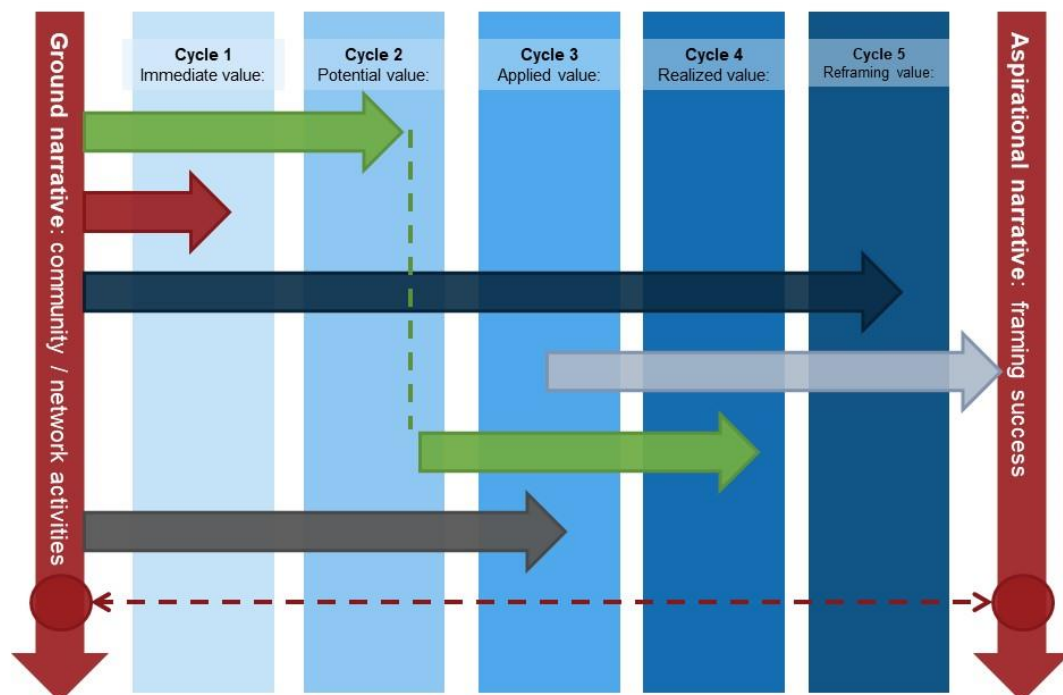# Value Creation
through EarthConnections

In 2016, Carleton College and a national team of partners were awarded one of the first National Science Foundation INCLUDES grants to begin a project called EarthConnections: Community Pathways to Geoscience Careers (referred to hereafter as EC). Like all projects in the first cohort of grantees, EC was designed to facilitate partnerships with the common goal of broadening participation in STEM education programs.

Annual value-creation stories have been collected to answer two additional evaluation questions: What are valuable EC activities? and How do project activities support the shared vision of EC? Wenger et al. (2011) present value creation stories as a method to record the benefits of participating in communities of practice and networks. For the purposes of the EC evaluation, interviews were conducted using a version of Wenger's specific value creation matrix (p. 47) to encourage steering committee members to reflect on the EC project, with a focus on experiences that the project enabled and that would not have happened otherwise.

To date, value creation data have been collected three times. Short-term value creation stories were collected from steering committee members via a written activity that was conducted at the conclusion of the project kick-off meeting in November 2016. Interviews were then conducted one year later and at the end of the project to capture shifts in EC's value to members over time. Thirteen members were interviewed at the end of first year, and 14 were interviewed at the end of the project.

The value creation model includes five cycles of value: immediate, potential, applied, realized, and reframing value. The graphic below has been reproduced from Wenger et al. (2011) and represents the ways that specific activities might progress across a typical value creation story. Each horizontal bar represents a different activity. Four of five activities shown in the graphic were grounded within the context of a network or community activity, represented as a vertical bar on the left side of the graphic. The value of each activity varies based on whether and how it influences later work and thinking by the individual sharing their value creation story. The activity represented by the green bar shows value in two ways, and was grounded first in a community activity that resulted in potential value. At a later time, that potential value moved through applied

and to realized value, as the activity was used to improve performance through the use of new tools.

The Value of EC, by Cycle

Value creation responses from steering committee members were coded in relation to each of the five cycles. This section presents results from both the end-of-year interviews conducted in fall 2017 and the end-of-project interviews conducted with steering committee members in August and September 2018.

Results are presented below to document the extent to which steering committee members experienced each type of value, and to share their reflections in their own words. Overall, steering committee members shared a greater number of examples at the end of the first project year than they did at the end of the project (N=308 compared to N=256). The types of value also shifted from one year to the next, and in developmentally appropriate ways. A greater number of examples of immediate and potential value were provided at the end of the first project year, while a greater number of examples of applied and reframing value were shared at the end of the project (see figure below).

Types of Value Cycle Comments Provided by Steering Committee Members, by Year
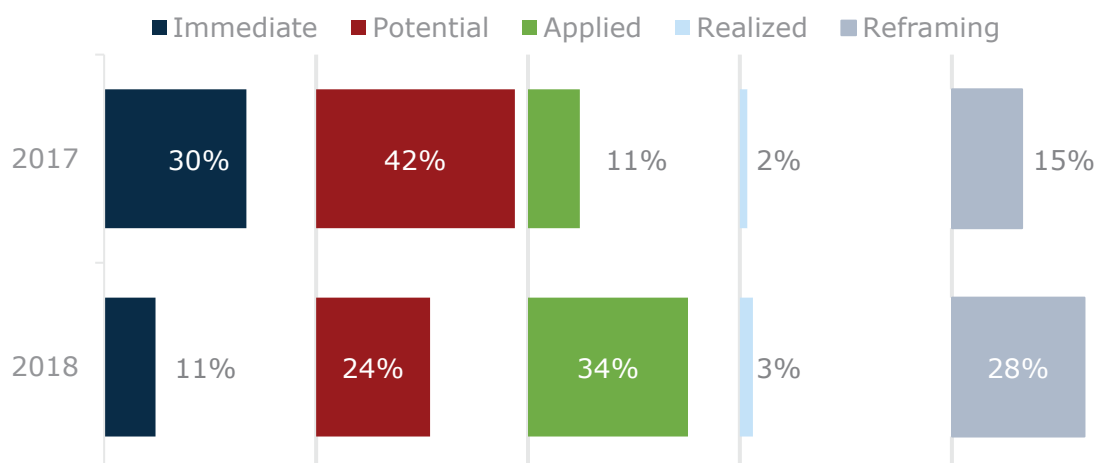
At the end of the first project year, steering committee members found the most value in the relationships created through the project. These included new and enhanced professional connections, both within and outside of the steering committee, as well as an enhanced understanding of how to work effectively with local communities. The regular steering committee meetings and the checkpoint process were the project activities that helped sustain connections and support the work. Additional project- or task-specific meetings also added value in this regard during the first project year.

One year later, at the end of the project, steering committee members had shifted their descriptions of EC's value, sharing deeper applications and more reframing than in the previous year. Interviews indicated that the networks and knowledge capital people had accessed through EC were being applied both professionally and personally in meaningful ways. This movement provided evidence that EC has evolved into a well-functioning community of practice. A key foundational piece in this evolution appears to be the high

value that steering committee members continued to place on the collective impact model and its associated pillars.

This evolution highlights the ways EC provided participants with the opportunity to engage in experiences in deeper ways over time. For example, the immediate benefits of making meaningful connections with people in the first project year developed into ongoing professional partnerships and collaborations during the second project year. Shifts in value appeared to leverage both relationships and knowledge from the EC community to accomplish a variety of personal and professional tasks.
Results are presented for each value creation cycle in the sections that follow.

Immediate Value. Immediate value is defined as the most basic cycle of value creation in that it focuses on activities and interactions that have value in the moment. All steering committee members (100%) shared ways that EC provided them with immediate value at the end of the first project year. A total of 93 examples were coded. Almost all described interactions and relationships.

These comments were then coded further based on the different levels of interaction possible across the EC system: national-national, national-regional, national-local, regional-local, and beyond EC. Immediate value was shared across each of these levels, reinforcing the project's goal to generate benefits and influence across the different levels of the geoscience educational system. Sample comments from each level of interaction are presented in below; the percentages indicate the portion of steering committee members that shared a value story at each interaction level at the end of the first project year.

Interactions between national partners (26%)	I would speculate and say that I think this project is an interesting way to bring together people that maybe otherwise wouldn't come together… And so, it's broadened the network a little bit. And I would say in some ways where it hasn't broadened the network, it's maybe deepened it a little bit.
	I think the connections across the country, and to be working on a more regular basis with the partner organizations in the projects, that's been good.
	Karen, Barbara, and I had started thinking about how were we going to apply the sort of collective impact and then the sort of vision for the project to some sort of checkpoint process.
	The value to me is the ecosystem. EC, the whole thing, cares about everything that I care about. The challenges everybody cares about and many of those challenges everybody shares. So that's where the collective impact [is], in I would say a collective investment. If you're going to struggle, having kind of comrades in the struggle—that is valuable.

Interactions between national and regional partners (20%)	I think each of the regional alliances came with some goals for their alliance and I think that the project has supported their ability to bring some people together to have conversations about these goals. That's part of that developing—I don't know—the shared agenda and some shared planning.

I'm coordinating with the meetings pretty much between Sally and San Bernardino and myself…connecting with people across the national alliance or just working with John or other alliance members who get on a call and plan things with you.

Things with the Native American community really do take a slower pace and it has been harder for me to gauge some of the ways in which we should proceed. Which is why it's so, so helpful to be working with Norma, because she really kind of helps both John and myself and other people in the alliance on how we should conduct ourselves. |
| **Interactions between national and local partners** (12%) | I'm going to go to Atlanta with Donna soon and I wouldn't have been able to go in that kind of capacity with community members welcoming me and showing me what they're doing on the ground. So, access: it's provided a lot of access.

It's just to kind of help them understand that the San Bernardino alliance is not isolated on its own, that we're part of a larger group and I think it really helped that one of our planning meetings for the March 25th outreach event was like a Skype session with some members of the national alliance. |
| **Interactions between regional and local partners** (25%) | The Atlanta alliance is a combination of local leaders, and maybe a few environmental kind of NGOs and, at least initially, the academic partner that Felicia represents. And so, just having a sounding board where we can all vision together is certainly a very important contribution. And the community oftentimes doesn't get access—the community leaders don't get access to be in those visioning rooms at times. So, I think that's an incredibly important opportunity to have them at the table, to have their say, to share their local knowledge, and to have that captured.

One meaningful activity I participated in was working with the STEM academy, Tim Kant at the Jones Academy. I got acquainted with our Oklahoma state seismologists. I saw the superintendent of Shawnee's school district recently and mentioned how we might have this geology super science Saturday and how that really lines up with the state of Oklahoma right now, wanting to have independent career pathways programs. So that's the way, the broader community. |
| **Interactions beyond EC** | From the organizational side, I think it's important for us to be able to show that we are working on diversity issues. Being able to say that we are one of the collaborators and one of the co-leaders of this project helps us a lot to be able to show—yes, indeed—we're doing things that are important.

There's a community inside of AGU that's really into this idea of co-created science and collaboratory approaches, working with people to design research, and it's akin to the spirit of community science that's part of the EC thing. Because of the connection with EC, I was able to bring people from the EC world into this conversation at AGU. I feel like one of the things this has done is help bring two communities that were working along similar [lines]—that had similar values, but were working in |

> parallel without knowing about each other—help bringing them together. So, that's pretty cool. I wouldn't have been able to do that if I hadn't been part of this EC group.

Fewer examples of immediate value were provided in the second round of interviews. Even so, most steering committee members (86%) shared ways that EC has provided them with immediate value. A total of 28 examples were coded. Almost all described new interactions, relationships, and one-time events that were generated during the second year of the project.

> "The only activity I really participated in was our meeting at the Earth Educators Rendezvous in July, and it was really great to be there to talk to people from other parts of the country who were interested in what we've been doing. So that aspect, and of course to meet with the EC leaders and talk about the plans going forward. "

> "We had a Super Science Geology Day, and this was a nice collaboration between the American Indian Institute and the Absentee Shawnee tribe here in Shawnee, Oklahoma, and the Citizen Potawatomie Nation here in Shawnee, Oklahoma. And we got together and planned this day for middle school students, advertised it through tribal newspapers and Facebook-type things, and it ended up being a very rainy day but it was a great day."

> "I'm working with people that I wouldn't have worked with otherwise or that are kind of outside the circle of people that I've worked with, but they're very much doing things that are very related. So, I would say that it's kind of expanded the network."

Potential Value. Potential value is Cycle 2 of the value creation model and involves gains in knowledge capital that may or may not be applied later. All steering committee members (100%) provided at least one example of potential value from the project at the end of the first project year. Most shared multiple examples; a total of 130 examples of potential value were shared overall. There are several types of knowledge capital, including personal and social, that can provide potential value.

- Gaining new knowledge or skills is an example of personal capital. Steering committee members reported personal capital gains in relation to evaluation and their understanding of the collective impact model.

- Social capital can also provide potential value through the relationships and connections established. Examples of social capital that provided value to steering committee members often focused on improved knowledge of the local communities involved in the regional alliances.

Comments related to the potential value of EC at the end of the first project year included:

> "Just thinking about how collective impact would intersect with sort of guiding principles and shared vision in a real form. You can read about a collective impact but thinking about it from a progress-monitoring standpoint was really useful."

> "It's reminded me or helped me understand kind of the importance of education as a real goal. It's helped me talk about education within my organization as part of what we should be attending to. And it's given me a concrete example of what that can look like. I guess that's the biggest change."

"I knew nothing about collective impact before this started, so obviously I know a lot more about that."

"The thing that I'm learning from working with the Native American community is maybe how to listen more and to really honor the contributions that they make rather than plunging in with solutions."

"[STEM in the Park] was very successful and actually meaningful in the sense that it gave me a deeper sense of what might be possible. Just trying to keep hope alive was my big takeaway. I guess I saw what was possible. The outcome is worth the effort."

All steering committee members (100%) also provided at least one example of potential value at the end of the project; a total of 62 examples were shared overall. Compared to the kinds of potential value shared one year earlier, responses at the end of the project were more targeted toward specific areas of potential value, rather than being focused on broad concepts. Comments related to the *potential value* of EC at the end of the project included:

"So, I haven't acted on that but…it's in the back of my mind—how can I maybe connect what I'm doing personally outside of work with some of the things that are happening here that are opportunities if something were to develop with the Colorado Regional Alliance that could be something that I could bring to the table for the Regional Alliance?"

"I continue to learn. Part of our checkpoint meetings and our planning meetings and learning what other alliances are doing—you're always taking notes about what you can bring back to your shop, right?...I'm not sure about skills but just learning what other people are doing."

"I sent her a document that sort of outlines all of our available resources that focus on geoscience education and I suspect when teachers get that info they're going to be contacting me to have the state seismologist visit their classroom and talk to the kids and things like that."

"I think the broadening access sort of questions dealing with evaluation and thinking about work on my other funded projects...I guess, your follow-up, 'Would it enable you to do something you hadn't done otherwise?' It's hard to say. I'm not far enough along to feel the effects of it but it's certainly giving me some other lenses to sort of question how I'm looking, particularly in the projects where I have research questions dealing with broadening access issues."

Applied Value. Knowledge that is gained through a community and then used in practice is considered to provide *applied value*, which is Cycle 3 of the model. Eleven steering committee members (85%) shared ways that they had applied knowledge gained through EC to their work during the first year of the project. Thirty-four examples were shared overall. At that time, steering committee members had leveraged project resources to create relationships and programs for the regional alliances, and applied components of EC to their work beyond the project as well. *Applied value* was exemplified through the following:

"[EC] has helped us accomplish the goal of making more Native American students think for their education."

"I just wrote another collective impact proposal, so learning that strategy has contributed not only for this project, but to our overall leadership capacity and infrastructure capacity…The metrics that we developed for the backbone to monitor participation and communication are, again, a strategy with an underpinning platform and we're using that in other projects now, too."

"I think for me it's mostly been about the negotiating personalities and taking advantage of opportunities, sorting through challenges, managing expectations…So I think from a professional development standpoint, it's been a little bit more opportunity for my work on that stuff than I get in my normal day job."

"Taking [collective impact] and applying it or defining how we're doing our other programs inside of that approach; that's probably going to be one of the most consequential to my overall program beyond EC, is using that framework to describe the things that we do."

Examples of applied value were more common at the end of the project, with all steering committee members (100%) sharing at least one way that they had applied knowledge gained through EC to their work. Eighty-seven examples were shared overall. *Applied value* at the end of the two-year project was exemplified by the following:

"One of the things that I have gotten from my own participation in this project is really an understanding of what's meant by a "pathway," at least as interpreted by our group and Cathy Manduca. And so, the elements and the signposting and the mentoring activities and so on. So when we had this meeting last Monday I really was able to work with John Tabor to make sure that we kept everybody on track and that we kept coming back to the elements...'Well, if we implement this program element, what specifically will you do to help with signposting? With making sure that your community is aware of this particular program element on this pathway?'"

"We [are] talking about our plans to submit a proposal to NSF Geopaths program to continue our work, and so we were just discussing plans and how that would take shape. It just felt really rewarding to feel like there's an avenue for the work that we've done to continue, and we've forged these working relationships and it feels like there's a natural path forward to seek out additional and new funding for the work that we've been doing."

"I think our alliance really did try to do what we were saying we were doing on a larger scale, which was to start from the community and ask them what mattered...They were all doing things already in different ways and connected in some ways, but not in others, and trying to bring those different people together to connect in a different way."

"I think EC, in addition to educating me around collective impact is also evolving the collective to have an agreed-upon sense of what that really means in practice. So, that's helpful as we develop programs and try to justify that we're knowing what we're talking about. An agreed-upon language is valuable."

Realized Value. There were few examples of *realized value* in the interviews during either year. *Realized value* is Cycle 4 of the value creation and involves improved performance that is catalyzed by using new practices or tools. Three steering committee members (23%) shared five examples of realized value during the interviews at the end of the first year.

Twice as many steering committee members (43%) shared an example of realized value at the end of the project, providing a total of seven examples. References included beneficial changes in professional performance, such as the following:

> "Well, we wouldn't have developed this huge group of people. I mean, the outcome of all this is we now have—I can't remember the numbers—a hundred-plus people who are excited about the EarthConnections idea and we know who they are. So, we wouldn't know that if we hadn't done this. We have examples of what they can do locally and we have a mechanism for collecting more examples, so we wouldn't have that otherwise."

Reframing Value. All steering committee members (100%) provided examples of Cycle 5, _reframing value_. The last cycle of value creation involves new ways of thinking in relation to the goals of the project, what matters, and/or how success can and should be defined. All steering committee members shared at least one example of _reframing value_ that occurred in the first year of the project; 46 examples were shared overall. Most shared new and more nuanced perspectives in relation to the project's overall goal of building pathways for underserved audiences, as illustrated in the comments below. A few also shared ways that they were reframing their ideas about evaluation and measurement. Steering committee members said:

> "I think professionally, it has made me pay more attention to how I might help to build this pathway in and for communities that I care about."

> "One thing that was really new for me, where my thinking has kind of changed, is recognizing the importance of community relations and helping students to see how geology relates to their local communities, and [that] it's useful and valuable to their local communities. That was really not a high priority for me when I first entered the alliance, but through the interaction with the national teams, I've really learned a lot about how important that can be."

> "I think it has maybe broadened my opinion of what matters when you're trying to work with a group of people. And the idea that it really takes some time to create a common agenda and sometimes it's easy to get impatient when you're working with other people and trying to develop that. I think it's sort of changed a little bit my thinking about how you go about that, because I see how this project is going about that."

> "The main thing is it made me think of the American-Indian Institute, that we really need to do so much more work on careers…These kids don't have any idea, basically. They only know about working in a convenience store or the local clinic or something; they only think about what's close to them. And so it's made me realize again the importance of giving these Native American kids experiences with careers."

> "We're really thinking about those measurements differently, because I think I keep pushing for how do you think about voice and contribution that is empowered."

All steering committee members also shared at least one example of _reframing value_ that occurred in the second year of the project, with almost twice as many examples shared overall, n=72. Steering committee members said:

> "I used to always go to the Esri conference…but this time around I zoomed in on GIS information for K-12 education. It was a very different experience. So, I mention that to everyone. I go every year. It's one of those conferences that's just part of my

regular ones…And so, it's changed my outlook working with these teachers and coming back, giving them the information."

"I think it was more a way of thinking…What I got out of it or what insights I got were how some people really had the strong community connection that the project was asking for. Others had more, you know, the connection to the institute of higher learning or whatever, and I guess an insight is that it's trickier than you might think to bring those together…I didn't appreciate the challenges there'd be in putting those together. So, for example, if a regional alliance with a really strong connection to the schools and institutions of higher learning—they would make what seemed like really good overtures to the community but sometimes they wouldn't lead where they were hoping to lead. So, I think it really gave me a sense for the challenges involved in that kind of work."

Value Creation in the Context of Collective Impact

The responses above document the many ways that steering committee members found value in the EC project. Given that the project was designed to create the infrastructure to support a collective impact initiative, the interviews were also coded in relation to the five pillars of the collective impact model (backbone infrastructure, a common agenda, continuous communication, a shared measurement system, and mutually reinforcing activities). At the end of the first project year, approximately half of the value statements coded (52%) referenced one of the CI pillars. This portion had dropped slightly by the end of the project to 41%. As with the results presented earlier in this report, the type of value associated with the CI pillars shifted from one year to the next.

CI was a new framework for the majority of steering committee members. The prevalence of CI in the interview responses from the first year indicated that the team had been successful at creating a common language for their collective work. The sustained use of terms related to CI during the second round of interviews seems to indicate that this language is becoming institutionalized among group members. The co-occurrence of value statements and the description of CI pillars in both rounds of interviews also underscores the value of the CI model to steering committee members who are implementing it. These trends were summarized in the following reflection from one steering committee member about the project's final in-person meeting:

"What I've heard—what was encouraging at Rendezvous was that collective impact language, like "common agenda" and "shared vision" and "shared metrics," sort of that language being used by others that have been involved. So, some of the folks that I'm working with in EarthConnections I'm starting to work with in other projects, including that language."

Two particular value cycles included a number of references to the CI pillars at the end of the first project year. The co-occurrence of these topics was most frequent in relation to *reframing value*, with 41% of comments in this cycle refencing at least one CI pillar. These statements often focused on the common agenda. In addition, approximately one-third of the statements describing *potential value* (35%) focused on CI. All five pillars coincided with statements of *potential value;* comments about the common agenda and shared measures were most frequent.

Reframing and potential value were also the cycles that coincided with discussion of the pillars again at the end of the project, and applied value also surfaced regularly in relation discussion of the pillars. Almost half of all comments that included both reframing and

applied value also mentioned a CI pillar (46% each). In both cases, at least one steering committee member mentioned the value of each of the five PI pillars. Reframing value was again mentioned often in relation to the common agenda, though several instances were also noted for each of the other pillars with the exception of continuous communication. Applied value was mentioned predominately in relation to the common agenda. As with the earlier interviews, approximately one-third of the comments about potential value mentioned a CI pillar. Shared measures were mentioned most often, followed by the common agenda, and backbone organization.

The comments made in relation to each CI pillar are presented below. Similarities and differences from the two rounds of interviews are noted throughout.

Five of the 13 steering committee members (38%) referenced the backbone organization or the leaders who make up the backbone organization at the end of the first project year. This number was up to 12 of 13 members at the end of the project (92%). All comments in both years were positive. Comments in the first year often focused on strategies and skills that have been learned from members of the backbone team, while those at the end of the project focused on steering committee members' appreciation for both their relationships with the backbone organization members, as well as the value of having access to their knowledge and support. For example, one steering committee member shared:

> "I do feel like working with Cathy has been a big part of that connection space…One is she's very well-connected and has thought a lot about systemic change. But the other is that she's just the leader of the group. So, I get to watch another leadership style and see how somebody leads and that's been useful because I think she does a lot of things really well as a leader."

All interviewees (100%) shared ideas related to the common agenda in both interviews. Some simply mentioned key terms related to EC's vision statement, such as pathways and diversity. At the end of the first project year, many shared examples of how the common agenda is being applied and/or reflected on the common agenda itself. These comments are presented in the table below and reflect both pride in relation to the successes achieved to date, as well as some of the frustrations experienced along the way.

Application statements	And so, a lot of what I'm trying to apply to EC and the pathway mapping…I'm trying to incorporate also into our organizational structure, particularly as it speaks to what we'll do at the outdoor activities center…This new focus that we want to embark on is to use the outdoor activities center as a very place-based center to talk about flooding, to deal with water quality impairment, and educate people around the value of watersheds…It just expands its [reach] and capacity to really have educational experiences and opportunities that can educate K through grey.
	If we're able to impact students who are interested in earth sciences and motivate them to care about earth sciences or geosciences, because we're looking at the earthquake risk, then that would be fantastic. Though we're not there yet. There's the potential for that but I don't think it's happened yet.

	What they want to do is provide quality education for Native American students, by providing geoscience that broadens the horizons of the students. So they get to learn more about science and other types of science than what they had been exposed to before. We'll be able to have students see that there is a path towards having a geoscience career that could be helpful to their communities, but it'll be that in sort of a long term sense not that we will have worked with the community to solve a community problem right away.
Reflection statements	I think for geoscience education, it's just kind of reinforced a lot of the things that I already think are important—the pathways, bridges, bridge programs between different academic levels or academic and professional workplace. It's terribly flawed to go in to under-resourced communities, under resourced [as a project], and try to build pathways to geoscience…Earth literacy, as long as we're walking on this planet, is paramount…It's all worth the effort because of that, so we don't have the answers completely. We don't know how to fix it…And so EC will play a small but important part in stumbling through some of it. And it means we're stumbling through that wilderness with strategies and the capacity for a very robust, thoughtful capture. So even if we get it wrong, we'll be able to say with precision what went wrong. And there's huge value in that. Deepened the appreciation for the need for what we're trying to do in terms of identifying socially relevant aspects that would interest students, interest teenagers, younger ages in the geosciences as a potential career choice…focusing in on aspects that can affect their local communities and to where they can make a difference for their family, for their neighborhoods, for their communities, I think has shaped my view of how we want to be highlighting that beyond EC as well. I think it has maybe broadened my opinion of what matters when you're trying to work with a group of people…I've seen that it really takes some time to create a common agenda and sometimes it's easy to get impatient when you're working with other people and trying to develop that…It sort of changed a little bit my thinking about how you go about that and what it takes. One of the things that I think is really exciting and interesting about this project is the idea that we're going to find ways to contribute geoscience to sort of community goals that are bigger and broader than geoscience in and of itself...I think what's cool about this is [that] we're positioning all of this passion around how those geoscientists and how more geoscientists would actually help communities.

The tone of the common agenda comments provided at the end of the project were more targeted and action-oriented overall. Discussion of the pathways was quite prevalent (86%), and often mentioned in relation to diversity. The examples coded to the *common agenda* showcased a number of examples of the ways members had used these concepts in their professional work and how they provided them with new perspectives for how to do their work.

> "The piece that is resonant with people where they really buy into the idea is the connection to the community. The pathway is incredibly important. They won't work

if they're not connected one level to another. But if you just talk about the pathways and the connections without talking about that connection to the community, it doesn't have the same motivational piece."

"I think all of the tribes, all of the stakeholders that we have worked with are interested in getting more diversity into the field of geosciences. [There's] very little diversity in the geosciences field, and for the tribes they want to have kids that have good careers and good knowledge and can be productive citizens."

"I feel it's contributed to my goals because increasing diversity in geoscience is important to me as a personal goal and that's also a goal of my university. That was sort of all focused on this collective impact model of how we can help each other have some sort of community of practice around teaching earth science as well as signposting the pathways so that the students at one institution know what the opportunities are at the other institutions within the alliance."

Continuous communication was mentioned more often in the first compared to second interview; seven steering committee members (54%) shared feedback related to this pillar at the end of the first project year, compared to 29% at the end of the project. Responses were consistent across both time points and focused on the project's regular virtual meeting schedule, participation in the meetings, and providing a mechanism for learning from and feeling encouraged by others. The first two comments below are from the first round of interviews, while the second two are from the end of project interviews.

"The regular phone calls are very valuable for everybody. We're all learning from each other and all getting new ideas and that makes us all better at what we're doing individually and collectively."

"I'm needing to have to break out of my very local network and be available and accessible to this larger network in a way that I've never had to do before. And I want to do it. And I like the—I don't want to call it pressure—I like the expectation, right, that they kind of share with me because they're giving me the sense that I have something to share."

"Well, it has really provided a network that I feel like is very supportive for me...It just has really kind of kept geoscience—creating these pathways across institutions and making the pathways visible, especially to the underrepresented students. Just having been part of this community that has that focus has really been helpful to keep me energized around those issues."

"I think the structures that are set up for reporting and the mile posting and these things are a way of kind of coordinating within collective impact are kind of good to be experiencing. I haven't done a lot of the actual documentation there myself, but just that organization and the gathering of that info as being key to the process of kind of keeping everybody in communication. Having the kind of common goals and common metrics known to everybody, I think that's been really useful."

Nine steering committee members (69%) described the shared measures component of the project and/or talked about evaluation broadly during their first interview, and 57% shared similar sentiments at the end of the project. During the first round of interviews, most shared the value of the checkpoint process and more than half noted the value of exploring student measures. The checkpoint process remained a key topic at the end of the project as well. Surprisingly, the student measures were only mentioned by those in the metrics working group during the second round of interviews. The approach used in the external

evaluation also surfaced as a topic at the end of the project. The first three quotes below are from the end of the first project year, and the last two are from the end of the project.

> "I think in terms of measuring impact, I'm learning by having other partners who are looking at my work and pointing out, 'Don't forget to download,' or 'Don't forget to do the brain dump so that we can understand what the impacts were,' and I think that's an important nuance that I'm learning to appreciate more, is that impact. I knew impacts matter. Now I know that it's so much more…and by having people that really expect these report-outs and really want to hold you accountable to be available, to hear back from you, has been interesting and challenging and helping me step up."

> "We're going to use an engagement survey tool and we're going to do a pre and post survey as well to see what the students learned. I'm learning a lot about the tools that are available to us."

> "Where I've learned a lot and I've really valued—when we get back together again with the checkpoints and talk about each pilot—I learned from the other pilots because they are approaching it in different ways. I think that a real strength is being able to have those multiple pilots, but then get together at some level. I think has been very good."

> "The whole interaction with the evaluation team—the more I interact with evaluators, the people who do evaluation, the more I appreciate how it isn't—it forces you to be clear about your intended outcomes and your goals in a way that you might not be if you don't have that interaction. So, that clarity of purpose and you know, 'What are you really trying to accomplish?' has been helpful."

> "I'm being exposed to different ways of evaluating projects, such as this protocol that you're using right now. And also, the approach of telling your story. Telling your story is very different from the evaluation approaches that have been used that I'm accustomed to or the evaluators I've worked with have done."

Discussion of the final pillar, mutually-reinforcing activities, was more prevalent in the second compared to first round of interviews. Eight steering committee members (57%) mentioned mutually-reinforcing activities at the end of the project compared to 23% who shared example at the end of the first project year.

At least one example was shared in relation to each regional alliance during both rounds of interviews. At the end of the first project year, all comments focused on a heightened awareness of common ground or common activities that could be leveraged to the benefit of a larger group of stakeholders. One example focused on aligning a geoscience focus with an organization's existing goals and interests. Another focused on specific activities that could be utilized to help key stakeholder groups achieve things that would not be possible on their own. The third focused on new connections to national resources that were made possible through EC that were leveraged at the local level.

At the end of the project, comments included ways that collaborative efforts contributed to an outcome that would not otherwise have been possible in executing a specific event or creating ongoing partnerships.

> "For me, maybe it fits better with some later questions, but this has helped me develop closer connection with the Oklahoma Geologic Survey. They have a big seismology educational project going on and this is—we didn't have as close

connections as I would have liked in the beginning, but I feel like now we're developing a closer connection. So, I see much more collaboration down the road that we might not have had otherwise."

"As a community-based partner to academic institutions, I think the role that we best play is to be a liaison with some real-world practicality as to how earth science could be utilized, in turn, back into communities. I think academic institutions, while great in terms of broad-based research and preparation for research, they may be slightly out of sync or out of touch with some real-world problems and what might be needed to create solutions for some of those real-world problems…Having a community-based partner to provide that feedback to our academic partners could be a value add that organizations lack."

"Well, the community resilience part also goes back to my exposure to collective impact and how I'm taking that into the work we do with Shakeout or the Earthquake Country Alliance group, which is a public/private partnership in California coordinating a lot of activities like meetings at baseball parks, like I'm going to right now."

Evaluator's Summary: EC as a Community of Practice

EC was structured to encourage the development of a community of practice to support a collective impact initiative. This social dynamic created a unique environment where members used this community to form relationships and partnerships that increased access to resources and knowledge. As evidenced by the interviews, EC has evolved into a well-functioning community of practice. Communities of practice are "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (Wegner, 1998). There was a clear indication in the interviews that activities, interactions, and knowledge capital were being leveraged by steering committee members to execute change in practice and performance, as well as to create new definitions for success (Wegner, 2011).

Being a part of a community of practice, at its most basic level, can be a rewarding and gratifying experience. Interviews from 2018 highlighted how this facet has been beneficial for steering committee members:

"I would just say that it's just been very different than any other grant projects I've been involved in, and so I feel like that's really been kind of refreshing. And there have been times early on where it's very uncomfortable so it's just like, 'Wait, I don't see exactly where we're going or what we're doing,' and it feels kind of undefined or ill-defined or ambiguous, but all along I could sense that there were some important pieces there and some important people. So, I really wanted to be a part of it even though it was uncomfortable at times, and I'm really glad that I did because I feel like things have come together, things have gelled a little bit and it's just really sort of given me new ways of looking at things other than just 'Okay, what's my next research grant that I'm going to apply for?"

"I'd just say that connecting with people that I've connected with—that's a value on its own. The project had a mission and all of that's great, but just personally having connected with the people I've connected, you know? Karen in evaluation to Cathy,

and like I said, personally with my local alliance and all the information I've gathered, but just the way I'm going to apply it moving forward."

While members indicated a general value in being a part of the community, they also used their access to the EC community in a number of specific ways as practitioners. Much of value appeared to come from acting on the *immediate* and *potential value* experiences from earlier in the project to create *applied, realized*, and *reframing* value later in the project. A key piece in this transition was the implementation of knowledge capital. Knowledge capital can be characterized by:

- *Human capital*, which includes new skills or perspectives
- *Social capital*, which includes relationships and/or connections to others
- *Tangible capital*, which provides access to resources
- *Reputational capital*, which includes status and recognition
- *Learning capital*, which includes new ways of learning outside more typical, formalized learning institutions (Wegner, 2011)

EC steering committee members gave examples of ways in which they had both gained and then used each of these types of knowledge capital during the project. This movement exemplified the ways potential knowledge had become something applicable in the professional lives of steering committee members, including the creation of new ways of doing work or by shifting perspectives.

Human capital	I'll talk about the checkpoint process. It's hard for me to point to a specific or remember the details of those discussions except that I found them very engaging, listening to how the various regional alliances were thinking about their work, and sometimes my role would be either to— you know, Cathy would assign people roles so my role would be to facilitate one of their discussions and summarize their comments that they left in their checkpoint reporting. And what I thought was really interesting was to see some of the changes they went through in their thinking, and I think something that was meaningful about it was to realize how much this involved—I don't know what to call it, maybe "systems thinking," where people had to be thinking about their regional alliance but also thinking about how that connected to the greater system of the project itself and navigate that and how people bounce back and forth and how as time went forward the regional alliances seem to find more value in the national alliance and in talking to each other. So, just watching that unfold I thought was a meaningful experience.
Social capital	I guess that's probably been—sort of feeling mentored a little bit by John and Kathy, I think has probably been the most meaningful social and professional connection that I made.[1]

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[1] The EarthConnections steering committee included the project PI, Cathy Manduca and the Kathy Ellins, who was a lead member of the Oklahoma Tribal Alliance.

Tangible capital	[…T]he Oklahoma Geological Foundation—I learned more about them and I also have been given a set of rocks now that I can use—they're these huge—they're big. They're like, samples of rocks, like a piece of quartz is like four inches by six inches. They're that big and beautiful, and I have been given a set of those to use for education purposes. I've even used them at the senior center in our community right here in Shawnee and the people love to see them. Again, it's a part of education and I wouldn't have been able to do any of that without this project. I wouldn't have really known about that.
Reputational Capital	I'd say that being on a campus that sees us help at serving the community. Being a part of EarthConnections helps to achieve or realize that goal. For example, it's included in the annual report for last year for the university. So, there's some value for the university and I'm coming from that perspective, from kind of the Clark Atlanta perspective. So, there was value for the institution and that was good.
Learning Capital	I don't think I would have had access to a peer group. Unfortunately, the environmental conservation spaces that I move in were largely all kind of cut from the same cloth, if you will. I mean, there are many scientists but we're not as deeply connected or rooted to academic institutions. EarthConnections has at least given me a space to be in that space. I really appreciate the fact that I have peer partners that I can talk about pedagogy with. I wouldn't have had that, and I certainly three to five years ago wouldn't have even used the word "pedagogy." And so—but yeah, you know, having a group other than my professional stakeholders and my community-based stakeholder partners has helped me personally and professionally.

This transition from a loose network to a realized community of practice is not inevitable. It is not uncommon for these types of communities to become stiff, too inwardly focused, or simply unhelpful distractions to the community members (Wegner, 2011). The data included in this report indicate that the EC project has been effective at forming a community of practice that provides value to its members in multiple ways. The collective impact model has served as a unifying force for this work, and seems likely to guide the implementation of the community into the future.