resourceful and creative problem solvers, but at school the children are cast in a passive role. She explained that often at school the

youth are seen by what they lack (e.g., they don't speak English), instead of by what they know (e.g., they are bi/multilingual).

Dr. Civil uses household ethnographic analysis in her research and works with teachers who go into the homes. During these visits, the researchers document active participation of children in their community and family. In visiting and learning from the families, teachers are surprised by how welcome they feel and how much they learn. Dr. Civil noted that often the problem is not "getting in" for home visits, but "getting out" again: they get invited back and invited to many events that follow. During this process, teachers develop a stronger rapport with students, which has affective and cognitive implications because it reflects the families' forms of knowledge. Dr. Civil shared a questionnaire, developed by the University of Arizona anthropology department, that is used for the home visits.



Dr. Civil posed the following dilemma: “How do we uncover the mathematics in contexts in which we have no experience? How do I know it is there? And what role do our beliefs and values of what counts as math play?” Math may only be visible in formal settings in schools. For example, a teacher may say, “Sewing is not math, it is just measuring.” To counter this view, Dr. Civil analyzed the activity of someone making a dress (see inset at right) and showed that the seamstress knows how to construct a quarter-circle even though she may not be able to define it in school terms. A Funds of Knowledge lens allows practitioners to learn about and from people's experiences in their homes and communities. Dr. Civil provided another example of a family they observed in which a mother and daughter were using a recipe to cook something. The daughter, who was in high school, tried to do the fractions using rote learning from school, but it was the mother, who had very little schooling, who was able to adjust the recipe proportions correctly. Dr. Civil said that the same is often true for gardening or construction: the family brings knowledge, and there is a lot to learn by listening to how people describe their work.

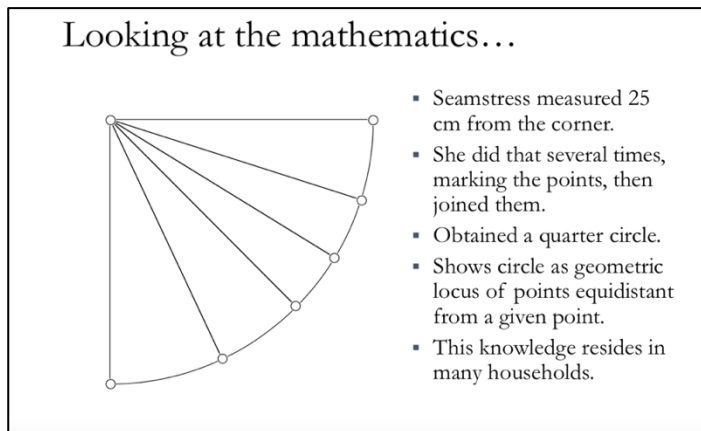


Figure 3: Slide from Dr. Civil's presentation

Dr. Civil closed by explaining that the Funds of Knowledge approach is not about replicating what students have learned at home, but about using their prior knowledge for new learning. The aim is to recognize and value the knowledge of those whose knowledge and experiences are often marginalized, and to use that knowledge as a scaffolding.

### **Dr. Shelly Valdez**

Dr. Valdez, a tribal member from Laguna Pueblo, New Mexico, said that she is a member of the Turkey Clan and a child of the Little Lizard Clan (clan memberships are important within many tribal communities), and would speak about the indigenous communities in which she lives and works.

She explained that she saw their whole culture as science-based, but to understand that, it is important to listen, be patient, observe, and learn to honor systems which have been marginalized through the traditional K-12 model. She said that often Native youth enter western institutions with incredible knowledge that lends itself to the more conventional science areas, but that western definitions of education minimize or overlook these knowledge systems and make it difficult for youth to move into an academic landscape.

Dr. Valadez demonstrated the ecology of indigenous knowledge, which is science based and heavy on observation, by explaining the process of drum making: Pueblo drum makers will usually harvest

their wood (for the base of the drum) from the foothills and mountains around their tribal community. The drum maker needs to understand the seasonal calendar in order to understand what's happening in the area where they will harvest the wood, targeting trees that have fallen naturally, and knowing when it is time to carve the section for the drum. The drum maker needs to know the physics of how to hollow out the drum, and what type of wood creates the best drum stick. In order to obtain and prepare the hide for the surface of the drum, the drum maker needs to understand the hunting season and the animal's habitat. The drum maker also needs to understand which part of the river is going to provide the best possible flow for chemically changing the hide. Dr. Valdez indicated that there is much more detail that goes into the drum making process, and that it is a beautiful process, honoring the animal and the tree that have given their lives so the drum maker can create the drum. The drum maker understands the science of all of this, and yet drum making is not given any attention in western chemistry, physics, or biology.

Dr. Valdez explained that in order to come full circle, so that all can heal, the story of place needs to be told. She urged the audience to think about ways to be inclusive of the indigenous community's knowledge systems, and how to support the learning of Native students, whose families do want their children to be part of the western educational system. She encouraged the group to think beyond the current deficit model that continues to marginalize indigenous worldviews, to engage Native people in more opportunities to discuss these areas, and to partner to make necessary changes to the current western educational institutional systems.

Lastly, Dr. Valdez explained that traditional short-term funding cycles and federal policy often do not align with how indigenous communities work, relying heavily on the land and on gradual relationship-building. She urged funders to begin to consider "time" in relation to indigenous worldviews, as they plan their funding cycles.

## Themes emerging from discussion

### Ideas of "saving" and "helping" are part of a deficit model of rural communities:

- *We got a grant from [a federal agency]. I found early on that the powers-that-be were trying to engage certain populations from the savior-based mentality, to save them and not work with them. I try to discuss assets. What can be built on? If you deal with populations that have a historical phobia, you have to make them realize they are already part of STEM.*
- *Yes, we need to be careful about savior mentality. What's important for our work is creating space for community rapport-building and listening to what the needs are, especially in communities we are not living in.*

*"Often, individuals have no understanding of the people they are hired to serve."*

*– Conference participant*

- *The other thing that struck me, being based at a college, we train students to do community workshops. After their first training they realize, “I thought I was coming to give knowledge, and I learned more than what I brought to the table.” The science of place feeds into that, honoring and respecting the knowledge people bring to the table and the ways people use science that differ... When we're working with communities and doing data interpretation trainings, we might look at data and maps and identify different themes. But these people discuss the landscape, they know what's going on where, what a certain farmer is doing. In the data interpretation spaces, it's the community partners and volunteers driving the interpretation process.*

### **STEM learning may be associated with trauma of having to leave a rural community:**

- *My dad grew up in rural farm country in Pennsylvania. He ended up going to college and getting a Ph.D. in physics, and he took my mom away, and she didn't hear the end of it for 50 years that they were gone from her community.*
- *I'm from Pennsylvania and I moved away, and that's the same thing I heard. “If I'll be shunned, why would I leave?”*
- *I am taking you away from your community, teaching that you have to leave.... How do I balance that with working with the families, and the relationships, that I might be taking their children and they're having to leave? I hope we can talk about that more, because I struggle with that every day, because these kids are leaving, that's not equity, and that's not helping.*



### **Intersectionality: other identities that rural learners may have:**

- *Nobody has talked about students with disabilities. And in rural areas, this is more of an issue than in developed areas. There's no assistance, no special education. I'd appreciate if we can somehow talk about that, because disability doesn't mean they can't reach for a STEM career, they just need support. This isn't the main focus, but don't forget them.*
- *Students with very high academic abilities will need access to opportunities to develop their academic talents to the fullest.*
- *A population I never considered in the rural/informal STEM is the homeschool population. There's not a whole lot of research on that. It's not true of all of them, but there's a big religious component to why people are homeschooling, and they come to the science stuff, they try to explain science, ... and somehow, they still come and are somewhat open-minded, and we can incorporate what the homeschoolers are doing on field trips.*
- *I come in thinking there's “a community” there, but how the locals slice the community is different than how I think it is. Often you see racial lines and people do identify in that way. But they might also slice the community into those who are newcomers versus those who lived there for generations, those living in town versus outside the boundaries of town, etc.*

## Conference leaders' recommendations

- Avoid a 'savior mentality' by listening to what communities want and need. Be ready to surrender some control, no matter how carefully you've designed a STEM program.
- Be aware that a STEM-based career may involve a wrenching move away from a rural home community.
- Seek out and include multiple underrepresented populations in your programming; don't assume learners are marginalized just because they're rural.
- Look for STEM knowledge and learning opportunities in everyday activities and a broad set of occupations; it may be hidden in plain sight.

## Questions to consider

Where do interest and identity fit in? Are diversity and equity the 'organizational definitions' while interest and identity are more personal definitions...of access for all?

How can you step back and ensure that you are reaching all youth, especially those who might be marginalized by multiple identities?

Why are so few non-white, non-urban, non-old people involved in rural informal STEM education?

### Issue 3: Building community support

Panelists: Mr. Steven Brown, Mr. Steve Krak

Facilitated by Dr. Tom Keller

#### Mr. Steven Brown

Mr. Brown, an engineer and agent for change in rural communities, began his presentation by providing some background on his organization, DIG (Dreams, Imagination and Gift), located in South Carolina. He explained that he formed the organization to tie STEM to what he thought was a need for those growing up in a rural area. Mr. Brown said that people in larger areas are able to see what they dream because they have access to role models. In rural areas, people rely on their imaginations and use natural gifts to capitalize on that vision. Mr. Brown talked about various ways to develop support within rural communities. He explained that two common fears identified when working in rural communities are, “When you realize how bad the community is, you will leave?” and “If you [educators in the community] succeed, my kids will leave.” Mr. Brown gave some suggestions on how to alleviate some of these concerns.

- Be mindful of language. For example, some communities don't know what STEM is, or don't like what it connotes. Instead of forcing members to use your language, adopt the language used in the community.
- Go to the community and listen to what they have to say. Involve community members, industry, and families.
- Find someone who can help communicate on your behalf. Identify those least likely to support your project and target their buy-in first.
- Address racial disparities, and understand what communities need. STEM can help erase racial and economic barriers.
- Holistic rural community growth that focuses on STEM involves development, education, community service, and recreation.
- Large proposals may be intimidating, so consider creating one-pagers for rural school districts instead.
- Identify what is popular and incorporate STEM. For example, DIG sponsors a basketball tournament that also has STEM competitions and drone giveaways.
- Urban areas have many 'doors' or STEM opportunities and options, but in rural areas you need to convince people that the doors exist at all.



Mr. Brown ended by describing the annual outdoor [DIG STEM Festival](#) that provides an opportunity for full community engagement among industry, government, students, colleges, faith organizations, schools, and community members and their families.



## Mr. Steve Krak

Mr. Krak, an engineer and educator with expertise in STEM learning ecosystems, explained how engineering is user-centric; before you can find solutions, you must listen. He referred back to the

*“It’s riskier with fewer people. You get a reputation very quickly.”*  
– Conference participant

panel on Diversity and Equity and underscored the importance of knowing where you are before you begin scaffolding. Mr. Krak segued into a STEM Ecosystems theory of action and posed two questions: 1) How do we achieve coherence between formal and informal STEM offerings? 2) How do we identify existing industries, develop interfaces between community organizations, identify gaps in interfaces, and fill the gaps with new industries? Mr. Krak

proposed steps to tackle these questions:

- First develop an economic forecast that applies to the *local* region, and use that to guide STEM preparation.
- Develop coherence to help families navigate what is being offered.
- Engage the business community and convince them that some of what they do is science.
- Show opportunities in the region and help youth access them by fostering interfaces with those industries.
- Involve adults as well as youth.
- Connect communities to organizations both inside and outside the community with existing STEM resources that are able to promote informal education.
- Study design should be co-created by researchers, program developers, and the community.
- The community should define the agenda.
- Ask the community what they need; don’t assume you know where the needs are.
- Ask yourselves, as evaluators, who you are serving.
- Replace ‘I am here to help’ with ‘I am here to learn and listen’.

## Themes emerging from discussion

**Including the entire community is often more successful than focusing only on youth or adults:**

- *My STEM festival catered to the community, and included food and music. People learned what companies do; adults wondered if they should go back to school and asked companies if they were hiring. Parents were tied into STEM because their kids were interested. My organization focused on finding volunteers and then added a STEM focus. If you told people in a community, “You don’t understand STEM, let us teach it to you” they wouldn’t even show up to your event.*

*“Make sure residents aren’t just using the STEM resources but feel empowered.”*  
– Conference participant

- *My AISL projects have been directed to rural adults. As for demographics, it's always important to address kids as well, and to remember that adults are creating tiny ecosystems within the households. Finding mechanisms to engage adults is important because they're often overlooked. Many people in rural communities don't have connections to school at all because they don't have kids.*
- *I loved Steven Brown's points about dreams and imagination. One thing to add is inspiration. What we try to do with our leaders in rural communities through public libraries is inspire adult librarians and library staff.*

*“We created mini-grants to the communities so they have choice in what they want to develop. Instead of introducing a completed robotics programing, we let them identify programs that resonate with them.”*

*– Conference participant*

*All the people who come into the library—from prenatal to grandparents. It's amazing what happens in libraries—moms and kids in the mornings, kids after school, and a different weekend crowd. And how powerful these events are—festivals, celebrations of STEM—in places that you wouldn't imagine. One of the libraries presented STEM activities at a corn festival! I think using events and celebrations to showcase STEM is brilliant.*

In informal discussions, participants further elaborated on the value of including whole families to achieve greater involvement from the rural communities. Some attendees said this kind of inclusiveness also helped to address the common fear of youth leaving the community. In some cases parents were exposed to STEM opportunities that they weren't aware of within their own communities, and sometimes they assisted in uncovering more resources and establishing additional relationships.

### **Communities may not recognize the local STEM-related industries:**

- *Machine shops and auto mechanics use computer diagnostics for their work, yet don't consider themselves STEM professionals. There's a lot of STEM out there that we might not recognize as STEM.*
- *I didn't look for a job in my area—I didn't know where to look. This causes brain drain. Industries don't have a platform to show they exist and what jobs are available. US2020 assists industries with coming into the schools and explaining what they do, but industries in rural communities complain that they don't have qualified workers, and that's because A and B level students leave their communities to seek jobs at companies they see on television. We need to shine a light on what opportunities exist, and get the employers to articulate what they're looking for. To hear it from our own local industries makes it more meaningful. Connect the dots between afterschool programs and what industries want.*
- *In urban impoverished settings people don't know enough about what companies do. I worked with a local science center to include information about STEM careers. On this display there was a list of jobs in that region, with what the job responsibilities are and the salary, so families could see.*

During informal discussions, participants said that rural communities are often insular, and less accustomed to people coming and going than in urban areas. This can make it difficult to build trust and relationships, and it's necessary to think about the time needed to do so. Nonprofit organizations, places of worship, and schools were seen as promising places to start when relationship building, because they are generally established and trusted within the community. Some

*“I worry about entering a community and getting people to “buy in” to an idea that I have. The best ideas are ones where I’m reflecting back what I’ve already heard, and there’s already leadership... I hope we can listen for what the issues are and try to find people already doing this work, and stand alongside or behind them, and help them actualize and bring to fruition what they’re willing to do.”*

*– Conference participant*

participants cautioned that the first people to volunteer for partnership may not be the best match in the long run, and it may be important to speak to potential partners from many organizations.

Participants noted that often one person may be wearing many hats, serving as a community firefighter, a parent, a school board member, and a 4-H volunteer. This can be an asset in relationship building, but can potentially lead to distrust if perceived slights are made. One participant observed, “In working with rural communities I get a sense of this interdependency, that they work together well and the people in the community know who to approach.... They really do rely on each other, and that’s why it’s important to find the right people to be that lever for change.”

### **Schools are essential community partners:**

Relationships with K-12 schools was an area of discussion that revealed nuanced and complicated experiences. One participant said, “In the world we live in today, K-12 is driven more by testing, and the informal space allows for more flexibility and hands-on, experimental activities. We’re pointing out that they should be complementary, not that the informal is the savior for a broken formal system. You can do more if you know what’s going on in the school space and can complement that. That’s the ecosystems approach in its best sense, providing these opportunities for sharing between the formal and informal, so you can identify who the partners are, and clarify your goals.” Participants also discussed the key role that schools play in rural areas in particular, since the school may be the hub for community activities as well as one of the biggest employers.

### **Conference leaders’ recommendations**

- Involve not just youth but families, community members, schools, and industry in STEM programs.
- Don’t assume communities or local businesses already see the STEM in their work; help to make these connections to show the existing local STEM career opportunities.

### **Questions to consider**

When building on a community’s activities, industries, and funds of knowledge, at what point do you use the label “STEM”?

What do you do if honoring a community’s expertise leads them to conclusions you don’t want to hear?

## Issue 4: Research outcomes and measuring impact

**Panelists: Dr. Lynn Dierking, Mr. Jeff Cole, Mr. Kalman Mannis**

**Facilitated by Dr. Sue Allen**

### **Mr. Kalman Mannis**

Mr. Mannis, a formal and informal STEM educator, began by describing a major program of his organization that focuses on building internal capacity within communities. To do the necessary survey work, they drew from local community members who were seen as neighbors, rather than people “from outside” getting information and leaving. Even so, they had difficulties with sampling: They attended county fairs, STEM festivals, church festivals, and similar community events, but found through their demographic questions that people attracted to and willing to take surveys tended to have at least some college education, which was not representative of the whole community. Mr. Mannis said there was a self-image problem, and that some people in the community thought their opinions didn’t matter. As a result, his organization began a new approach and started meeting with people informally around places such as cafés, with food being the common element between survey conductor and participant. Preliminary results suggested that this approach was working to expand the set of people willing to be surveyed. Another issue Mr. Mannis reported on was the challenge of reaching people in mixed-population areas such as frontier towns around tribal borderlands. He said that local teams are currently exploring different approaches to address issues of non-sampling of marginalized subpopulations within marginalized populations.

### **Mr. Jeff Cole**

Mr. Cole, an expert in afterschool programs and networks, explained that his work focuses on K-8 students in both rural and urban communities, and supports inspiring, engaging STEM activities within an active learning framework. He sees a major opportunity for rural communities to be pilot sites for testing innovative programs as well as new forms of assessment, since rural communities tend to have more flexibility in their programming than the urban sites. As an experienced user of impact data, Mr. Cole said he would like to be able to use video to obtain data regarding how inspired and engaged youth are while participating in programs. He posited that it would be a great opportunity for rural communities to use distance technology (for both programs and assessment), and there is no reason why rural communities couldn’t be leaders in the afterschool field in doing this.



## **Dr. Lynn Dierking**

Dr. Dierking has worked in rural areas in many roles, including conducting evaluation and research and developing outreach and other programming. She began with a series of questions for the audience:

- What outcomes are appropriate when designing STEM opportunities in rural areas?
- At what levels can we investigate those outcomes?
- What are the opportunities and challenges in doing this kind of research and evaluation?

Dr. Dierking discussed the problems of expecting the same kind of outcomes in informal learning settings as in a K-12 environment. She also highlighted the pressures, even within the AISL program, to assess “STEM learning,” and encouraged the field to move beyond narrow interpretations of learning. She suggested considering outcomes such as sustained interest, inspiration, or engagement, rather than focusing only on concepts or scientific tools and practices. Dr. Dierking also discussed measuring social capital, and said that she had studied girls in both rural and urban areas, and the social capital they gained in terms of finding mentors and understanding what STEM is. Like earlier presenters such as Dr. Civil, she encouraged researchers and evaluators to think about social (and perhaps science) capital in asset-based ways, focusing on the capacities and knowledge that communities already have, such as resourcefulness, knowledge of the outdoors, etc. She reinforced the statement that the ultimate goal of long-term STEM learning in informal environments should not just be content and career outcomes, but also hobbies, pursuits, habits of mind, and leadership skills.

Dr. Dierking also argued for investigating outcomes at different levels. For example, the impact on families might be a group-level outcome and an opportunity to think about assessment in innovative ways. She referred back to Dr. Civil’s studies with mothers, and their excitement about math as a key outcome. Another important outcome might be whether the adults better understand the role that STEM can play in their children’s lives. In Dr. Dierking’s work, adults are asked what they learned about their children, and the children are asked what they learned about adults, both of which can be insightful.

Dr. Dierking also raised the possibility of impact at the community level, such as how rural communities perceive STEM and their role in it. She particularly encouraged the use of alternative measures, such as asset mapping, especially if such asset maps are created by talking to community members one on one about their dreams and aspirations for their community.

Dr. Dierking cautioned against generalizing across communities, and stressed that each has its own language, culture, and historical background to consider when assessing changes over time. She praised the work of Dr. Shelly Valdez and evaluator Ms. Jill Stein, who work in close collaboration to assess learning experiences and integrate Native and Western approaches. She said that one challenge can be pushback against proposing STEM outcomes that are considered “soft” or “fuzzy.” She suggested that as a field we need to be working on how to communicate the importance of broader outcomes in STEM learning that may be more meaningful to individuals, groups, and communities.



## Themes emerging from discussion

### It is often difficult to determine which outcomes to measure and what can be inferred:

- *I am struggling with measuring outcomes. How do you measure the cultural impact your program is having? I see more cultural gains than educational. For example, the town changed their website to be more like ours, because ours looked a certain way.*
- *One of the issues we had was that we did a lot of work on the impact of our program around the state and as we came out with our results we saw other people who had services like ours. You can't really say your results are specific to you, because there were all these other things that were impacting it. It was difficult to separate.*
- *One of the things we do in citizen science is verify that the data are of a certain quality to match their intended use. With skills assessment, we can look at quality-checking techniques: Are they using the tools properly, identifying animals properly? There are already measurements embedded into citizen science in the data collection. The other thing is, we're monitoring the role of study design in a co-creative process, so that as people are designing the scientific study they're looking at the intended use of the data. You can use that as a form of assessment too: Did it result in some sort of change of action?*
- *Evaluation is a political process, and that answer depends on who are you doing this assessment for, and what will be acceptable evidence for them. If you're doing this because you want to improve your own program, if you can identify questions quickly that are helpful, go for it. If you're doing formative work, if you start getting a consistent response, what you're doing is fine and you can move on to the next challenge. If you are getting federal funding, we have to have some kind of assessment of our research, and the stakes are higher, you have to talk about triangulation and more rigorous design.*



### Collecting data can be complicated:

- *In working in the public library system, they're under constraints about what they can or can't do. There's a culture in the library of protecting people's privacy. We often push up against that. We've been working, fairly successfully, and developing techniques with the library staff themselves in helping us collect the data. NSF likes to have large sample sizes and validated measures, with comparison groups and so on, and it's challenging for us to be able to reach that bar with our programs. Someone helped me see that it's not always the large numbers of people you're attracting, but the percentage of the community you're attracting.*

- *Often when you're working with multiple partners they have different data collecting strengths and constraints. Some may not collect data that is identifiable, etc. It's a methodological problem. I don't know if anyone has sat down with all the organizations at the beginning and asked what each one's norms for data collection are, because you get in the middle and then find out "we can't do it this way."*
- *It was amazing to me how hard it was to survey people, to interview people, arrange phone calls. People just didn't respond to us, even when our community liaison set it up. We did slightly better gathering people together for a focus group, over a meal.*

### **Collaborative approaches are often key to success:**

- *Sometimes, other organization or researchers may have already come into the community, done research and left, which is typical of the funding cycle. That could have an effect on the willingness of people to participate in a similar project.*
- *I think, it keeps coming back, knowing the history of the community you're working in. When doing evaluation, you become the protector of the program, of the community.*
- *Coming from a small town you may feel like you don't want to be studied, don't want to be a guinea pig. So maybe we have to communicate why we need the data.*
- *Use approaches like participatory research, where you ask the community to do the assessment. I've been employing youth researchers who live in the community, and they've helped by creating an ethnography of their lives. Regular community leaders can provide a little guidance around how you talk and what the goals are. Co-construct projects together; we should co-construct how we're going to decide if we've been successful or not.*
- *You need to be constantly reexamining these social structures that you've benefited from or you may have been disadvantaged by—understanding your position is important. It made me realize how people might be seeing me.*
- *Your evaluation process should be emergent and fluid, an organic process. The community should be engaged in the research from the onset. Working with Jill, she comes from this very strict western construct environment, and I come from an organic, holistic, emergent environment, and we build so much together. And language is key, when you're writing. We come from the mindset where we focus on the community: "If my grandmother can read it, I know it's good."*

*"There's no timeframe—it's been 10-15 years of getting to know the place before we get comfortable enough to ask the questions. That's how we build trust. There's been a lot of science-related exploitation and abuse, so you have to understand how scientists might be perceived."*

*– Conference participant*

### **Qualitative methods and storytelling are valuable tools:**

- *It strikes me that really robust qualitative methods will be able to capture a lot of this.*

- *Rural places are always at a disadvantage any time you count people impacted, or investment per person, or anything like that, just because on-the-ground programs can't ever reach large numbers. It almost feels like a discriminatory kind of measurement. So we need to find ways to tell the stories of impacts, and rural places might be especially good for those because there are strong relationships and long community memory.*
- *Funders want a compelling logic model and stories about why your program matters. They want to know how kids in the community are being impacted by the program... I often think more about how to tell a compelling story that will create an emotional connection with the reader, so I can get more funding to do what the logic model says is important. The kind of questions we're asking about scale, academic studies are important but if you tell a story it will resonate.*

### **Conference leaders' recommendations**

- Use participatory and collaborative approaches to respect rural communities that may be wary of researchers who drop in just to harvest data.
- Use qualitative approaches, including storytelling, when showing impact; numbers of people reached will unavoidably be low.

### **Questions to consider**

Where is the overlap between the needs of your funders and the kinds of collaborative evaluation and qualitative approaches that need time to build with a community?

What are other creative measures of impact that might be especially appropriate in rural places?

## Conclusions and Next Steps

At the end of the conference, participants were asked to reflect on the following questions: What is the most important programmatic work that the field of informal STEM should focus on? What should be the priorities for policy decisions and funding? And how can we get broader involvement? Participants' responses included the following:

### Programmatically OST STEM should focus on:

- Distance learning as a means to break down isolation, including use of inexpensive computers (e.g., Chromebooks), and professional development or mentoring approaches that are truly engaging.
- Supporting more collaboration between formal and informal learning (i.e. in and out of school) so that they are seen as complementary and mutually reinforcing, rather than in opposition to each other.
- Requiring program developers to spend time locating not just STEM resources but social resources, to support cultural system change and sustainability.
- Building a national network of rural R&D centers for informal STEM learning; this might be modeled on networks from the afterschool world, but with a foundational focus on rural needs and assets rather than adapting urban models.



### Policy and funding should focus on:

- Bringing to the table and giving real power to a range of rural/indigenous worldviews, to reflect the great diversity within this group.
- Ensuring that project leadership includes one or more people in the community.
- More early stage experimental programs, as well as those that are ready to expand to the national level.
- Longer-term funding structures for building trust and relationships.
- Major investments in technology infrastructure, such as broadband internet and mobile devices, to address the growing digital divide and allow rural residents to learn about big data, AI, social media, etc.
- Assessing key STEM impacts such as “math achievement” in ways that match the true goals of out-of-school programs, rather than just teaching youth to pass high-stakes tests.

### Involvement could be broadened through:

- Extending programming to include adults as well as children.
- Partnering with agencies and organizations both in and outside rural education communities.
- Helping communities recognize that a lot of what they do is already STEM-based.
- Starting with small community-driven projects that can grow and broaden in a sustainable way.

- Supporting forums and networks that already or potentially tie communities together.
- Creating resources, fact sheets, and advocacy kits modeled on those offered by existing organizations such as the After School Alliance.

## Conclusions from the conference leaders

While rural places have far more diversity and complexity than we had previously realized, they also have some commonalities that we believe make it worth aggregating them to address historical inequities in funding and policy. Among these characteristics are: a deep connection to place and residents with long memories and deep interconnections, the prevalence of small-scale businesses and organizations rather than large ones, the centrality of schools as community hubs, and low population densities that make raw counts of “people reached” a biased metric of impact. Above all, we note that across a broad range of projects, participants reported the fundamental importance of outsiders taking time, preferably many years, to build trusting and reciprocal relationships with rural residents.

## Acknowledgements

Running even a simple conference turns out to be a big undertaking, especially when the conference is in Arlington, VA while our headquarters are in Augusta, Maine. Making all the moving parts intersect smoothly took the combined efforts of many dedicated people. Foremost were our colleagues at the Maine Mathematics and Science Alliance, especially Kate Kastelein, Sherry Portillo, Stefany Burrell, Cindy Caverly, and Natalie Reis.

We are grateful to the participants, both panelists and observers, for their pre-conference work and for their ideas, experiences, and interactions at the conference. Despite some difficulties beyond our control (including a hurricane in the region that affected flights, and some technical challenges with the videoconferencing system), people found ways to work in large and small groups both face to face and virtually, and new relationships were built as a result. Finally, three highly talented documenters took excellent notes throughout the conference—Corinne Kaczmarek, Asia Williams, and Sam Theriault—whose time was generously donated by Randi Korn & Associates.

The kernel of the idea for this conference emerged from discussions among Sue Allen, Jan Mokros, Wyn Jennings, and Tom Keller. But without encouragement and support from Wyn Jennings, this conference would not have been possible.

### Photo credits:

Sue Allen: p. 17.

Paul Cyr: pp. 7, 9.

Tom Keller: pp. 2, 5, 12, 15, 21, 23, 26.

Sam Theriault: p. 4.



## Conference detailed agenda

### **INFORMAL STEM LEARNING IN RURAL PLACES**

#### **DAY 1: Thursday, Sept. 13, 2018**

- 8:30 *Breakfast and mapping activity*  
9:00 Welcomes and introductions  
9:30 Comments from Dr. Sylvia James, NSF  
9:45 Where are we coming from?  
**10:00 PANEL 1: WHAT DO WE MEAN BY “RURAL”?**  
11:00 *Break*  
**11:15 PANEL 2: DIVERSITY AND EQUITY IN RURAL STEM EDUCATION**  
12:15 *Working lunch*  
**1:15 PANEL 3: BUILDING COMMUNITY SUPPORT**  
2:15 *Break*  
**2:30 DESIGN CHALLENGE 1: PRINCIPLES OF EFFECTIVE PROGRAM DESIGN**  
4:00 Choosing next day’s design challenges  
4:30 *END*  
**6:00** *Working dinner with Jeff Weld from OSTP: The new federal STEM plan*

#### **DAY 2: Friday, Sept. 14, 2018**

- 8:30 *Breakfast*  
9:00 Comments from Dr. Evan Heit, NSF  
9:15 Reflections from yesterday  
**9:30 PANEL 4: RESEARCH OUTCOMES AND MEASURING IMPACT**  
10:30 *Break*  
10:45 **DESIGN CHALLENGE 2: SCALING UP OR WORKING WITH SCHOOLS OR OTHER CHOICE**  
12:15 *Working lunch*  
**1:15 WHAT GOES IN THE UPCOMING REPORT?** (discussion, writing, short presentations)  
2:45 Dissemination discussion  
**3:15 OUTSTANDING LOGISTICS**  
3:20 Final words from Dr. Wyn Jennings  
3:30 *END*

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