

**CLIMATE CHANGE EDUCATION IN INFORMAL SETTINGS:
USING BOUNDARY OBJECTS TO FRAME NETWORK DISSEMINATION**

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This study of climate change education dissemination takes place in the context of a larger project where institutions in four cities worked together to develop a linked set of informal learning experiences about climate change. Each city developed an organizational network to explore new ways to connect urban audiences with climate change education. The four city-specific networks shared tools, resources, and knowledge with each other. The networks were related in mission and goals, but were structured and functioned differently depending on the city context. This study illustrates how the tools, resources, and knowledge developed in one network were shared with networks in two additional cities. Boundary crossing theory frames the study to describe the role of objects and processes in sharing between networks. Findings suggest that the goals, capacity and composition of networks resulted in a different emphasis in dissemination efforts, in one case to push the approach out to partners for their own work and in the other to pull partners into a more collaborative stance. Learning experiences developed in each city as a result of the dissemination reflected these differences in the city-specific emphasis with the push city diving into messy examples of the approach to make their own examples, and the pull city offering polished experiences to partners in order to build confidence in the climate change

messaging. The networks themselves underwent different kinds of growth and change as a result of dissemination. The emphasis on push and use of messy examples resulted in active use of the principles of the approach and the pull emphasis with polished examples resulted in the cultivation of partnerships with the hub and the potential to engage in the educational approach. These findings have implications for boundary object theory as a useful grounding for dissemination designs in the context of networks of informal learning organizations to support a shift in communication approach, particularly when developing interventions for wicked socio-scientific issues such as climate change.

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PREFACE

I have appreciated the skill, ability and energy with which my colleagues in this project and in each city network have approach the work of inviting our communities into envisioning a world that limits climate change and addresses its impacts. Opening conversations and constructive thinking across varied experience in this way has been a joyful process, even in the face of such frightening future prospects.

I dedicate this work to my parents, Jake and Louise Steiner, who taught me to love learning and community life.

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1.0 INTRODUCTION

“Wicked” problems are unstructured, crosscutting, and relentless (Weber & Khademian, 2008). In the 21st century, climate change is perhaps the most challenging and threatening wicked problem. The science of climate change evolves quickly and requires a fairly sophisticated level of science literacy to comprehend (Intergovernmental Panel on Climate Change, 2013). Climate change education will be an essential piece of addressing the problem, but it too is challenging (Allen and Crowley, in press). Furthermore, social science research has shown that simply teaching people about the science of climate change does not necessarily change how people respond—the problem is so vast and complex that social norms, beliefs, and habits often trump knowledge when people make decisions about how to act in response to climate change (Kahan et al., 2012).

In this study, we explore an approach to climate change education that goes beyond teaching people about the science of climate change. Our approach is to focus on helping people understand and adapt to the impacts of climate change on their community. The study took place in the context of a larger project where institutions in four cities worked together to develop a linked set of informal learning experiences about climate change (Snyder et al., 2014). The idea was that each city would develop a network of local organizations interested in climate change because of work they do—be it policy, education, or service efforts. Together these organizations explored new ways to connect urban audiences with climate change education. The four city-

specific networks informed each other about progress and shared tools, resources, and knowledge with the support of a science museum, acting as a coordinating hub, in each city. From the beginning, it was understood that networks may need to evolve to reflect each city's identity, specific climate challenges and existing organizational landscape. Thus, the networks were related in mission and goals, but were expected to be structured and to function differently depending on the city context.

This study explores how the tools, resources, and knowledge developed in one city's network were shared with networks in other cities. The central problem in this cross-network dissemination is the problem of local relevance. In order to be most effective in engaging audiences in a city, informal learning experiences were tailored to address the interests, concerns and resources of public audiences in each city; as well as the interests, concerns and resources of the specific organizations that made up each city-specific network. While this approach maximized the fit of each experience to the city it was designed for, it created problems in sharing across cities. Essentially, the project ended up asking itself: How can we generalize from something that was designed from the outset to be fundamentally local?

Our work focuses on a pressing global issue, climate change. Climate change education is important for adults and children across multiple contexts (UNESCO, 1992) and this wide range of audiences adds to the complexity of developing and disseminating educational experiences. Indeed, we will argue in this paper that wicked problems such as climate change are precisely the problems that most urgently require us to go beyond the traditional "shrink wrap" approach to educational dissemination. Whereas formal education is compulsory, standardized, and occurs with specific audiences in structured environments (i.e., teachers and students in schools and classrooms), informal learning is interest driven, optional, non-standardized, and occurs with a

wide range of audiences in all sorts of settings (NRC, 2009). We know that dissemination is difficult in the relatively controlled and predictable context of formal education (Knapp, 1997; Cohen and Hill, 2001; Stein and D'Amico, 2002). So what hope is there for the less controlled and unpredictable context of informal learning? Rather than vetted, structured curriculum and kits focused on science content that can be “shrink wrapped” and used across contexts with little adaptation, we see a need for flexible, socially oriented learning that is adaptive in referencing emergent, local examples that can change across local climate and stakeholder conditions. Our hypothesis was that process would generalize better than product in the dissemination effort. Thus, we focused on sharing network-level learning processes where experiences, tools, and professional development could be adapted and customized from one city to the local context of another city rather than a more traditional dissemination approach that offers a set of kits and a handbook along with the presumption that program success would involve a similar delivery across sites.

To help with this complexity of context and topic, we draw on boundary object theory as a way to understand the dissemination process. Star and Griesemer (1989) defined boundary object theory as a way to understand their observations of the cross-disciplinary process of science as they conducted a study of the 1906 establishment of the Berkeley Museum of Vertebrate Zoology. They observed an emergent use of shared tools and processes by cross-disciplinary professionals that allowed the disparate goals, knowledge and perspectives of members to be met, while generating a scientific collection that allowed the scientific world to ask innumerable questions. They noticed that the creation and protocols and taxonomical systems maintained coherence across the intersecting social worlds of the varied administrators, collectors, educators and scientists involved in the museum’s development. They noticed a

balance of structure (the protocol for systemic gathering of biological data) and flexibility (the ability of multiple professionals and amateurs to contribute to the collection in meaningful ways and the myriad questions that could ultimately be asked of the collection by science). The ability of these structured yet flexible processes in coordinating dispersed work across diverse stakeholders became key features of a new theory in organizational and educational settings, boundary object theory.

Based on an extensive review of boundary object theory, twenty years into its use, Akkermann and Bakker (2011) synthesized the role of boundary objects into the ability to identify, coordinate and generate ideas, and collectively iterate on solutions to a shared problem, despite differences in a group's professional language, processes and goals. In addition to boundary objects, boundary brokers—the people who typically carry the objects across boundaries (Wenger, 1998; Kimble, Grenier, & Goglio-Primard, 2010; Fliggstein & McAdam, 2011)—play a role in creating trust and framing the objects in ways that constrain or open up their potential. Rather than dispersed contribution to a system as in Star and Griesemer's seminal paper, in learning contexts, boundary objects act as a touchstone to open up conversation and activate full group experience in generating collaborative thinking and solutions (Richardson, 2014; Warr & O'Neill, 2007).

In this study, the use of boundary objects as collaborative experiences that carry structured yet flexible core ideas is positioned as a way to understand dissemination of learning experiences across contexts. We explore ways that informal learning experiences developed in one city can be shared with another city and support customization while resisting “lethal mutations” (Brown & Campione, 1996) to core the principles that make the learning experiences

effective in the first place, and we look at the vision of boundary brokers, the hub staff in each city, in determining the boundary object use.

1.1 INFORMAL LEARNING

Informal learning is a broad term encompassing all the ways people are personally drawn to engage with arts, sciences, and humanities through the places and people they know, the values they hold, and the information they encounter through social interaction, nature, and designed experiences like exhibitions or media (NRC, 2009). This idea of learning across all aspects of life has been called life-long, life-wide, and life-deep learning (Banks et al., 2007). Learning is life-long in the sense that humans are always learning, although the goals, purposes, and mechanisms of learning may change across the life-span. Learning is life-wide, with a wide array of formats including the one-time experience of a television show, visits to museums, or participation in afterschool programs. Finally, learning is life-deep as it influences and is influenced by the social culture and context of the learner as they, for example, delve into medical knowledge based on the condition of a loved one, explore notions of environmental science or communications to help a community address a local concern, or learn the art of paper folding to make holiday cards for a friend. In other words, as opposed to compulsory education in the formal school system, this is interest-based or “free choice” learning that people select to engage in based on personal motivation, opportunity, and access to appropriate resources (Falk, 2001; Falk, Storksdieck, & Dierking, 2007).

The diverse audiences, settings, and topics for informal learning are reflected in the number and range of “sectors” that make up the field (NRC, 2009). Informal learning takes

places, among other contexts, in museums, on-line, in afterschool programs, during citizen-science engagements, through broadcast media, in print, in community programs, adult education experiences, during visits to parks and recreational areas, in the activities of hobbyist and advocacy groups, and more. On the one hand, this diversity of sectors and approaches is a strength. Informal learning experiences are often developed “bottom-up” through front-end and formative evaluation (McLean and Pollock, 2007) so that they are targeted to the needs of a specific audience in a specific context with specific learning objectives. This makes it more likely that people will choose to engage and learn. On the other hand, the diversity of sectors and approaches makes it harder to spread and share knowledge in the field. In fact, at one time, many informal learning institutions, like public television, historically did not even see themselves as being part of the field of informal learning, preferring instead to more narrowly identify with their sector (Falk, Randol, & Dierking, 2011).

However, in recent years the field has developed a stronger, unified identity around the concept of learning ecologies (NRC, 2009, 2015; Bevan, 2016). Following from Bronfenbrenner (1979), the idea of learning ecologies recognizes concentric spheres of influence starting with the individual then encompassing the local context of family, school and community. The model further expands to include layers of broader social conditions, politics, services, media that influence a person’s institutional access to cultural resources. Cremin (1976) called this unintentional side of learning “configurations of education” made up of the institutions, actors, places, materials, and ideas each individual encounters on their own path, in their own time, pursuing their own interests.

This idea has become important to informal learning professionals because it reframes the goal of designing experiences. Rather than creating a series of isolated sector-specific

experiences, informal learning designers have begun to think about how to create tools to support coherent and connected learning pathways (Baron, 2006; Bevan et al., 2010; Bell et al., 2012; Traphagan & Trail, 2014). Studies include the diversity and redundancy of resources within a particular landscape (Falk, Randol, & Dierking, 2012; Bevan, 2016; Pinkard et al., 2016) and how those resources interact (Ito et al., 2012; Russell, Knutson and Crowley, 2013; Kehoe, Russell and Crowley, 2016). As learning pathways necessarily cross and blur traditional sector boundaries in the field, informal learning professionals are looking now for news ways to work together to maximize the impact of informal learning experiences.

1.2 LEARNING ABOUT CLIMATE CHANGE

Climate change is an example of a wicked socio-scientific problem. It is unstructured in that there is no single source or outcome, crosscutting in that it is systemic in nature and behavior, and relentless in its cumulative nature with feedback loops and urgency (Weber & Khademain, 2008). Figuring out how to communicate the science of climate change is complicated. The phenomenon of climate change consists of multiple dimensions, such as geographical distance, temporal distance, social distance, and uncertainty/hypothetical distance and these dimensions may contradict each other and overlap (Brugger et al., 2015). The topic of climate change proves to be difficult for the general public to engage with productively. Often scientific complexity is the perceived barrier to engaging the public in behavior change and evidence-based decision-making. But what has come to be seen as the most crucial barrier to public engagement and behavior change around critical science issues are the social norms and values involved in a particular belief alignment, rather than lack of understanding of scientific evidence (Allen and

Crowley, in press). Because of this, “What does my community believe about this topic?” and “How do I align with them?” are the more salient questions to people confronting or avoiding these critical science issues. Allen and Crowley argue that prior approaches to climate change education have often been grounded in a knowledge-first approach to behavior change, using the assumption that if people are taught how climate change occurs then they will change their behavior to reduce the impact. In this context, the low hanging fruit of ready-to-disseminate educational experiences would focus on bits of scientific knowledge such as how the greenhouse effect works, the factors that cause sea level rise, or the ways that individuals can reduce their carbon footprint by driving less or changing their light bulbs. However, although most prior studies make this assumption, there is little evidence that learning per se is likely to lead to adaptive behavior change. Rather, social science research indicates the necessity of considering a learner as part of a community with a shared set of norms and values and with emotional responses to information. Knowledge alone is certainly not sufficient (and perhaps not even necessary) in generating behavior change in ways that will enable effective society-level responses to climate change. Recent research argues instead for human scale stories (Kahneman, 2011), education that addresses values, ideology and place attachment (Marshall, 2014), with attention to personal experience (Marx et al., 2007; Sterman, 2011; CRED and EcoAmerica, 2014; Corner et al., 2015).

The climate education project we study here was guided by three learning principles that were meant to be at the heart of each learning experience they developed (Allen & Crowley, 2016). These principles acknowledge the person in context, to better support social engagement with complex socio-scientific concepts. The first is *relevance*, the idea that the topic must be presented in a way that meshes with a person or community’s interests and experience. The

second is *participation*, connection to a role, a way to engage, a possible next step with others to create a social identity with the topic, and finally, *interconnectedness*, the idea that learners need to understand the ways elements of the issue impact other elements creating problems or co-benefits, for instance planting trees helps to reduce urban heat island effects, but can also reduce storm water run off and lower electric bills in buildings. Interconnectedness also relates to understanding that the learning they engage in around the issue is connected to other learning opportunities in their communities for instance, a local watershed group might present an extreme weather kit and then invite the public to a local remediation effort they are leading.

The idea is that when these principles are included in educational experiences, members of the public have a sense of larger collective efficacy, in that they have familiar concrete examples to relate to the topic and invitations to next step opportunities that allow them to engage in behavior change with others. This movement from individual to group interest helps the public see the local capacity of potential collective behavior as being commensurate with the issue at hand and therefore worthy of an investment of personal energy (Brugger et al., 2015). We also note that the principles of relevance, participation and interconnectedness fit well with learning ecologies notions of a web of possible actors and resources within a community that create the social norms and influence on learner experiences.

1.3 SHARING KNOWLEDGE THROUGH BOUNDARY OBJECTS

Our study takes place in the context of the Climate Urban System Partnership (CUSP), which was a collaboration between informal science institutions that act as hubs for local networks in Pittsburgh, New York City, Philadelphia, and Washington DC. CUSP aimed to change public

engagement around climate change from the debate about whether or not climate change is happening to a more proactive conversation about how cities might mitigate or adapt to climate change. An important part of this was to shift the educational focus from changing individual behavior to that of collective behavior that can impact city-level systems, which reflects a community and collaborative approach to sustainability (Snyder et al., 2014). In the CUSP plan, each city hub institution would develop a local network to identify city-specific learning experiences, but the hub institutions would be in conversation with each other throughout, and, at critical moments in the project plan, would disseminate learning materials between cities.

Initially, we thought about dissemination between the four cities in CUSP as a jigsaw puzzle. To divide and conquer, each city would take on the role of developing and refining a unique “learning platform” which, when perfected, would be a piece of the puzzle that could be straightforwardly adopted by the other cities. Thus, by the end of the five-year project, each city would have a complete suite of tools to support their learning ecology for climate change. Snyder et al. (2014) characterized the four platforms as temporal (programming for time-bounded events such as city festivals), neighborhood (programming focused on specific geographic spaces), cyber (web-based communities), and community of practice (learning and development for professional audiences concerned with climate change education).

However, as the four cities approached the first major dissemination moment in the middle of the second project year, it became clear that dissemination might not be so straightforward. Although these Northeastern U.S. cities shared the same basic climate change future (hotter, wetter weather), the particular examples, strategies, and audiences in each network also had highly localized components that might not necessarily resonate with partner organizations or public audiences in another city.

Furthermore, it was becoming clear to us that the networks themselves were developing their own unique approaches. The hub institutions differed in the resources they offered to the network in terms of funding, in-house expertise, and how they arranged their work with the network. Each city network was shaped by member composition, which varied to include organizations focused on policy, education, advocacy, service and community development. Networks also varied in the extent to which participants come from the organizational leadership vs. front-line staff. It was becoming clear to the project that dissemination between networks would not be as straightforward as shrink-wrapping experiences and shipping them off to another city for easy implementation.

It is helpful, at this point, to turn to theory around networks to guide our thinking about how knowledge might be shared and implemented effectively in the context of network-to-network variation. There are many ways to define networks. Some definitions highlight differences in how people join, the kind of focused or diffuse work they do, or how the network is managed in distributed or centralized ways (Lima, 2010). Building on an extension of the communities of practice theory developed by Lave and Wenger (1991), collaboration between a heterogeneous group of organizations is sometimes referred to as a boundary space (Wenger & Wenger, 2015), or a place between communities of practice. This shared space at the boundary of practices draws on the differentiated practice of adjacent fields, with their unique values and implicit rules of practice. It is an innovation space that can allow groups to problematize and address shared complex problems with solutions that emerge from groups and resources that might not have been accessible otherwise (Kania & Kramer, 2011). In collaborative problem solving and planning fields, the benefit of diverse networks operating in boundary spaces include access to the range of expertise, perspective and resources of the group, while the constraints are

associated with generating understanding across fields and productively managing conflict and consensus (Fligstein & McAdam, 2011; Innes & Booher, 2010; Kania & Kramer, 2011).

Sometimes, in a boundary space, in addition to a process, a physical tool can help with the definition of problems and negotiation of solutions. In their extensive review of boundary crossing and objects, Akkerman and Bakker (2011) note the value of research on boundary objects as an acknowledgement of the increasing diversity in and between school, work and everyday life. Star and Griesemer (1989) originally conceived of boundary objects as a tools to help in analyzing collaborative work in the absence of consensus (Star, 2010) allowing them to focus more effectively on work processes and arrangements and to see tacit practices. Indeed, because boundary objects help to externalize thinking (Richardson, 2014). They often emerge in areas addressing complex social problems where values and goals are not necessarily aligned and norms of practice can be hard to identify (Sismondo, 2010).

Education reforms are susceptible to the notion of “lethal mutations” when implementation takes a compelling transformative practice and turns it into a surface level routine thus losing the intended educational goal (Brown & Campione, 1996). In a similar way, Star and Griesmer (1989) emphasize that boundary objects are about the activity the object inspires, rather than the object as a product.

In light of all this, the project decided to approach dissemination as a design product, testing to see if and when the learning principles of relevance, participation and interconnectedness were supported by boundary objects as they help to convene, ground, and support generative thinking in networks (Cobb et al., 2003). This grounding in the beliefs underlying the intervention helps to support the intervention’s ability to retain core features as it is adopted in new contexts (McKenny and Reeves, 2012). Star and Griesemer (1989) thought

about this plasticity of boundary objects as the balance between ill-structured and tailored uses of objects. The idea of engineered implementation (Burkhardt & Schoenfeld, 2003) or emphasizing the principles behind the intervention over the products, is familiar in implementation studies in education and management (McLaughlin, 1990; Hargreaves, 2002; Sherin & Han, 2003; Datnow & Park, 2010; Sabelli & Harris, 2015). Working with others on shared practice creates opportunities to provide objective, supportive feedback about how an actual activity went, rather than talking in abstract or subjective terms (Burkhardt & Schoenfeld 2003; Bryke, 2009). The process itself not only develops relational trust and social capital among members when successfully implemented (Gadja, 2004), but provides a process to problematize and improve practice (Cobb et al., 2003). Network learning approaches are time intensive, and rely on the network's enthusiastic participation. Thus, the project's idea was that not only would the eventual learning experiences be more potent when grounded in each city's specific content, the networks themselves would be stronger as a result of having tailored learning experiences to their own context.

1.4 RESEARCH QUESTIONS

The current study focused particularly upon the temporal platform developed by the Pittsburgh network as it was shared with the networks in New York City and Philadelphia (See Appendix A for a taxonomy of project related terms). This platform is called temporal because the notion was to reach the public at festivals, time-bound events where people gather around a social experience or to explore a topical interest. Local organizations convene at these events to market their work through activities, food or promotional materials. Over two years, the Pittsburgh

CUSP network developed a set of 12 table-top exhibit kits for use at community festivals. These kits supported participatory experiences where public audiences explored different climate change topics, facilitated by members of the CUSP city network. The kits were made of everyday materials, they were easy to carry, and they were designed to provide an intuitive way for members of the public to engage climate change through familiar game play or modeling of systems (See Appendix B for a list of kits).

We approached the sharing of this platform across networks from the standpoint of boundary object theory in that the actual kit or festival plan was not as important as the principles of relevance, participation and interconnectedness embedded in each activity, in fact we expected variations and changes to the actual activities and public presentation approaches based on consideration of these principles. As we studied how the kits were shared with New York and Philadelphia, we explored three research questions:

Research Question 1. What is each hub's vision for how the kit platform may be useful in their local context?

Research Question 2. What did dissemination implementation look like in each city? What evidence is there that the implementation tools and processes acted as boundary objects that helped in convening diverse partners, coordinating thinking, and generating a shared iterative process in each context?

Research Question 3. What evidence is there that CUSP learning principles were taken up by network members in each context?

2.0 METHODS

2.1 DATA COLLECTION AND MANAGEMENT

As the lead researcher, I acted as a participatory observer both in the design and implementation of structured aspects of the intervention (Spradley, 1980; Creswell, 2007). In collaboration with the Pittsburgh hub, I worked with each city hub to co-define, plan, and lead local dissemination events (Roschelle & Pennuel, 2006; Penuel, Roschelle, & Schechtman, 2007). This was a co-designed study that meets descriptions of design based research presented by Barab (2006) in that there is a complexity of variables in the research; not all the variables are identified in advance with some emerging through implementation; research procedures are flexible and evolve during the study; complex social interactions involve collaboration and sharing; the participants in each hub institution influence the design of the study; and the reporting involves a description of design in practice. Along these lines, the timing, goals and leadership roles for these events were determined in collaboration with the focal hub coordinator in each city. As a result, roles for the hub institution staff members in each city, the hub coordinator from Carnegie Museum of Natural History in Pittsburgh, the initial kit building institution, and me, as participant observer, varied from city to city, based on a city's interest and needs.

For each data collection moment, I reviewed and transcribed field notes into an expanded form to clarify and better describe the context and wrote reflective summaries about the process

to record ideas that were of interest or surprised me (Spradley, 1980). The field note taking process varied based on my designated role. As a facilitator of dissemination experiences, I created reflective summaries just after the event and then drew on collaborators' protocol-based observations. I also solicited, written co- reflections from co-facilitators to fill in gaps in my perception of the event. As a participant, when collaborators led activities, I took notes as events unfolded, guided by a protocol, then reviewed and expanded notes post event, again summarizing themes noting questions that emerged through the process. As an observer of festival activities in public settings, I used an observation protocol to document the day's activities, jotted down general notes about the day, crowd, and festival set up, and then transcribed my field notes into an expanded narrative post event. Each dissemination event was followed by a debrief discussion with key planning collaborators from hubs, to review the collective experience. These discussions resulted in notes and a brief summary of my immediate response to the discussion. In most cases they were recorded and later transcribed.

Dissemination events in this study occurred across the year 2015, during the third year of the CUSP project. Dissemination events took the form of a network meeting and a festival implementation, each with elements of climate change related activities intended for public audiences. Post dissemination, I also conducted follow up interviews with hub staff and partners in each city about their experience with kits and festivals.

Table 1: Timeline of Dissemination Implementation

Date	Activity
1/8/15	Platform dissemination call (NYC, PGH, PHIL, Researcher)
3/26/15	NYC kit workshop
4/8/15	PHIL network meeting “Chat and Chew”
5/2/15	PHIL festival “Climate City at Philadelphia Science Festival Carnival on the Parkway”
9/12/15	NYC festival “Queens Library Street Festival”
October- November 2015	Interview with NYC Hub staff member: 10/23/15 Interviews with four NYC partners: Ella 10/22/15; Paul 10/27/15 Sophia 10/28/15; Emma 11/10/15
October 2015	Interview with PHIL Hub staff member; 10/30/15 Interviews with 3 PHIL partners; Jackson 10/23/15 and 10/27/15; Michael 10/28/15; Hannah 10/29/15

Multiple sources of data and data collection procedures were used to answer the study's research questions. They are outlined in the sections below organized by their relationship to the activities in one cycle of kit dissemination including 1) planning the dissemination with the Pittsburgh educator and each hub coordinator; 2) a meeting of the city network to explore kit-based activities; and 3) a public festival where kits were used to engage city audiences with climate change education. Finally, these activities were followed by 4) post-dissemination interviews with hub and partner staff members that referred to each step of dissemination, including future plans.

2.1.1 Planning

Hub staff participated in planning meetings with the Pittsburgh hub and me to define the goals, schedule and activities for the kit platform dissemination in that city. An initial call between New York City, Philadelphia and Pittsburgh was recorded and transcribed, with subsequent emails and drafts of meeting agendas further documenting this planning process.

Table 2: Planning Data Sources

Data type	New York City	Philadelphia
Notes	Platform planning recording and transcription “Climate City” festival planning recording and transcription	Platform planning recording and transcription
Emails	30 planning emails between NYSCI and researcher	20 planning emails between TFI and researcher
Agenda	5 draft iterations	2 draft iterations
Artifacts	PowerPoint slides, workshop guide recruitment email, and festival passport	PowerPoint slides, feedback posters, and recruitment email
Research Tools	Workshop observation protocol, festival observation protocol, festival intercept survey, and evaluation form	Workshop observation protocol, festival observation protocol, festival intercept survey, and evaluation form

2.1.2 Network meeting

As part of the co-design process, each city chose a different approach to dissemination however both began with a network meeting. New York City co-planned a three-hour professional development meeting that included an introduction to kits, exploration of facilitation of kits and the potential public experience with them, and prototype building. The meeting culminated with a hub-led discussion about what should happen next with this platform in New York City (see

Appendix C). Due to my role in facilitating much of the workshop, field observations were taken by a second researcher using a co-designed protocol tied to the workshop agenda (see Appendix D). The observation protocol included an engagement scale at the top of each agenda section with a ranking from “none” to “all engaged” and a place to enter examples of observed engagement behaviors. Prompts relevant to each segment of the agenda solicited descriptions of participant experience. For instance, in the roundup the prompt read “which kits participants are most excited about and why.” The protocol guided observation to topics of interest to the group, interactions between people and perceptions of kits as a useful tool for the network.

Philadelphia hosted a two-hour meeting to orient partners to an upcoming festival where partners would collectively present their organizations under the umbrella of a “CUSP Climate City”. At the network meeting they shared and critiqued existing partner activities, learned about the festival and planned a layout for their “Climate City” area within a larger festival. Facilitation tips and climate messaging that might be useful with skeptical members of the public were also presented (see Appendix C). Using an observation protocol again tied to the meeting agenda (see Appendix D). I took field notes. I paid particular attention to network dynamics, i.e., partner and partner/hub interactions, apparent level of comfort giving or taking critique and interest in using kits across organizations. The protocol also prompted attention to how the activities elicited partner talk related to the learning principles, i.e., any climate or city solutions talk, talk about the public engagement with activities, verbal suggestions exchanged about qualities of activities being presented,

In both contexts, I gathered artifacts of programmatic materials developed during the workshop i.e., photos of participants in action, and photos of physical activity and kit prototypes, later annotated with descriptions. I also captured group discussion notes posted in room, and

evaluation, and workbook responses. Immediately after network meetings in each city, I led and recorded a debrief meeting with the core facilitation staff from the hub museum, the Pittsburgh hub coordinator and, in New York City, another researcher who observed. That same day I created a summary reflection about the interview and later transcribed the recordings (New York City) or verified a research assistant's transcript of the recording (Philadelphia).

In New York City because of my role as a facilitator and the large amount of small group work that occurred, I also crafted an email to other facilitators to capture their reflections providing wider perspectives on the event. Reflective prompts included specific feedback on participants they worked closely with, thoughts on the specific segments of the workshop, and their personal "big take away" from the meeting. Another researcher transcribed observation notes and created a report including evaluation responses. Combining these data, I generated a descriptive summary of the event, shared that summary with city hub staff to verify the narrative and noted their feedback and questions in the summary.

Table 3: Network Meeting Data Sources in New York City and Philadelphia

New York City Kit Workshop, 3/26/15	Philadelphia Festival Planning, 4/8/15
Observation field notes, second researcher expanded notes, evaluation results	Observation field notes expanded notes, evaluation results
Participant group notes on kit features	Participant group notes on each other's activities
Photos of participant notes in kit individual workshop guides	
Photos of three group prototypes and workshop process	Photos of partner activity exchange and workshop process
Debrief with facilitation team recorded and transcribed by researcher	Debrief with facilitation team recorded, transcribed by research assistant and verified by researcher
Post event, written reflections from two NYSC facilitators, one TFI visitor, one CMNH facilitator and researcher	
Participant roster	Participant roster
Summary report combining debrief, expanded field notes, evaluation results, reflection notes, and hub verification notes	Summary report combining debrief, expanded field notes, evaluation results, and hub verification notes

2.1.3 Festival

Each city network presented kits at a community festival as a collaborative CUSP group. In other words, multiple partners shared a common space and banner within a community festival, where they facilitated activities and began a climate change conversation with the public. I observed these festivals, took pictures and administered surveys to public audiences during the course of each 5-6-hour event. General observations of the overall festival were made to about set up and context. Multiple discrete observations of facilitators using a specific activity with the public were conducted across the day. These observations were guided by a protocol and occasionally followed by a brief interview with an observed member of the public who had demonstrated focused engagement with the activity (see Appendix F). The activity protocol prompted for examples of facilitator actions (lectures, poses questions, answers questions prompts inquiry), visitor engagement (looks, touches, chats, highly involved). Conversational prompts included specific emphasis on activity, climate message, city solutions and personal connections. The duration of the experience was recorded and several families who showed some interest in the activities were interviewed. Questions included they had been to the CUSP Climate City, how they would describe the experience (with the kits just observed) to a friend, and how would they get more involved in that topic if they were interested. New York City also created a passport for the public to encourage visits to multiple stations, 20 were completed and returned to the festival booth.

Similar to the workshop events, I documented experiences, transcribed observation notes, wrote day-of memo of experience and created a festival summary document including observations of the day, photographs, and reflections from the dissemination city. This document was shared with hub city for comment and pertinent changes were incorporated. I also led a

debrief conversation during the van ride home in New York City, writing up the notes immediately after the unrecorded talk. In Philadelphia, we scheduled a post-event phone call that was recorded and transcribed.

Table 4: Festival Data Sources

<p>New York City Climate City 9/12/15</p>	<p>Philadelphia Climate City 5/2/15</p>
<p>Observations of facilitators with four kits: Extreme Weather, Hidden Cost Café, Tiny Slimy Carbon Keepers, and Get to the Game</p>	<p>Observations of facilitators with seven kits: RE: Our Creative City; CAC: What’s that Smell?; ECA: How do air and energy work in homes?; PHS: Are Trees Your New Best Friend?; FoN: How do local gardens help a hotter wetter Philadelphia?, GT and TFI: Is Your Row Home Ready?, and FWW: Do I live in a watershed?</p>
<p>Debrief notes from van ride home</p>	<p>Debrief call recording and transcript</p>
<p>20 passports filled out by visitors</p>	<p>Impromptu visitor interviews</p>
<p>Photos of event and activity stations</p>	<p>Photos event and activity stations</p>
<p>Expanded field notes</p>	<p>Expanded field notes</p>
<p>Summary report combining debrief, expanded field notes, and hub verification notes</p>	<p>Summary report combining debrief, expanded field notes, and hub verification notes</p>

2.1.4 Interviews

When platform dissemination experiences were completed, hub staff identified partners for a post-dissemination interview. The common criteria for selection across cities was that partners attended at least one of the dissemination events. Beyond that criteria, participants fell into a range of organizational types with varying experience within the local network and in the longevity of their relationship with the CUSP project itself (see Appendix G).

Table 5: Participant Pseudonyms and Network Organizations

NYC/NYSCI: Abriana, Special Projects Manager and CUSP Hub coordinator for 4 years. Led implementation for all dissemination events for New York City.

NYC/ We Grok It: Emma, founder of citizen-science education community-based program. Emma has been active in CUSP meetings and collaborative program design for 1 year. Attended kit workshop.

NYC/Trust for Public Lands: Sophia, outreach educator for group that establishes parks and public spaces often in partnership with schools. Sophia has been involved in CUSP meetings for 1 year. Attended kit workshop.

NYC/Queens Public Library and Discover Center: Ella, director of science-focused Discovery Center within a large youth-serving library. Ella had been talking with CUSP for one month, and this was her first meeting. Attended kit workshop, hosted festival.

NYC/Queens Community House: Paul, director for teens' and children's programs for this settlement house agency with multiple sites across Queens. This is Paul's first CUSP meeting but the agency has been a CUSP partner for 1 year. Attended kit workshop.

PHIL/TFI: John, CUSP hub coordinator has been involved in CUSP for 2.5 years and led implementation for all dissemination events for Philadelphia.

PHIL/Green Treks: Hannah, educator for environmental education group and also an independent education consultant has worked with CUSP to develop and implement curriculum. She has been involved with CUSP for 3 years. Attended network meeting and festival.

PHIL/Clean Air Council: Jackson, outreach coordinator for air quality advocacy group. Jackson has been an active member in CUSP for 1 year. Attended the network meeting and festival.

PHIL/ Energy Coordinating Agency: Michael, outreach coordinator for energy efficiency service group. Michael has been an active member of CUSP for 1 year. His agency was involved before his arrival. Attended the festival.

Interviews were semi-structured (Rubin & Rubin, 2005) and contained four sections (your organization, you, kit dissemination, kit features and how you plan to use them) with a total of 21-36 questions (See Appendix H). The interviews lasted from 30 minutes to two hours (in one case, across two calls) depending on the participant.

Partner interviews began with information about the person, their prior experience and organization's activities. The discussion then moved to questions of how CUSP aligns with their institution, what they thought of the dissemination experiences and what might have made them better, and ultimately how they thought about the specific activity they were involved in through dissemination (kits or festivals) and how ideas from that process were supporting or changing their own work, if at all.

Hub coordinators also agreed to participate in a similar interview to reflect on their experience over both dissemination moments. As with partners, hub interviews began with contextual questions about the coordinator's background, their goal for the kit platform in their museum and city, and how that goal played out, or not. In addition they were asked to characterize their network and the roles they play in CUSP. Then the interview focused on the kit transfer process in terms of the design goals for the dissemination and the ultimate implementation of that design in terms of their own learning, challenges, and/or value for the process, their perception of their partners' experience and possible next steps for CUSP in relation to this platform in their city.

2.2 DATA ANALYSIS

Prior to analysis, all interview data were coded to indicate at which parts of the interview participants were referred to the planning; network meeting; or festival phase of dissemination. (Data that were collected during a particular phase (e.g., observations) were by default, coded as referring to that phase).

2.2.1 Research Question 1: What is the hub's vision for how the kit platform may be useful in their local context?

Using just the data coded as referring to the planning stage, I iteratively searched for evidence of local context (e.g., network structure, hub resources and stance, partner organizations, collaboration history) and evidence of a specific vision for the dissemination. Themes emerged that were then discussed with another researcher, revised, and reapplied to another iterative pass through the data. Based on continued conversation with the other researcher, descriptions were constructed and iteratively revised for each city that summarized context and vision.

2.2.2 Research Question 2: What did dissemination implementation look like in each city? What evidence is there that the implementation tools and processes acted as boundary objects that helped in convening diverse partners, coordinating thinking, and generating a shared iterative process in each context?

Using data identified as pertaining to the network meeting and festival data sources, I coded for evidence that the dissemination process exhibited features of boundary-objects: convening,

coordinating thinking, and generating a shared iterative process (Table 6). These codes were developed initially through a literature review that compared a variety of features of boundary object use.

Table 6: Boundary Object References

	Convene Diverse Groups	Coordinate Thinking	Shared Process	
Warr and O’Neill, 2007	Elicit conversation	Create shared language/ understanding	Generate critique	Generates new knowledge
Akkerman and Bakkar, 2011	Identify the nature of boundaries	Reflection on process- perspective making/taking	Coordinate efficient cooperation	Transformation in practice/ knowledge
Richardson, 2014	Convene groups	Externalize thinking through “messy” examples	Generate improvements	Transform thinking

Sub codes and decision rules were then developed iteratively in conversation with another researcher. From the coded data, cases were constructed for each city’s collaborative process around adopting the kit platform (Table 7).

Table 7: Decision Rules for Boundary Object Feature Codes

	Code	Sub codes	Decision rule, evidence of dissemination
Boundary Crossing Features	Convene	in bold	(+) attracting diverse participants and creating an environment conducive to engaging around the CCE. (-) attracting homogeneous participants , little variety in interest and point of view.
	Coordinate	in bold	(+) engaging partner/hub collaboratively in thinking about kits and about kit design process in ways that bring out unique thinking across network members, surface terms or concepts , help to identify specific variables or solutions to a CCE, discussion about multiple outcomes for CCE. (-) resulting in solitary work , single message designs by participants
	Shared Iterative Process	in bold	(+) supporting partners in picking up and testing or adapting group ideas , expressing interest in the process and principles in the CUSP approach. (-) sustaining notion that CUSP work is separate from institutional work , misconceptions or lack of connection to or CUSP principles, focus on knowledge first approach instead.

2.2.3 Research Question 3: What evidence is there that CUSP learning principles were taken up by network members in each context?

Using data that pertained to the network meeting and festival data sources, I conducted a second coding process to identify evidence that the networks grappled with and implemented the core CUSP learning principles of relevance, participation and interconnectedness (Table 7). Descriptions of whether and how this occurred for each city were constructed, discussed, and revised with another researcher.

Table 8: CUSP Learning Principle Code Decision Rules

	Code	Sub	Decision Rule (+/-) Evidence of partner/hub:
Learning Principles	Relevance	In bold	(+) consideration of personal or public experience with, current activity around, hope or fear about, interest in, or other affect toward CCE (climate change example). (-) lost interest in CCE (personally, or their perception of low interest to public audience or organization).
	Participation	In bold	(+) thinking about how to move beyond individual action to group/system level solutions . Evidence of thinking about particular next steps or ways to draw public into the CCE. (-) focus on individual action, lack of next step notion.
	Interconnectedness	In bold	(+) considering system or cross system impacts of CCE; more than one relevant network connection to CCE, co-benefits or impacts of the CCE. (-) intentional exclusion of climate change impacts in the experience due to organizational preference, choosing a knowledge first or socially irrelevant approach to climate change education over the CUSP approach.

Both of the two coding passes involved constant revisiting of data sets, documenting emergent themes in research memos, and realization that the parallel activities of boundary object features and learning principles created some overlap in coding, for instance, the “participate in climate change education” example often overlapped with “coordinate thinking within a meeting or public engagement experience”. So the data were considered in a fresh way with each analysis wave, while still taking note of the parallels between.

3.0 FINDINGS

Our analyses contrast the two cases in order to explore how differences in hub structure, goals and network membership impacted dissemination of the CUSP kit platform to each city. At the most general level, our findings suggest that the two cities used the dissemination moment in different ways that helped them advance the needs of their network at the time. Perhaps the easiest way to think about this difference is to think of New York City CUSP as a “push” network and Philadelphia CUSP as a “pull” network. As described below, New York City was a network that prioritized learning together. Their culture was to approach network activities as a way to push the responsibility for ideas and execution out to the members of the network, establish a common vision, and prioritize cross-fertilization of approaches across network members. Members participated in network activities as learning opportunities.

In contrast, Philadelphia CUSP approached working together as an opportunity to “pull” organizations into the project. Their culture was to think about how the ongoing work of members could be linked together to form larger messages that would reach more people than most of the individual organizations could reach by themselves, and that emphasized concrete next steps that the public could take to respond to climate change. Rather than diffusing responsibility and vision across partners, the move in Philadelphia was to pull partners into common work would allow the hub to achieve its own impact goals throughout the city.

3.1 RESEARCH QUESTION 1: WHAT IS THE HUB'S VISION FOR HOW THE KIT PLATFORM MAY BE USEFUL IN THEIR LOCAL CONTEXT?

Although organized as part of the same cross-city project, New York City and Philadelphia CUSP evolved to reflect their local contexts. The goals and resources of the hub staff, the nature of the organizations in each network and the issues and opportunities in each city, all impacted how the networks approached adaptation and uptake of the kits.

3.1.1 New York City CUSP

Network Kit Prototyping Workshop. New York City's CUSP effort is led by the New York Hall of Science (NYSCI) in Queens, NY. NYSCI is part of a founding wave of institutions that emerged in the 70s and 80s known as science centers—educationally-oriented museums that hold collections of phenomenological or interactive exhibits. NYSCI is located in Corona, one of the most diverse urban centers in America with immigrant populations from all over the world. The museum has a reputation for being very connected and committed to the local neighborhoods, especially through its youth programming.

The hub facilitator, Abriana, came to CUSP with prior interest and academic experience in climate change science, cognitive studies, and the process of iterative program development. In particular, she was a curriculum developer on a prior project focused on urban pollution, where she developed, vetted and refined curriculum through a summer camp testing process with New York City middle and high school students. Through this work, she learned how to think about sustainability in terms of systems and networks (Abriana, NYCSCI interview, line 1), and became a strong advocate for iterative activity design. She has been at NYSCI for 8 years, where

she leads special projects and online professional development. CUSP draws on 30 percent of her time. Staff support for CUSP New York City also includes 20 percent of two educational program developers, Joshua and Alison. Together, the team plans meetings, designs CUSP educational tools and tests those designs with partners and at partner sites.

Recently, NYSCI launched a new institutional initiative called design/make/play to reframe its outcomes and to prioritize the processes of learning over the products of learning (Honey and Kanter, 2013). As CUSP began testing out ideas and building its network, Abriana was balancing the needs of her network with the needs of her institutional mandate:

...this (new) initiative right now (is) really our focus. Everything has to align to that. So (I'm) thinking about how CUSP actually aligns—and making sure that it does fit, because everything that we're doing right now really has to fit under this umbrella. (Abriana, NYCSCI interview, line 8)

New York City CUSP has 36 partners from across the metro region including organizations in Manhattan, Queens and Brooklyn (Appendix G). Partners range in structure and audience with combinations of local, national and/or international audiences and some organizations with multiple locations regionally. Partners focus on education, advocacy, community development, and service, along with some city utility/government agencies. For instance, in advocacy, a group of partners lead a white roof initiative to address urban heat island issues and energy efficiency. For science education there are informal educators at museums, zoos and botanic gardens. Community-based educators work in afterschool and in-school programs. These educators are particularly interested in the kits as part of their ongoing programming and staff development offerings.

Each partner participates in the network in different ways. In her interview, Abriana named some of these roles: *connectors* who bring in new partners and talk about CUSP at outside meetings, *cheerleaders* who are great engaging in CUSP ideas in CUSP meetings and

outside the network, *stalwarts* who always show up and get things done, and *brainstormers* who push the network to think outside of what's traditionally done in informal settings box (Abriana, NYCSCI interview, line 11). In terms of how and why people join in, she says that partners sometimes engage around a discrete topic and work on it until it can be taken on by the broader network, others participate in an ongoing way across topics and efforts.

Abriana describes the network as an enthusiastic group, fully dedicated to their work. It can be hard, however, to get the network together because of long travel times between locations across New York City. Every face-to-face meeting, then, is a big commitment. But getting there appears to be worth it, when possible.

When I walk into a network meeting, it just feels comfortable, because people are happy to see each other, people are excited to share ideas. (Abriana, NYCSCI interview, line 11)

This sentiment is echoed by partners who also cited network meetings as an opportunity to get access to new tools, share ideas with people, or as one partner said:

...here's something I can glom onto to help me do what I'm tasked with doing ...I'm always thinking, there's lots of other brains out there who are working on this and I'm always really excited to connect with that. (Ella, Queens Library, interview, line 141)

Indeed, Abriana's sense for partners' value in participating in CUSP is the opportunity to network more than "a burning desire to transform what they are doing... they are looking to make connections" (Abriana, NYCSCI interview, line 13). She also notes that co-developed CUSP activities, "take a little bit of work off each partner's plate" (Abriana, NYCSCI interview, line 13). The work she and Ella refer to is that of developing educational experiences for targeted audiences. She hopes the network will take on CUSP tools and make them their own, and sees her role as an evolving one—first introductory, supporting participation, and then acting as part of a more equal-status network where everyone develops and uses tools and finds uses for them.

Thus, Abriana views success as network co-design and active negotiation of the value of CUSP tools. With each network engagement, partners should feel more confident grappling with core CUSP ideas in future network activity. Abriana hopes partners will develop more autonomy to take the CUSP ideas forward without NYSCI always being explicitly in the lead. This is partly practical—she does not have resources at the hub to do everything that the network might like to do. But she also sees empowerment of the network members as aligned with NYSCI’s new organizational mission that focuses more on process than product.

Vision for CUSP kit platform: From the start, Abriana expressed interest in kits as a potential professional development and network-building activity:

I think (kits are) the most concrete thing for people to wrap their minds around. Especially, as a lot of our early partners, other informal education institutions, are used to going straight for that kind of activity. (Kits were) always a good touch point to help ground what we were talking about. (Abriana, NYCSI interview, line 16)

Now, in order to fully incorporate kits into CUSP New York City’s work, Abriana was ready to systematically develop the networks’ capacity to develop and deploy their own kits:

The next step for us is how do you start from scratch with a kit? How do you pick the topic, what are the steps that follow after that to realize a fully formed kit at the end? Because right now, they give feedback on a kit and maybe one or two people help us tweak it, but they don’t have the same sense of ownership as if a subset of the ULN conceived of the idea and followed it through all the way to the end. So that’s one thing, start to finish what does that process look like? (Abriana, New York City and Philadelphia planning call 1/8/15, line 29)

Abriana positioned the kits as concrete examples of and an opportunity for engagement with the CUSP approach.

I always wanted that part of it (the kit workshop) as training for us, but I also think the process is really important. Thinking not just “here I’m going to hand this to you,” but, how is this kit different from the kit you might already be using? Or, where did this idea come from?” (Abriana, NYSCI interview, line 17)

This aspiration to engage the network in CUSP thinking is reflected in her goals for the kit design workshop:

Provide a PD experience for NYSCI CUSP ULN that:

1. Brings group through an idea-generation cycle resulting in initial prototype kits to test and develop.
2. Models a process useful to other aspects of communication work.
3. Supports selection of design approaches for ULN uses of their kit prototypes with public (tabling, festivals, other). (NYSCI workshop plan, draft 5)

On the planning call she also expressed interest in learning more from Pittsburgh about how their festival experience was structured as she hoped to adopt that aspect of the platform as well.

The Climate Playground would help the ULN see the potential of the kits beyond just the way they have been using them so far, so this idea of how do you form a climate playground, what were you thinking about as you set up the different areas, and what would we need to think about if we were to do that here.” (Abriana, New York City and Philadelphia planning call 1/8/15, line 30)

Abriana considered the timing of network events in terms of busy and slower seasons, responses to partner interest at the kit workshop, and took advantage of an opportunity for a festival at a Queens Library, a CUSP network institution. She structured the kit platform roll out with a workshop, a mini kit workshop outreach to her library partner and then a festival with facilitation training on the festival day for multiple partners.

3.1.2 Philadelphia CUSP

Philadelphia’s CUSP effort is led by The Franklin Institute (TFI). Founded in 1825, TFI is one of America’s oldest and well-respected museums. Compared to NYSCI, TFI is a very large museum in terms of square feet, staff, and budget. In addition to historic collections of objects and contemporary interactive STEM education exhibitions, the museum is well known locally

and nationally for a broad portfolio of community education programs. Soon after CUSP began, the original TFI staff left the project to pursue other opportunities. The museum hired two new full time people: Elena, with a background in climate science, as the project manager for the four-city collaboration, and, with a background in community development, as the Philadelphia hub coordinator. and Elena are guided by Janet, a veteran of TFI and part of the senior leadership, with extensive project management background. The project also drew occasionally on the time of seven educators from the museum to assist in CUSP program development and implementation.

John was the focal staff member in this study as he coordinated Philadelphia CUSP. was drawn to the CUSP job because it combined his passion for environmental education (honed during a Peace Corps stint in Central America), and his experience working in community development and youth programs around Philadelphia:

I think my community development background definitely helps a lot with the formation of the network and being able to work with a lot of different organizations across the board, because I kind of know their world. I've done some of these cross-cutting initiatives before in Philadelphia. My education background in community development and youth programs before this, that definitely has helped with how to integrate these (community agencies) with other informal education institutions. (John, TFI interview, line 9)

Where NYSCI's institutional design/make/play initiative aligned pretty closely with CUSP goals, John sees the CUSP approach as a new approach to community partnerships at TFI, and explained how that has not always been easy for the project:

I don't think the museum always knows what to do with us because we're a little outside the box of what the museum is most known for. Sometimes people don't understand why this is a Franklin Institute initiative and the value add to the museum. We see that from marketing and development a little bit. I think we underestimated the effort it would take to get our own staff to see our vision on that front, that we're doing these innovative approaches based on social science research but people (staff at TFI) expected (us) to do more traditional stuff. So

that's been interesting. But people seem to be coming around now." (John, TFI interview, line 10)

During the time period of this study, the Philadelphia network had 41 partners (See Appendix G) like NYC, representing education, advocacy, community development, and service, along with some city utility/government agencies. As one partner noted, this was unusual:

Not too many times when the service delivery non profits and the city agencies and the universities and the advocacy groups can all sit down together and chat, and CUSP gives that opportunity. (Michael, Energy Coordinating Agency interview, line 128)

Whereas NYSCI flies a little below the radar as a mid-sized institution in an outer borough of a city with a very large number of prominent museums, TFI is a universally recognized as a major player in Philadelphia. At the beginning of the project, partner organizations often sent senior leadership to network meetings. Organizations were interested in learning about TFI's new direction on climate change, networking with other leaders, and thinking about how organizations might work together in a new city-wide approach. But these senior leaders attending the early meetings were not necessarily the people who would be doing the work of adopting the kits:

We have a lot of director level people in our network and they might not care or see the relevance (of kits). We have people in our network that don't traditionally go out and do this work with the public, their organization doesn't do that, so I don't know, who do we target? (Elena, New York City and Philadelphia, Planning Call 1/8/15, line 15)

In response, Philadelphia CUSP explored activities that might help to attract more program-level staff: Workshops, webinars with climate scientists, networking events, an online community, weekly Climate News Alerts, and social events (CUSP Philadelphia Web page). In tandem, Janet, deeply experienced with networks and collaborative projects, coached her new staff to consider a more flexible and functional approach:

Janet saw the amount of resources we had to work with and what our goals were, and said “this needs to get a lot more informal for it to have any sort of ability.” And – that’s when we started shifting away from members to being just a community. We’ll have opportunities and you can take advantage of them or not... and not taking advantage of them doesn’t mean you’re any less a part of CUSP than the people who take advantage of everything. The fact that we got a lot more decentralized with our governing structure, the fact that we don’t really have a governing structure anymore, I think has helped the network flourish, because it’s very low risk to getting involved. (John, TFI interview, line 18)

The new emphasis on being a community, as opposed to a formal network, went both ways, with the TFI staff also exploring new ways of building trust and engagement with network partners. As a staffer from one environmental organization told us:

(I was organizing) a volunteer day and John came and actually brought another volunteer, too. It was not something that he got any credit for, he certainly wasn’t networking there or anything, he just came because he thought it was a good thing to do. That kind of blows me away. I mean there’re plenty of people in my office that just didn’t want to come. I’ve never really doubted their (TFI’s) commitment to it. A lot of people are, I don’t know, scared to go in those neighborhoods but he was there, and dirty as hell afterwards, and really funny. I mean, we were tearing insulation out of people’s nasty basements. (Jackson, Clean Air Council interview, line 77)

This kind of relationship building and the range of opportunities has created great energy in the Philadelphia CUSP network, and John feels this, plus the unique CUSP approach, helps to keep partners coming back to the network:

I think people have a positive experience with us. I think they like that we bring a little bit of the informality to our approach to networking and whether that be a different type of meetings or if it’s just that we don’t always have formal structured meetings or sometimes we’re just kind of hanging out doing stuff together. I think people like that. They like our tone to climate change, which is a little more playful than a lot of what they’re used to. Because I’m sure a lot of these organizations are getting climate change information from other sources, and it can all sort of bleed together. So I think us being a little more unique is something that people appreciate, and it’s the fact that we’re local. People like to know what does climate change mean for Philadelphia, and what is Philadelphia doing about it. (John, TFI interview, line 16)

3.1.2.1 Vision for the CUSP kit platform

Philadelphia CUSP, at the time of the study, was experiencing a shift in network structure from having mainly leadership show up at meetings to having more front-line staff. Their goal was to pull more members into a collective festival effort and build a sense of activity and shared accomplishment within the network. As they were at a somewhat fragile network building stage, the Philadelphia hub decided not to engage in deep co-design, but instead to move quickly to sharing finished and field-ready kits with partners:

We decided to lean on the in-house expertise that we had... instead of asking our partners initially to come up with the activities themselves... (we focused on) themes that we knew were important to our partners and asked our in-house experts to come up with something.” (John, TFI interview, line 19)

This approach resonated with the network partners, for example Hannah told us:

The Franklin Institute is this big institution that has the facility, the resources to build. Some of these other agencies don't have the resources, the money, the staff, to do that. So that's what made it really great, being associated with the Franklin Institute makes a big difference. I know at our agency, if somebody told us we have to build a prototype row house, I would be pressed to do it as well as that kit. (Hannah, Green Trek interview, line 55 & 56)

In this way, TFI was positioned as providing a unique and valued service to the network. The earliest kits developed by TFI were similar to Pittsburgh's *Extreme Weather Events* kit, but specifically adapted to include the row houses common in Philadelphia instead of the downtown and river setting presented in Pittsburgh. TFI staff showed the prototype to the network for feedback, tested it with some groups and then built 30 copies for partners to check out and use as part of their ongoing programming and outreach. Subsequently TFI created multiple copies of a second kit: an urban heat island activity using the same row house base. These two kits, then, cover two of the main regional climate change impacts, a hotter and wetter climate and the main benefits of green infrastructure: cooling and water retention. The duplicate format offered an

efficient approach to getting polished kits into the field quickly, at scale and for multiple contexts from single kit presentations to classroom settings with 20 teams working at once. In house developers designed the row houses with knowledge of the prior work in Pittsburgh and the concurrent work in New York City, but the highly experienced designers and builders in the TFI shop were perfectly capable of receiving specifications from the TFI CUSP staff and then quickly turning out these slick field-ready kits without outside assistance in concept or testing.

Although the kits were successful in many aspects, the TFI staff noticed that they had not had much impact on their ongoing quest to encourage more involvement and commitment from network partners. Elena noted a tension between TFI's ability to produce kits without help and the needs of co-design and co-thinking among the network:

I think that's partly what we are struggling with here, how do we better involve the ULN (the network), the partners? Because we have museum programs, they are so strong at developing hands on activities, developing workshops, developing kits, that we could tell them "do something on climate change and health" and they'll come up with some amazing thing that we can then just give to our partners, that's already built, already designed, already, you know, the facilitation outline is there... but where do we get the type of buy in and the collective collaborative ideas and impact that come from the ULN creating from scratch a kit, that's kind of I think the problem for us. (Elena, New York City and Philadelphia planning call, line 6)

As TFI took on the kit platform their goal for the network was to create a sense of accomplishment and collaborative activity. As Elena indicated, they were also concerned about the best way to draw on the talents and ideas of their network and their own institution. For this reason they focused on the festival element of the kit platform as the first activity in kit platform dissemination. This first step had a low bar for participation because of the blended approach of using existing TFI kits or creating simple climate connections to existing partner activities. With this existing content, the festival offered an opportunity to pull partners into the CUSP effort

through a familiar activity, collective marketing of the experience, and the added value of reaching broader audiences with a more concentrated CUSP message.

3.2 RESEARCH QUESTION 2: WHAT DID DISSEMINATION IMPLEMENTATION LOOK LIKE IN EACH CITY? WHAT EVIDENCE IS THERE THAT THE IMPLEMENTATION TOOLS AND PROCESSES ACTED AS BOUNDARY OBJECTS THAT HELPED IN CONVENING DIVERSE PARTNERS, COORDINATING THINKING, AND GENERATING A SHARED ITERATIVE PROCESS IN EACH CONTEXT?

From the beginning, the dissemination of kits from Pittsburgh to the other two cities was intended to be customized around the needs of each network. The customization of the dissemination process occurred through joint conversations between Pittsburgh, New York City, and Philadelphia, so that each dissemination city was aware of the plans of the other city. In this section, we compare the experiences of the two networks as they put on a “Climate City”—a group of CUSP kits presented as part of a community festival. In both cases the network planned and engaged in new work to get ready for the Climate City, although, consistent with their different visions for the kits, the planning and execution varied. Our analyses focus on the major planning meeting they each held to get ready for the festival and then the festival implementation itself.

This analysis revealed themes of “messy” verses “polished” examples when considering what makes for a physical kit experience in the CUSP approach. In New York City, Abriana’s commitment to pushing the process behind the CUSP approach to partner agencies led to

thinking deeply about how the CUSP approach translates to concrete examples in kits. Kits were positioned as messy examples that could be improved through an iterative process and that were grounded in a research based approach to how people take on wicked problem topics like climate change. In most cases, kits were readily picked up and adapted by partners for their own audiences and hyper local (neighborhood and community level) contexts. For many their work was to create new learning experiences and this process supported that work. However, with this focus on the process of adapting kits to hyper local needs, partners did not feel compelled to rally around a common festival experience but rather addressed their individual audiences with the CUSP tools and approach.

In contrast, in Philadelphia, John 's attention to building participation by pulling network members into a common experience positioned the CUSP kits as more familiar and polished tools to apply towards the end of a bigger, public CUSP message; "Preventing and preparing for a hotter, wetter Philadelphia". This high level agreement on the CUSP message and the ability to use existing kits, attracted partners to repeat experiences, often with much broader audiences than they were accustomed to, at public festivals. This focus on the end experience without exploration of messy examples that illustrate the approach, created an assumption that climate change needs attention without exploring partner's beliefs and interests in terms of how and why. In interviews three very different opinions about the CUSP approach were expressed by partners but the polished and familiar kits did not support a network discussion about those beliefs. While the festival approach supported partner work and led to small adjustments by individuals in their planning for festivals, using kits as polished ready to use products, didn't engender a network discussion about the CUSP approach.

3.2.1 New York City CUSP Implementation

Network Kit Prototyping Workshop. New York City began its process with a workshop focused on prototyping and co-design. Abriana hosted the kit workshop at NYSCI on March 26, 2015.

Her goals for the meeting were to provide a PD experience that:

1. Brings group through an idea-generation cycle resulting in initial prototype kits to test and develop,
2. Models a process useful to other aspects of communication work,
3. Supports selection of design approaches for network uses of their kit prototypes with public (tabling, festivals, other). (NYSCI workshop plan, draft 5)

This workshop was designed to introduce the core ideas of CUSP through shared experience with materials, to encourage networking so people in the room are familiar with the expertise and interests of the whole group, and to encourage participation in critique of existing and design of new ideas.

The agenda

- | | |
|-------------------------|--|
| <i>9:45-10:30 a.m.</i> | <i>Kit Roundup</i> |
| <i>10:30-10:45 a.m.</i> | <i>Let Me Introduce You to...</i> |
| <i>10:45-11:10 a.m.</i> | <i>Kit Roundup Discussion</i> |
| <i>11:10-11:30 a.m.</i> | <i>Kit Topics We Care About</i> |
| <i>11:30-12:15 p.m.</i> | <i>Lunch Project Overview and Getting Started</i> |
| <i>12:15-1:20 p.m.</i> | <i>Group Prototyping!</i> |
| <i>1:20-1:50 p.m.</i> | <i>Next Steps: Kit uses from tables to playgrounds to...?</i> |
| <i>1:50-2:00 p.m.</i> | <i>Post Workshop Evaluation (NYSCI workshop plan, draft 5)</i> |

The workshop began with the kit roundup, where participants freely explored a collection of 15 CUSP kits set up in close quarters in one side of the workshop space. The kit roundup

opened fifteen minutes before the workshop began and was the first half hour of activity in the schedule, allowing a generous cushion of time for people to arrive and for those who arrived early to be productively occupied. When reflecting on the workshop, one of the New York City partners commented:

That carnival setup. That was just – instant engagement. You walked in, and it’s colorful and it’s fun...it was just like being in a toy shop. You know? ... It took me a while to get settled down and to finish discussing feedback, because I just wanted to play all of them. (Emma, We Grok It interview, line 91)

The main goal of the roundup is to put the kit topics, design and engagement experience in the forefront of people’s minds. The kits are made deliberately to look and feel like working prototypes. Following boundary object theory, these “unfinished” examples invite engagement, modification, and critique, because they are clearly still in process and thus can be modified through joint exploration. The roundup included many kits at once, with the hope that participants would start to make connections across kits in terms of what designs are most successful, what topics might be interconnected to their own work, and/or realizations of the kinds of experiences the workshop participants find themselves drawn to, or think that their home organization’s core audience might be drawn to. In preparation for the New York City workshop, the Pittsburgh team made some alterations to kits that had specific geographic references, for instance incorporating maps of New York City into the kits “Get to the Game” and “What’s in your Neighborhood.”

During the roundup, “there were multiple ‘bumping into’ experiences and overall high engagement with ongoing discussion, exchanging contact info and good energy throughout” (Second researcher, expanded observation kit workshop, line 4). As participants milled about chatting and trying different activities, they were drawn to what resonated with their current work. Several participants were interested in “What’s in Your Neighborhood?” a map of New

York City with 1x1 Legos™ stacked into bar graphs representing different individuals' answers to sustainable practice questions. One network member from the zoo made immediate connections to work he has been doing with a New York City virtual mapping project, (Manahatta 2409, 2016), that helps people look into the future of the city based on the past. He discussed with others how he had been thinking about the idea of change over time within geography and was excited to think about a way of using physical maps with his teen audience simply to get them off-line in productive endeavors (Steiner, reflection kit workshop, line 59; second researcher expanded observation, line 2).



Figure 1: “What’s in Your Neighborhood” kit elements

Participants were comfortable trying the kits and often ran through the activity multiple times, shifting variables to see what would happen. For instance, at “Get to the Game”, participants make choices at each of four bases. First they spin a wheel to designate how they get to the game. This random spin is designed so that people do not have to reveal their actual transportation choices, unless they want to, and also to introduce some extreme and funny options like taking a helicopter or kayaking to the choices of bus, SUV, and biking. They also

identify on a big map of the area, the distance they have to travel to get to the game. This helps people see the relative costs of local or long distance public transit vs. commuting by car, and brings up conversations about proximity and the value of dense urban living. At second base they select refreshment cards and at third base, souvenir cards. All of these choices have a carbon footprint number on the back. At home plate you add up your carbon footprint and the lowest footprint gets seats in the best section of the stadium.

As the New York City partners played, people paid attention to the carbon scores of others in comparison to their own. One participant went through it once as a ball fan. He took the helicopter to the game and the absurdity of that (plus where to park it) got people laughing. When I asked him what it would look like if he considered his daily commute to work, he went through the whole process again, thoughtfully picking out how he gets to work and the closest proxies for the kind of food he buys for work (Steiner Reflection, line 57). Others also replayed the game a second time with a new form of transport or changing their purchases now that they knew the scoring system.

After trying out the kits with colleagues the group was called together, Abriana gave a formal welcome and context for the day and then paired the group up by network members who were new to each other, leading to an activity called “Let me Introduce You to...” Participants interviewed each other and then shared their stories with the group. The idea of this was to provide a networking moment early in the event and to surface any shared interests, connections, experiences that might be useful in the prototyping process. We wanted participants to realize at each step of the workshop that this process is about their interests and ideas.

After being clear about who was in the room and getting to know a bit about each other, we held the kit roundup Discussion—a group critique organized around questions such as: What

drew and held you to a particular kit? What connections can you see between the kit and your work? How would you improve the kit? Participants noted desirable kit features such as the opportunity to compete or collaborate with other learners, the appeal of unusual or repurposed materials, and appeal of examples and content that were relevant to their organizations and audiences. They also responded to kits where you could “play” several times, imagining alternate routes, weighing differences, or trying on behaviors that were very different from your current behavior. They liked that the kits did not involve climate shaming and they liked that many of the kits addressed systems level problems and responses (Kit Debrief, group notes).

The group identified shared considerations and potential modifications needed for New York City. For instance, an example of local identity arose in the “Get to the Game”. In preparing for the workshop, the Pittsburgh team adapted the game to include a New York City map and Yankee stadium, but did not quite get the local culture. Participants let us know right away: “Yankee Stadium? I’d never go there! Mets stadium is right next to us here in Queens!” One partner, who lives closer to Yankee stadium, said that while she has gone to Yankee stadium, she would never admit it to the people she works with. This led to conversations about the importance of picking the *right* local context for their audiences. Other examples included Ella from Queens Library who thought lacrosse might be the most important sport in her neighborhood, so why not include community, as opposed to professional, sporting grounds in the map? The group decided they would plan to attach multiple venue maps to the “Get to the Game” banner so that they could tailor the use to the most specific local context possible.

Having established some shared thinking around the features of good kits, participants got into small groups to brainstorm kit topics they cared about. The groups identified three locally relevant themes—air quality, city infrastructure, natural ecosystems—and the rest of the

session was devoted to prototyping new kits based on these themes. From time to time during prototyping, facilitators stopped the activity and asked people to share their favorite idea or how they were using materials and to share a challenge with their project for feedback from the group. Groups developed three prototypes:

- **Three possible futures** was a “choose your own adventure” card game where players make choices that each affect players’ final carbon footprint. The group wanted to focus on who has power to make choices, the role of individual vs. community, and the idea that regardless of what cards you are dealt, you can make choices that lead to more hopeful futures.
- **Climate Toss** involved tossing beanbags through openings in the board, big openings representing easy climate actions and small openings, harder climate actions. As participants toss beanbags and add up points, they aim for a lower carbon footprint. To show how systems’ responses can make some choices easier for individuals to achieve a lower footprint, players can add wide funnels (representing different kinds of green city infrastructure for instance) to some of the smaller holes, making it much easier to target bean bags at some of the harder climate actions.
- **Migration Game** had players toss Velcro cubes, representing migrating birds, at a map that showed green space, water and gray infrastructure in the city. Cubes stick to natural habitat but bounce off gray infrastructure, representing parts of the city that welcomed or repelled migrating species. The group also discussed using historical maps compared to current ones so players could see changes to the environment over time.



Figure 2: “Make Your Choice” prototype (photo A. Howell)



Figure 3: “Behavior Toss” prototype (photo A. Howell)



Figure 4: “Migratory Birds” prototype (photo A. Howell)



Figure 5: “Migratory Birds” game board prototype (photo A. Howell)

In the next steps discussion, participants noted that they liked how the workshop got them involved in co-designing new ideas with their network colleagues:

I think it got people’s creative juices flowing. And I think it also gave people the idea that you—that anything was fair game. You know? I think especially making something—just the process of making in general—can be really intimidating. They’ll be like “Oh, it’s not finished, oh you know, I just came up with this myself, it’s not official.” If you have people go through the kits first, it kind of takes away some of that anxiety to make something perfect, and polished, and...yeah, you’re a little more likely to take risks, you know? (Emma, We Grok It interview, line 92)

Some participants were excited to immediately try the kit prototyping process back in their home organization, while others wondered if NYSCI staff could come and facilitate workshops for them (Kit workshop debrief; second researcher expanded observations, line 93). Participants also wanted to keep joint kit development as a core activity of the network, suggesting that NYSCI, as the hub, could help facilitate “learning more from others who have created kits”, “staying in touch with the network to avoid feeling like ‘a voice in the desert’.” (Second researcher, kit workshop expanded observation, line 99).

Abriana was pleased that the process appeared to be the main takeaway of the workshop:

Hearing ... people say, I want to use this process starting with the kits and building ideas out, and many of them saying this is the way they use kits at their organization, learn a concept, design something and build it, that taking that process away is as important as using these particular kit ideas, developing them further. (Abriana, kit workshop debrief, line 6)

This participatory workshop with kits as a focal point, affirmed Abriana’s conviction about design, play, make as an underpinning to learning.

In our workshops (we ask) imagine your most impactful experience as a learner what were the characteristics of that and how can we apply that to climate change work? But making that jump is really hard for people, whereas when it is something physical, with materials, it’s easier for people to pull in those prior experiences. You want it to be fun, engaging and personal and then they come out with something totally different (laughter), when you give them something physical to do its more of that direct connection. (Abriana, kit workshop debrief, line 11)

Abriana felt “having time to think really deeply about a concrete topic was the most important part of the experience for participants” (Abriana, kit workshop debrief, line 51). Additionally, she felt as a result of that experience, participants gained a stronger connection to the local network. For her as NYSCI, it also hinted at her evolving role as coordinator of CUSP New York City in building network capacity to engage in the CUSP approach.

This to me confirmed that it is important to involve the network at the start of the process even if they don't take next steps in making the kit ideas a reality. Even if NYSCI has to develop new kits on our own and deliver finished products to the network, I think being part of the initial brainstorming gives the network a sense that the kits are never really final, and that they can iterate on them at any time. (Abriana, kit workshop debrief, line 53)

New York City CUSP Climate City: Climate City was the title Abriana selected for a public CUSP event held as part of a library street festival. She borrowed the title from The Franklin Institute's festival (to be described in the next section) and the concept of presenting multiple kits to public audiences in a concentrated festival format, from the Pittsburgh team who had led Climate Change Playgrounds in prior years. The festival was held on an overcast fall weekend with a steady crowd throughout the day. Library staff reported 1,700 in total attendance. The neighborhood context of the festival and the local reputation of the library drew a diverse and engaged crowd representing many different languages and nationalities. In the CUSP area, business was brisk. Most tables had a family doing an activity and another family or two waiting in line. Families were offered a CUSP passport to be stamped at each of three activity stations in Climate City that could be then be redeemed for a (temporary) tattoo.



Figure 6: Queens Library community street festival

CUSP Climate City consisted of three tents set up against the library building near a small street tree. One housed “Extreme Weather Events” and “Tiny Slimy Carbon Keepers”; the second housed “Get to the Game” in the first part of the day and then “Hidden Costs Café” in the second part of the day. The third tent had a table labeled “Communicate” that was pushed back against the library building to create a shady, dry place for visitors to rest as desired. The table held passports, tattoos, sponges for applying tattoos, and a bulletin board for posting completed passports.



Figure 7: CUSP Climate City activity stations



Figure 8: “Contemplate” tent to rest in and work on passports

To give a sense of activities at the festival, we present a brief vignette. “Get to the Game” went through several iterations with the New York City network. In preparation for the design workshop Pittsburgh changed the banner to include a New York City map with Yankee Stadium highlighted. The network partners had an extensive discussion about appropriate icons for Queens, including Mets stadium and local sports venues. Before the festival, the teens at the library suggested making the point system easier to understand with Carbon Bucks as a more direct metaphor for the cost of different choices to the environment. NYSCI added new cards with low impact choices, like bring your own shirt, water, or food. They also created photographic cards for each base so that transportation and product choices would be recognizable to local audiences whether or not they read (young children), or read English (their diverse immigrant audiences). The game involves moving from base to base making consumer choices: 1st base: a ride to the game; 2nd base: treats to eat; 3rd base: souvenirs; home base: purchase a seat.

During the festival, the facilitator stood behind the table assisting players and welcoming new people with a fist full of carbon bucks to start the activity. As one family left, an African-American mother and her son Brandon approached, followed by a Middle-Eastern mother with a son and daughter. All three children appeared to be 8-10 years old. The facilitator led them through the bases one by one:

Facilitator: “Today you are going to a Mets game! You can use this money to pay your way”. The kids hold the money, shuffling and counting it.



Figure 9: 150 Carbon Bucks



Figure 10: Transportation choice cards

First Base: Transportation

Facilitator: “Here at first base you can choose a way to get to the game”. She gestures to a set of cards on the table. The children look at the cards, considering. Brandon’s eyes light up when he sees the helicopter, he reaches for it.

Facilitator: “Oh, a helicopter! That would be a fun way to go! Turn it over to see how much that would cost...”

Mom and facilitator: “Oh, 100 carbon bucks!” Brandon looks at the other cards, puts the helicopter down and picks up a train, and gives the facilitator \$20 Carbon Bucks as his mom watches all three kids’ choices.

The girl from the other family says: “I chose ‘walk’ because it’s good...”

Brandon’s mom: “Good choice! When you walk you don’t burn energy, see Brandon? It’s good we’ve started walking more. Try to keep as much of the money as you can!”

Brandon’s mom narrates, compares choices and reiterates the idea that there are relative costs to the choices. While the helicopter was disappointing to Brandon, his mom highlights their real life positive behavior of more walking of late.

Second base: Food

Little brother from first family: (shouts) “I’m bringing water and having potato chips!” He looks at the cards and hands over 20 carbon bucks for the chips.

Brandon goes for the ice cream

Brandon’s mom: “He wants ice cream...”

Facilitator: “That’s expensive, because the milk comes from cows, so we have to raise them to get the milk, once we get the milk it has to be refrigerated and transported- that’s why it’s higher in carbon bucks. “

Brandon’s Mom: “Honey, you need to start saving your money!” He glumly puts the ice cream back, they move to third base, Brandon holding his money...



Figure 11: Third base: Souvenirs

Third Base: Souvenirs

Older sister from first family: “I’m wearing the shirt I already have... “

Brandon’s mom: “Another good choice to save money! “

Facilitator: “The new shirts take energy to make so they are more expensive.“

All the kids choose and then add up their money to find seats at home base.

Home Base: Seats

Mom and Brandon look at seating chart together crouching down by the map.

Brandon selects his desired seat.

Girl and boy: “We’ll sit together because we are brother and sister!” Their money is not the same...80 and 50 points left.

Facilitator: “You can add your money together and pick a seat you can afford with your total savings!”

Brandon's mom points to a better seat in the seating chart: "If you saved \$50 more you could have sat here!"



Figure 12: Seat selection at "Get to the Game"

After the activity, I asked Brandon's mom, how she would describe this to a friend? She responded, "It was about saving, using less energy to get to the game. I think he enjoyed it, he is a mild-mannered boy always, but I could tell he was into it. I think the activity made sense and liked how the seat selection part fit in." (Steiner, Activity Observation, "Get to the Game")

This intended sense for the game was supported by visitor responses to the passport question "What is one thing you can do to reduce how much Carbon is released when you are enjoying a sports game?" Participants wrote about bringing water from home, low impact transportation choices and 13 responses mentioned things that had 0 or low cost in the game. With the teens' addition of Carbon Bucks, the activity successfully modeled a cap and trade

mechanism, with prices being associated based on carbon costs. In this event, most of the discussion about why the high or low costs were initiated by the facilitator's explanations, but Brandon's mom and the other families' children picked up on what would be lower cost choices even before the explanation.

3.2.2 Philadelphia CUSP Implementation

Philadelphia Network Planning (the Chat and Chew): Philadelphia CUSP decided to debut their Climate City at The Franklin Institute's own large event *The Philadelphia Science Festival Carnival on the Parkway*. Many of the Philadelphia CUSP partners already attend this event separately, but this time the plan was to gather together in a coordinated approach. was excited but apprehensive as this would be a big splashy event for their first effort together as a network:

I feel like it is great that we have this special CUSP area at the festival, but I also feel like it is a big stage to debut on, to get our legs. I think at each festival, we'll be even better and better. (John, Chat and Chew group debrief, Line 11)

Rather than asking partners to create something new to present at festivals, Philadelphia CUSP offered the use of the two TFI Row House kits or asked partners to make a climate connection to one of their existing activities.

If people have issues outside (our kit topics), those that they wanted to get a little more nuanced on, we say, "well let's have you do that activity that you created." Some of them had already created activities and just need a bit more around the climate message. (John, interview, line 26)

Philadelphia's main planning meeting for their Climate City Festival was called the "Chat and Chew" because they would be serving food and TFI team was aiming for something "More informal, not like a workshop, but loose, and see if discussion and climate connections come out organically" (Planning, Chat and Chew agenda notes, line 35). The two-hour meeting included

five partners who were asked to bring an existing activity and think about a climate connection beforehand. The plan was to share and critique activities with other network members during the meeting. The five at this meeting plus two additional partners participated in the Climate City installation two weeks later at the science festival.

Agenda

9:00am – 9:20am Arrive/Breakfast

9:20am – 9:30am A little about the day... (overview of layout, etc.)

9:30am – 9:50am Showcase I

9:50am – 10:00am Break

10:00am – 10:20am Showcase II (same as the first one)

10:20am – 10:40am Brainstorm of any ideas to make space more cohesive

10:40am – 10:55am A note on handling common climate questions

10:55am – 11:00am Farewell (and evaluation) (Planning, Chat and Chew agenda notes, line 36)

The goal of the meeting was to share the various activities that people would bring to the CUSP Climate City and to co-develop common Climate City messaging that celebrates what Philadelphia is doing to adapt to climate change and to give partners a sense of what the festival set up and expectations were. Although some of the partners had been part of the festival in prior years, this year they would be together in a prime spot just outside the museum itself with signage that designated the group as CUSP Climate City. In the center of all their tables a large kinetic bicycle sculpture called Rider on the Storm drew attention to the space. As one partner said: “to have this really amazing—arguably the best spot in the whole festival—was incredibly impressive to me.” (Jackson, Clean Air Council interview, line 92). Thus, even those who were

seasoned festival presenters could appreciate how their collective activity represented an opportunity over their past individual efforts.

After the opening presentation, half of the partners presented the activities they had brought with them while the other half acted as visitors. Roles were flipped halfway through the session so that everyone had a chance to present. Large pieces of paper were posted on walls behind activities for people to provide feedback for each activity. TFI presented its “hotter” and “wetter” row-house kits. Jackson, of Clean Air Council, presented “What’s that Smell?”—a smell matching activity for children to play, as a facilitator shows their parents clean air pamphlets or uses an iPad to demonstrate how people can visit an EPA website to look up clean air violations in their neighborhood. Amanda from ReSource Exchange showed an activity she developed for the festival, her first CUSP experience. In the activity, visitors picked pictures of items out the “landfill” and then imagined how they might reuse them. Mindy showed a PA Horticultural Society activity called “If Trees are the Answer What is the Question?” She had two card games for children to match tree-themed features while she told adult visitors about shade tree planting programs and showed them an online tree calculator that showed the value of trees in the yard or neighborhood.



Figure 13: “Creative City”



Figure 14: “What’s that Smell?”



Figure 15: “If Trees are the Answer”

As they used the kits, the partners began to notice connections between the stations and connections to the pieces of the bigger climate change story. Partners spontaneously began brainstorming how to arrange the kits at the festival, thinking about proximity flow of themes. This was an exciting exchange, led by the partners, as they identified connections between the green infrastructure issues in the TFI row house kits and the tree initiative promoted by Pennsylvania Horticultural Society. They made energy connections between the Clean Air Council kit and Resource Exchange’s reuse activity. In the course of this discussion, some partners noticed that the titles of their activities did not necessarily leverage such connections as well as they might. We reminded them that titles might be more about a connection to climate

change. He used the TFI kits as an example—their titles make a direct connection, preparing for a hotter, wetter Philadelphia.

The workshop also included professional development around effective kits and facilitation. showed a TFI training video that gave tips such as including hands-on activities, letting the audience “be the scientist”, be high energy and welcoming, and make sure to have multiple staff at each activity—at which point someone in the partner group shouted out “We have each other!” In addition, two TFI educators showed a video from a national informal climate education network that focused on what public audiences might know about climate science, which wasn’t very much. The educators then discussed some examples of how partners could use straightforward language to connect their issues to climate change and also ran through some metaphors that can be helpful in communicating climate change to the general public. The information was appreciated:

I'm really glad to have this info as one of the only people who is coming from the arts, it's a constant struggle to connect the dots to the science side of our work, this is really helpful. (Amanda, Resource Exchange, Chat and Chew Expanded Observation, Line 47)

Overall, the meeting was successful in letting partners network and share ideas. Partners were excited for the notion of a shared experience at a festival, and enthusiastic about the collection of activities they were planning to present. Although they did not co-design any kits during the meetings, partners did collaborate on co-designing what the larger layout of the Climate City would be. Although it remained to be seen whether the group would actually be able to transcend their individual organizational messages and engage visitors about climate change:

I feel like we gave them tools but I still feel like it's hard to bring up and it's easier to rely on talking about what you are comfortable with. Putting their work into the bigger climate picture, that's something I'm a little worried about. I hope

everyone feels comfortable enough to engage and start these conversations. I have confidence that they could and will, but that's something I could see them being great at getting their own organizational message out and forgetting this part. (Samantha, TFI educator, Chat and Chew Debrief, line 31)

Climate City at Science Festival and Carnival on the Parkway: Seven CUSP partners joined TFI, presenting activities in a horseshoe string of tents that created a gentle semicircle around the undulating umbrella bike. The big Climate City sign was on the far side of the bike and faced TFI with its back to the tents. Each tent at the festival had a clear activity sign to let people know the content topic within and the public often referred to these signs as they decided which place to go, what line to wait in.



Figure 16: Climate City banner and Rider on the Storm sculpture



Figure 17: Standard tent set up and Science Festival signage



Figure 18: People waiting to try activities

Each CUSP Climate City activity station also had a signature object that drew public attention—for instance, the PA Horticultural Association had a gnarled tree root structure sitting on a table just outside the tent.



Figure 19: Pennsylvania Horticulture Society's tree root



Figure 20: Children’s card sort

At the front of their tent the Energy Coordinating Association displayed a large model house demonstrating airflow and energy efficiency in a house.



Figure 21: Energy Coordinating Agency’s house model (Photo from Philadelphia Science Festival website)

The partners each brought interesting activities and were in high gear throughout the festival, engaging hundreds of people. Facilitators adjusted their opening lines to draw people into conversations and activity, they worked to get the climate message in, and the public showed interest in what all the partners had to offer. When visitors went to multiple tents, they

picked up complementary information about the bigger message of climate change. People understood that rainwater can cause river pollution and that green infrastructure is part of the solution, that using energy in homes can cause air quality problems and cost a lot, that there are regulators for local air pollution problems, and that transportation is a big energy cost of food (Expanded Observation, Philadelphia Festival).

These tents all had next-steps ways for people to get involved in solutions. For example, Clean Air Council's "What's That Smell?" had the large colorful tri-fold board with cartooned images of a city street, school and house placed in front of the table at ground level. Children pulled their families over to stick images of objects that might be smelling in the locations to where they have noticed them, for instance garbage in the alley or kitchen, exhaust in the street or school, etc. At the Chat and Chew, Jackson told me he wanted people to connect to the sensory nature of pollution and how they feel when they experience pollution. Even given that hyper personal relevance, he then said the activity mainly serves as a draw so he could talk to people about his programs but he has noticed that sometimes it gives parents a break sometimes from grumpy kids who are not finding enough to do at the festival.



Figure 22: Clean Air Council activity tables for kids and adults

During the course of this festival, the volunteer working with Jackson shifted from using the activity simply as an attractor—inviting people to use the board and then giving them a coloring book—to actively facilitating the experience in ways that drew out the relevance of visitor decisions by discussing family choices and personal experience with smells. This created a compelling hook into the next-step actions Jackson offers, with emails to legislators and online services to figure out what office in the city to report smells to.

In his post-event interview, Jackson talked about the way the experience of presenting, more than the Chat and Chew, taught him something about how he prepares for presentations. He said he used to grab everything he could and cover the tables with materials and giveaways, drawing people in and gaining credibility by how much he knew about each topic. After the Chat and Chew he spent a couple weeks taking some time to think about what to bring and how he would use it (Jackson, Clean Air Council interview, line 97).

I enjoyed that opportunity, but I definitely learned more about CUSP the day of the actual festival than I did that morning (Chat and Chew) I definitely felt like we were getting better reactions than we normally do. (Jackson, Interview, line 94)

3.3 EVIDENCE OF THE KITS ACTING AS BOUNDARY OBJECTS

The three key features attended to in analysis using the boundary object frame are the role of the object in convening diverse participants, coordinating thinking and generating a common process in approaching shared work (Table 9). We consider each of these features in turn.

Table 9: Boundary Object Features in Dissemination

	Low	Medium	High
Convene Diverse Groups	<p>NYC Diversity <i>Individual Members:</i> educators, general and content specific</p>	<p>NYC Diversity <i>Organizational Types:</i> formal and informal, destination and community-based orgs. with children, family and community audiences</p> <p>Philadelphia Diversity <i>Individual members:</i> mainly marketing and outreach professionals, with some educational program staff</p>	<p>Philadelphia Diversity <i>Organization Types</i> Advocacy, service and education with expertise in energy, efficiency, water, green infrastructure, and gardens.</p>
Coordinate Thinking	<p>Philadelphia Strategized on single given problem-discussion about festival set up, i.e., what organizations should be adjacent for best topic flow. Activity presentations were not critiqued to improve or iterate.</p>		<p>NYC Defined problem space in terms of audience needs (teens, preschool, families, ESL); best local examples; and questioned how to make systems connections</p>
Shared Process	<p>Philadelphia Valued festival approach; full participation between planning meeting and CUSP festival (as well as subsequent festivals); some talk about personal effort to find/test the best activity for next festival but felt it worked without iteration; Differences in opinion about the CUSP approach did not surface in network meeting but in interviews partners mentioned the approach was not a fit for their organization, too strident/too gentle.</p>		<p>NYC Introduced and discussed features of the CUSP approach as a group, i.e., determined that “opening up the conversation” was their best contribution to CUSP model; identified key features of kits; collaboratively built new kit prototypes; discussed ways to do more using kits including PD at home institution, collective or local festivals, and specific ways to adapt kits for organizations’ work. Little direct connection between dissemination workshop and planned CUSP climate city at first festival.</p>

3.3.1 Convening Diverse Participants

The diversity of the participants in a boundary crossing experience determines the nature of the boundaries that will be crossed, i.e., how different are the experience and practice of the participants, the organizations they work for or the kinds of problems they address in their daily work? Boundary crossing theory would suggest that with more diversity comes a greater potential for generative and transformative thinking. Both cities convened fairly homogeneous groups in terms of New York City attracting educators and Philadelphia attracting services providers. For the partners who showed up for the workshop in New York City and subsequent Climate City, their primary focus was the way their audiences could learn about environmental issues from the kits. Their work was typically connected to local context, sometimes with a general science education focus and sometimes focused on specific project work. Audiences tended to be local to a neighborhood, sometimes with the educators providing programming across multiple sites. These partners were interested in how kits could be used with program participants. Philadelphia partners who attended the planning meeting and the Climate City were primarily involved in communications about institutional services or specific concepts of importance to their organization. Communicators cared about talking about the issues in a way that prioritized quick connections to their work. Audiences of these groups tended to be dispersed and focused on residents that might use their services. The broader audiences they could reach through shared festival work were of great interest to these communicators.

While both cities convened fairly homogeneous groups within New York City's educator group and Philadelphia's service providers, there were partners that did not typically work together. In New York City this was because partners' efforts were highly localized to audiences—some in community settlement houses, others in school programs, or in zoo settings,

among others. In Philadelphia, while partners commonly offered programs to dispersed audiences and possibly the same audiences, they focused on different topics such as combined storm sewer overflow, clean air, or energy efficiency. Many of these organizations did not typically collaborate outside CUSP.

3.3.2 Coordinate Thinking

Boundary object experiences support stakeholders in making tacit knowledge explicit. The boundary object provides a touchstone to elicit and document thinking about the topic. Focusing on the kits or festival process, we expected ideas about CUSP principles to emerge and be connected back to major ideas in each partner's work -- for instance new connections and problem spaces might be identified. The kit design process in New York City created opportunities for partners to coordinate thinking about what features make a successful kit. In Philadelphia, the festival meeting and festival itself served to generate excitement about working together and generated a new awareness of how work across organizations relates to climate change, but this theme was not actively problematized in terms of how to make a clearer connection with the public. Partners focused mainly on their standard communication strategies.

3.3.3 Shared Process

When a group uses a collaborative process to iterate and develop thinking, common practices emerge that help to refine that group's sense for the shared work they are engaged in. In New York City boundary processes and objects were engaged through kit building. The group was able to problematize, iterate and be flexible in adapting the experience to new uses, while

retaining CUSP principles. In Philadelphia, the CUSP festival experience was seen as definitive and complete. Iteration and engagement with underlying CUSP principles was minimal and mainly occurred through constant iteration across repeated experiences with visitors.

Overall, even in NYC's fairly homogenous group, considering the design and intention of the kits in the kit round up elicited coordinated thinking and the beginning of a shared process, where as bringing already developed activities to the Philadelphia festival led to traditional use of those activities and new information shared at the network meeting became back pocket resources.

3.4 RESEARCH QUESTION 3: WHAT EVIDENCE IS THERE THAT CUSP LEARNING PRINCIPLES WERE TAKEN UP BY NETWORK MEMBERS IN EACH CITY?

All the cities that were part of CUSP were working with three common learning principles—relevance, participation and interconnectedness. Project staff came to refer to these as the “CUSP DNA,” recognizing that although there would be a wide range of learning experiences developed across all CUSP platforms, every experience would optimally be an expression of these three basic principles, which had been derived from a review of what made for effective climate change education in informal settings (Allen & Crowley, in press). In the final section of the results, we explore the extent to which the dissemination process in each city supported expression of these learning principles. The themes from this analysis are kinetic and potential engagement with New York City partners actively identifying the principles through the kit round up and then applying them to new kit ideas and to adaptations of existing kits for their own

work. Philadelphia partners in interviews demonstrated a potential to engage with the CUSP principles given more focus on deconstructing how they operate in festivals or kits, how they might be applied to their own work. With this common experience of festival presentations under their belt, partners in interviews expressed both how CUSP does and doesn't fit with their work goals, but also identified interesting CUSP strategies that could shift their work in meaningful ways illustrating a potential to adapt the "CUSP DNA."

3.4.1 New York City

This network began their kit dissemination process with co-design of new kits and heavy modification of existing kits. From the first, they were discussing learning principles and looking to create new ideas that spanned boundaries between organizations in the network. In this sense, the kits functioned as boundary objects that allowed the partners to make new meaning and strengthen and change as a collaborative network. The dissemination process was enabled by the prototype nature of the kits shared from Pittsburgh—as the kits were clearly modifiable and unfinished, they invited creative and equal-status tinkering from a range of partners. From the point view of the hub staff, this approach was driven by the overarching goal of creating new partnerships that pushed the work of CUSP out from NYSCI's sphere for broader impact in the partner organizations, reflecting an institutional focus on building strong processes and increasing the museum's capacity to partner. (And as a practical matter, NYSCI also did not have the internal capacity on this project to support an approach where its staff did all of the kit building for the partners, so, from the NYSCI perspective, the "push" approach was a win/win.) Throughout the dissemination process there was a strong focus on, and creative expression of, each of the three core CUSP learning principles.

3.4.1.1 Relevance

New York City CUSP partners focused on how audiences would be engaged with the kits—framing their conversations about how the partners could change their work to better connect with the concerns and needs of specific audiences in the city. For example, Paul joined CUSP because of a desire to connect with younger audiences:

Well, we try to see young people in a holistic approach, not just target one specific area, and the environment is something which we should all be concerned about because that's what keeps us alive! (laughs). I felt that (CUSP) was something that would be worthwhile bringing to the young people. (Paul, Queens Community House interview, line 102)

During the workshop discussions, Ella from Queens Library was relieved to find a new approach. At one point, she described herself as an overly serious environmentalist who says in frustration to the kids “You don't care about this, it's only your future!” She was excited by the way kits were fun and hopeful and thought it would work better to get teens involved in the ideas (Steiner, kit workshop reflection, line 60).

This aspiration for engaging teens in meaningful ways emerged in discussions at the kit workshop where at one point the idea of environmental racism and social justice came up as a way to connect audience understanding to larger societal systems. Structuring kits to allow participants to “go to the dark place”, allowing teens to think about how systems around them are structured, but not always to their benefit, was one way Emma thought to address the standoffishness of “eye-rolling” teens. While a little hesitant to approach climate change in this way in the context of his organization, Tyler from the Bronx Zoo noted the teens like having the opportunity to understand how decisions are made and being able to vent about it. For teens, he thought, there is something productive in this type of discussion in terms of motivating them to think about the world around them (Steiner, kit workshop reflection, line 58). He was

encouraged in this by Emma, who works directly in the community without the big institutional image to hamper her efforts. Here, organizations with slightly different bents were able to connect on an idea of how to make the experience of kits and the topic of climate change examples relevant to teens, to generate a more productive engagement and, through the group discussion, feel less intimidated about it being too radical of an approach.

Abriana from NYSCI, Caitlin of the Queens Zoo and Sophia from Public Land Trust brought up the idea of what is relevant for families with young children. The group discussed questions of what is too abstract for a 4-year old, asking themselves whether a kit would be successful if the relevance is simply a child wanting to try it; and what if the child doesn't connect to bigger goals of getting involved in solutions for the climate change example?

Talk of young children led to talk of the high levels of diversity in New York City and in Queens in particular. NYSCI and the partners have noticed and adapted kits to support better engagement with groups who may not speak or read English. At festivals while the kit itself might draw visitors over, sometimes the references in the kit were obscure, and not relevant to an audience member.

At the festival, there was a clear example of a cultural miss with an English-speaking Chinese-American father and his young daughter of 4 or 5 years old. They approached the "Hidden Costs Café" where the colorful toy food and scale drew the girl's attention. The facilitator asked the child to pick out food she liked from the burgers, fries, cheese, veggies, fruit, and beverage selections. She stood and stared for some time and the facilitator picked up the salad and put it on the color-coded scale.

Facilitator: Where is the arrow? What color?

Girl: Green...

Facilitator: That means it has a low carbon level! How do we get salad? What all do you see in here? (he points to each part of the salad one by one) Tomatoes, lettuce...

Her dad helped her answer but after the experience he mentioned to the researcher who was observing: “She doesn’t know what any of this is (pointing to the toy foods), we eat Chinese food at home.”

In post-dissemination interviews, Emma from We Grok It, a partner who works with environmentally stressed communities, was excited about the potential of this kit with some revision in approach. She wanted to approach food in a way where each community can share a food type and recipe, so learning about each other around the activity of eating is the focus.

Everybody loves food. You can get people. We actually did this in a cross-cultural program down at Two Bridges neighborhood. If you want to get the Puerto Rican people talking to the Chinese people, you take them on a food tour. They teach each other what kinds of things to buy at each market. People don’t recognize the food, and it’s intimidating, it’s a foreign language, and the people—they’ll self-segregate. But you get them talking about food and you do a little workshop on like “Here’s a dish you can make with this thing!” Now all of a sudden people are laughing and talking and chatting with each other. (Emma, We Grok It interview, line 86)

3.4.1.2 Participation

As they were designing experiences from the ground-up, the network often talked about how to maximize learner participation. Emma talked about giving people repeat opportunities to engage, take roles and get comfortable with the kits:

If you’re working with little kids and you have enough time and space, you can have thunder, you know, the sheet metal thunder and the flashing lights if you have kids that are interested in production. So I think adding that kind of theatrical aspect is really fun. You can get kids to help you with that, especially kids who maybe need to see the model a couple of times to get it, it’s a great way to give them that repetition without making them feel insecure about needing to see it a few times. And uh, if you’ve got parents that want to stay and talk about the issues, you know, they’ll sit around. They can. They don’t mind hearing it a couple times, or you can even ask them to jump in and explain, which is – I just think it’s a really good tool for engaging people that need a different approach on the topic. (Emma, We Grok It interview, line 77)

Even Paul, who did not feel prepared to take kits on in their current state of development, had a clear idea of what would make kit use successful in his organization.

I would have liked to have seen people who have experience with the materials present it to the young people so we could get a gauge on how it would be received, how it plays with them and would we have to tweak it before hand, before we roll it out to the trainers, because if we roll it out to the trainers and they are not being received well or being received well in one section and not in the other, we'd have to go back again and figure that out. (Paul, Queens Community House interview, line 107)

In the kit workshop, these concerns about participation arose in two of the developed kits, “Climate Toss” and “Three Possible Futures”. In “Climate Toss” Paul was interested in the competitive structure of the beanbag toss but did not want people to feel bad about failing at some of the represented sustainable behaviors. That is when the idea emerged of adding a funnel to make the hard tasks easier to do collectively than as an individual. Because of a concern about participants’ experience, the team came up with a more powerful mechanism for their kit that ties in more directly to the CUSP, solutions and systems focused approach. With “Three Possible Futures” the team mocked up the activity based on a role playing game, all were excited about the notion of taking a role card, and playing out the future of that individual based on choices in a random set of cards, then participants had the opportunity to select the role they wanted and exert some more control over the path. This group was balancing the concern that people not think “this is someone else’s problem” and not wanting to be shaming of current behaviors. They chose to reveal some of the potential future consequences, good and bad, so people see the benefits of sustainable solutions.

3.4.1.3 Interconnectedness

Partners talked about systemic connections as a piece of their work that they strive for and sometimes struggle with. Ella, the self-proclaimed “dour environmentalist” described it this way:

I have come to realize through many experiences that just thinking bugs are cool and knowing that they visit flowers and pollinate them is just not enough to affect the way people behave. We need to figure out how to really help people understand that we live in a very integrated system, and the choices we make on a daily basis really do have an impact on the larger world. I think so many people feel like “What difference can I make?” I think things are at a critical point in terms of climate change and I think a lot of us have been grasping at straws, what kind of education does it take to help people understand their role in the bigger picture? So, CUSP is one of the first things I’ve seen in a while that I feel like people really are thinking about that and trying to arrive at some – some helpful conclusions, or helpful, strategies. (Ella, Queens Library interview, line 126)

Emma identified as perfectly aligned with cusp (Emma, We Grok It interview, line 95), and her existing programs demonstrated interest in systems and climate change interaction and how to use educational opportunities to draw local residents in to local decision-making. For instance, she describes a pop up park project she coordinated with scientists, artists and residents for New York City’s City of Water Day.

Anybody from the neighborhood could just walk over and participate in interactive activities and observational activities to help people understand what was going on ...(one example) We took some planters and distributed them around the pier, in a scattered fashion...The activity was to time how long it took a person to run unobstructed (from a starting point to an end point) versus how long it took them to run through the little planter obstacles and then to make observations about how hard or how fast they could hit the wall. And then we started equating that with soft versus hard edges for storm surge...people could (try these activities), discuss with their parents, and think about what they want their green infrastructure to look like moving forward. Because there are a lot of design plans (for this area)... because the East River just came up and over, it just covered that whole neighborhood during Sandy, and even Irene. The stuff that you see there (in the “Pop Up Park”), is all product of neighborhood kids or seniors, depending on which group did the project, working with artists or scientists, to come up with something to populate that space for that year, for that summer/fall. (Emma, We Grok It Interview, line 70)

Sophia did not always talk explicitly about climate change but thought about how to get teachers and students engaged with the local examples in their own schoolyard and how to bridge that connection between student interests and larger system issues:

I think we could get into the climate change concepts eventually, but what I love about (CUSP) is starting and ending it with a really positive message. Taking care of your schoolyard is also helping with this other problem. You're presenting a solution and at the same time, introducing the problem. You know? So the kids don't feel powerless and scared of how big it is. I like that a lot about it. (Sophia, Trust for Public Lands interview, line 47)

Abriana echoed this interest in systems, solutions and importance of the visitor voice as she considers the CUSP approach with her own institution's approach:

So I think the "Extreme Events" kit is a good example of how CUSP aligns ... because one of the aspects of how we define design under design/make/play is divergent solutions. When kids are designing what their city's going to look like there's no right answer. It's not like you have to put the rain barrels here and you have to put the green roof here, but there are different options. I think it's showing that multiple solutions for one problem is a good fit. That—deciding what is the problem, is it the precipitation, that the climate's changing, is it that there's a lack of green infrastructure, is it the trash—kids are really deciding the problem they're solving. I feel like that's a good, concrete example of climate change education with this DMP approach. (Abriana, NYSCI interview, line 9)

In the kit workshop Abriana noticed that the experience of using and critiquing multiple kits before prototyping acted as a grounding experience, "people internalize what CUSP means in different contexts which they can then apply to their own." She goes on to say that seeing the way an impact related message emerges in each kit, how each kit is tied to a solution acts as a "grounding piece that we talk around to come to a shared understanding of what CUSP messaging means" (Abriana, NYSCI interview, line 19).

During prototyping the idea of interconnectedness emerged in different ways. Two of the groups created activity designs that could allow for any number of topics to be the focus of the kit. The activity focus was on how individuals engage with a system. For instance "Climate Toss", the basic beanbag toss with harder and easier holes to hit, helped to illuminate choices and behaviors that are easy and hard for an individual to do. The addition of a "city-system" funnel demonstrates how hard behaviors become easy when there is infrastructure. After the workshop

during her interview Emma brought this kit up as a memorable piece of the kit workshop. She then went on to elaborate on how she might use it with her community engagement efforts.

... a way that I would use that in New York, composting. They're on the verge of making composting mandatory here. Last meeting I went to, they're leaning towards it. So city-wide composting will eventually happen, but the big talks that are going on right now are, how do we make that possible? Because right now it's just not possible with our waste streams, the way we have them. And that, really, that game would be a really great way to talk about, how do these funnels get put into place? YOU could be involved in making this funnel. You know? If you care about this, you can get started, you can say "Sign me up for the trial composting." Or you can learn about where these meetings are happening that you need to go to in order to make this happen. So there's a lot of community activism that can happen in using that. (Emma, We Grok It interview, line 87)

Emma also mentioned a new initiative that allows low income people to get green market point on their EBT cards, that allow them to buy fresh produce and meats at farmers' markets but also generates an increased value for those goods to account for the higher costs.

... a systems example for that, they recently started making, in New York, the green markets, you know, the farmers markets? They now take EBT cards and WIC so that's a perfect example, and it's even changed the value—so on your EBT or your WIC card, you get a certain number of points or dollar amounts. Because farmers markets aren't subsidized and are therefore more expensive, if you're using your EBT or WIC there, you actually have more money on that card to get the same amount of produce. So you don't get penalized. (Emma, We GROK It interview, line 85)

So whether using the climate toss to begin a discussion about what could or should happen or using it to highlight a program that is in existence that people might understand the value of yet, she was excited about this systemic approach to sustainable behavior.

3.4.2 Philadelphia

In contrast to the New York City case, the dissemination process in Philadelphia did not position the kits as boundary objects. Rather than beginning their process with a design workshop that

involved prototype kits, the Philadelphia network began with the pre-set goal of doing a Climate City festival based on the existing resources of the partners. To prepare for the festival, the partners showed each other what they were already planning to do, with the idea that they could find ways to connect the existing kits to a shared message around a hotter, wetter future for Philadelphia. From the point of view of the hub staff, this approach was motivated by the network's need to energize and activate partner organizations, pulling them into joint work that enabled TFI to gain broader trust and traction around the CUSP mission. TFI staff described the process as “baby steps” and did not want to risk the potential loss of focus and momentum that might happen if partners who were not already fully involved in CUSP were asked to do true co-design of activities across organizational boundaries. Rather than changing the nature of partners' work, the dissemination process in Philadelphia focused on fitting existing work together under a common message—a rebranding rather than rethinking the network's resources. Discussions of core learning principles did not come up much as part of the dissemination process.

3.4.2.1 Relevance

Philadelphia CUSP partners focused on connecting visitors to programs as possible next steps, for example through distribution of flyers, petitioning decision makers, or joining mailing lists. These engagement goals were traditional to tabling at festivals and framed relevance in terms of how audiences were relevant to the partners' current offerings. At the *Chat and Chew*, partners discussed the flow of visitors from station to station, the kinds of topics they would encounter and how experiences at each table might add up to a climate message. As Hannah reflected, her expectation of the festival was “that we would show lots and lots of people on the parkway about things we could do to mitigate the effects of climate change specifically, too much water”

(Hannah interview, line 43). At the *Chat and Chew* John also presented the Science Festival promotional video to help festival partners prepare for the large audiences and audience expectation of fun interactive experiences. At Philadelphia CUSP's request, each partner identified a climate connection to their work, submitted in writing to TFI (see Appendix B). These statements helped to set the expectation of collaborative climate messaging in the partner group, but the messages themselves were not crafted at the meeting or made publically available except in the case of the Federation of Neighborhoods whose table title included the message: "What's local food have to do with a hotter wetter Philadelphia?"

The planning was structured to promote the notion of the importance of the climate and solutions message, of interactive experiences with materials and upbeat presentations. The partners themselves made interesting connections between their work and built those into the Climate City layout. However, in reflecting on the experience, the relevance of the festival approach in the kit platform seemed to be to provide visitors with organization specific information. On the one hand Hannah, the long-time educator, had hoped to be able to communicate what is going on with climate change, to talk about the background of why we have more rain, but she felt this goal was limited by the audience's expectation of the festival.

Just not a parkway thing...They wanted to move, they didn't want to—they didn't want to sit and hear a lecture. They wanted to see the activity, do it, and go on to the next. Also it's called the science carnival, so you're imagining balls being thrown in the air. You know, that kind of thing. (Hannah, Green Treks interview, line 49)

For the Philadelphia network members whose goal was to communicate information, access to this audience was of great value and very relevant. Because of the metrics used to assess his work, namely how many letters are sent to representatives, Jackson from Clean Air Council noted an outcome difference between a festival activity and his festival goal.

What I need from a guest at a tabling event? I want them to enter their information into my iPad and send a message to the senator. I'm very jealous of people who have looser goals and are just trying to encourage people's creative thinking on those issues. (Jackson, Clean Air Council interview, line 82)

For those like Jackson, with specific festival outcomes in mind, the relevance to the organization of participating in a Climate City had to do with reaching a broader audience with their programs. This aligns well with the CUSP goal for having a network where diverse members bring CUSP ideas to a broader audience. Jackson describes his access to audiences as part of the benefit of working with TFI:

After doing a lot of tabling events, you meet people that are interested in it, you meet people that are not so interested in it, and you start looking at your venue as being a function of that. Like "oh, am I in a good space, where people are going to be open to these things?" I mean, the Franklin Institute is that space. We meet the nicest people, even more so than a college campus. We meet people that are extremely willing to believe what we're saying and take some immediate political action. (Jackson, Clean Air Council interview, line 76)

For Jackson, the relevance of a Climate City is to achieve organizational goals, a foundation for strong partnerships, an important mechanism of connecting audiences to next steps in the CUSP model, but he was not particularly grounded in the CUSP approach. In fact, Jackson talks about the CUSP approach as being the direct opposite of his approach:

Our goals are almost the opposite, because in my messaging work it seems that the thing that really gets people going is kind of getting people a little bit scared and making them feel alarmed by what's going on in politics, whereas CUSP is on the total other end of it where they are making sure that people don't feel overwhelmed. At the last meeting that I was involved with, the words "doom and gloom" come up a lot, that we're not going to do "doom and gloom." And unfortunately I found that if you want people to really click on that button to send a message to their senator, it's most effective when it's getting a little bit scary. (Jackson, Clean Air Council interview, line 73)

Michael, from the Energy Coordinating Agency, also tried to find audiences interested in the programs he offered and expressed his initial delight at the visibility and support he reached at the Climate City:

For me I definitely see visibility being a benefit of being a part of the CUSP Climate Cities...I don't think we would have paid for our own independent table at the ... science festival if there wasn't a CUSP (saying) "Hey, all CUSP members, let's do this together". (Michael, Energy Coordinating Agency interview, line 130)

After that first *Climate City* where he saw the value of an activity to draw people into his tent, Michael focused more attention on selecting just the right activity to bring to the next Climate City:

I can say that every climate city I've been to I have brought something different in search for the right balance between portability and how interesting the audience will find it. There's one particular exhibit that I think does a really great job of illustrating how air moves through the home. It's a great launching point for discussions around building science. It's big enough that it stands out and draws people over, however it's also so big that I need to borrow a work van to move it around and it's a ridiculous hassle, (laughs). (Michael, Energy Coordinating Agency interview, line 132)

Michael is an example of a CUSP partner taking on the idea of relevance in his work but at the same time he is a counter example because his interest (at least in terms of his work for his organization) is not in thinking about the broader question of climate change or even city systems. He carefully focuses his presentation on programs he can offer for individual homes.

3.4.2.2 Participation

Partners wanted the public at the festival to sign up for their organization's programs or listen to their content. These partners *are* the next step agencies in terms of connecting the public with something to do. Resource Exchange, a materials reuse center, wanted people to shop at their store. Pennsylvania Horticulture Society had a tree planting and tree-tending program. Energy Coordinating Agency had efficiency programs they could offer. Clean Air Council wanted people to write to their legislature about air pollution issues. On the other hand, TFI, GreenTreks, Fairmont Waterworks and Federation of Neighborhoods each had an educational message to focus on with the public. In these tents, people's main interaction was with the facilitator around

the activity that they were offering, rather than on print materials or signing up for an additional step.

For Hannah of GreenTreks, as a representative of the educational cohort, the festival context was a bit frustrating as people did not have the focus to stay and really talk about the ideas that interested her about the issue of green infrastructure. When pressed about how kits could be more engaging she pointed to a basic visual features, brown row houses rather than white would be more familiar. At the Chat and Chew she told me she had developed a whole activity where kids made their own houses and created a whole neighborhood but that was *really* hard to pull off at a festival, so she was happy to be able to borrow the TFI row house.

Both groups, the educators and communicators, had some success and challenge in using the activity to make climate connections. As stated in the relevance section, the communications partners tended to use the activity to draw people into a conversation about what programs were on offer at that table. Thus, deep participation in the activity was not the main objective. The presentation process was intense and, as soon as one round finished, another person was in line to try. Often the teens were quickly handing out plants without any conversation. Brandy from Fairmont Water Works figured out how to present to a crowd with a line of kids up front operating her storm sewer system model to increase her capacity.

The Philadelphia hub goal had been to build the network, so the facilitation style was not as central as participation in a shared activity. John respected the expertise and prior experience of each partner and wasn't as interested in pushing them to do things differently.

I'm not too worried about it. I think we're going to touch on it (concern about the facilitation approach) with our network as a whole, whoever wants to just, get best practice on facilitation. But ... the people who are using (activities) now, I think are pretty well versed in doing it and we don't really worry about it too much. (John, TFI interview, line 23)

Given the nature of their organizations, some of the partners framed participation as an ongoing process and not just the role of the public visitor during the festival. After an event experience where Jackson saw participants engaging with the Wetter Philadelphia kit, he expressed humorous dismay at how impossible it was to draw people to his write your legislator message at the next table, “at that point, I just closed my lap top and joined the group”. When pressed about how he could bring that energy to his work, Jackson went through a series of steps in thinking about it:

It would depend. I’m not sure if I would be able to start with the kit and then convince people that they need to go send their senator an email... I feel the kit is definitely pulling you in the other direction. Rather than wanting to go petition some elected official, it makes you want to go rethink your home. Not that one is better than the other, but they’re just opposite directions. (Jackson, Clean Air Council Interview, line 103)

He reflected on the impact of petitioning legislators as a motivating activity:

The main problem with communicating with your elected officials is for the most part it’s a very one-sided conversation. So you can send this email and then maybe two weeks later you get a canned email back. That can be really infuriating, because sometimes they’ll send you the generic tree hugger email and you’re like, “oh, this isn’t really what I was talking about.” They just went into their filing cabinet and pulled out the closest response available. Oftentimes if you call, you’ll get an answering machine and you won’t get a call back. So in encouraging people to do those kinds of things, once you do that, it’s very difficult to feel satisfied afterward, and take it somewhere else. Bringing people in to meet with the Senator’s office can be helpful because then you’re actually having a conversation with someone. Then hopefully if, like (a Pennsylvania US Senator) has really changed his view in the time that I’ve been working on this. So that’s kind of exciting to be able to tell people that your action resulted in this concrete thing. But even that is over the course of years and is fairly unique, whereas with the kit, there’s no end in that conversation. You’re giving someone a place to start. (Jackson Clean Air Council interview line 104)

Having identified this limitation of the approach he takes and the possibility of kits as a starting point he then describes a way a kit could lead into a more connected, solutions focused, social kind of involvement.

Ideally it would be nice to have people do that kit at a workshop or a community meeting and then be able to invite them to something more realistic, a month or so later, where maybe you're doing a site visit on a place that drains really well, or you're going to help people literally put greenery on their homes or something that's immediately tangible... (Jackson, Clean Air Council interview, line 105)

This thought refers to community building and issue engagement, and that by the time a person in that scenario writes to their legislator they have experienced the issue first hand and with others who also care about it.

Then at that point, you've given them enough to where the interaction with the senator isn't the endpoint. If they don't get a letter back, it's not going to kill their spirit in such a way where you don't want to keep working on your home just because some politician doesn't want to talk to you. (Jackson, Clean Air Council interview, line 106)

Jackson's post-implementation experience with the kits and reflective conversation with the research led him to consider a role for kits whereas initially kits were for groups with time to engage with learning for learning's sake. In this reframing he's found a possible way kits might help him do his work, possibly more effectively than he had been. This realization came from focused discussion on the nature of kits and his work.

3.4.2.3 Interconnectedness

Partners were focused on the stories they wanted to tell and programs they wanted to promote rather than the approach to telling that story. Indeed, they sometimes saw CUSP approach as antithetical to their own work. As Hannah pointed out, it was too fast paced and not rich enough in content. For Michael, too politicized for his organization with its contracts with energy utilities and government agencies. And for Jackson, too happy and not doom and gloom enough to motivate action with his letter campaign goals. Others were happy to be aligned, as Amanda from ReSource Exchange said, she was glad to find this kind of content to connect to the use of materials in their store, to branch out from an art-only approach to reuse. Pennsylvania

Horticultural Society, Fairmont Water Works and Federation of Neighborhoods all had activities that directly connect to TFI's message of "Hotter, Wetter Philadelphia" climate impacts. Each focused on some aspect of green infrastructure, urban heat island or storm water management through trees and land use. The ReSource Exchange activity brought up systemic issues with waste disposal and offered individual and creative solutions to that problem, based on the availability of a store like theirs to gather and re-sell materials. Pennsylvania Horticultural society promoted the one million tree initiative and tree care efforts but the activity they presented did not help people think about the value of trees, but rather was a "Concentration"-like matching game of specific content—what leaves match what trees. The Federation of Neighborhoods had an activity that helped people think about the relative carbon footprint of local food based on transportation costs, but rarely used it with the public instead handing out seedlings to the steady line of visitors.

While the partners at the Chat and Chew were excited about the connections between their work that made a CUSP statement, there was not a lot of time to talk about how to bring these themes out beyond placement of tables and there was not follow up discussion about how well it worked. Hannah in her post interview was still excited about the way that planning came about as she describes how the festival was intended to work and how the plan emerged at the chat and chew.

Oh, yeah! It was kind of cool, because then the Clean Air Council was there, and the recycling agency, they all mentioned how all of these things are solutions to the problem of climate change or how we can mitigate the results. And it was all connected. And if somebody – maybe, I'm not sure if they realized what was happening, but we did it—it even worked out where everyone should stand in order to make a flow if somebody, in a semi-circle, who should be first, second, third, you know, we really thought about how it would all kind of mesh together. (Hannah, GreenTreks interview, line 45)

Michael, who had not been at the Chat and Chew, noticed the benefit of the Climate City arrangement as a kind of subliminal approach.

On the more active side of things, I think the coordinated programming through the CUSP climate cities, does work well as a draw for the crowds, rather than us all having our own isolated tables at an event. Making it the CUSP Climate City, I mean it's a good brand and a good way of drawing people and without even saying anything about—look at all these organizations engaged on the same issues—getting people to think about different parts of the climate puzzle all together. (Michael, Energy Coordinating Agency interview, line 128)

The festival format as implemented in Philadelphia provided useful resources, structure, and opportunity to participate with the goal of drawing members into more active roles in CUSP events. At the same time it offered minimal opportunity for partners to actively grapple with the CUSP approach, the festival planning conversation was exciting to many of the participants, but they quickly went back to a more formalized meeting where TFI presented and the partners absorbed. Even with this moment of excitement in planning the layout of the festival, Hannah's memory of the meeting was how it met her expectations rather than surprising her.

Exactly like it was. It was John saying, you know, who's going to stand where, who's going to do what, what should we say if somebody's, you know, arguing a climate change issue, what is our way of discussing it without being impatient with the person, suggestions like that. I expected what we did, and a planning meeting. A meeting with, here's a one-pager that tells you points you can make if you don't know exactly what to say, these are the kind of CUSP stand on climate change. So we were all of one mind and nobody really objected to that. (Hannah, Green Treks interview, line 46)

Instead of excitement about new generative ideas from working together, the partners seemed content with feeling supported around the expectations they held walking into the meeting and festival activity.

4.0 DISCUSSION

Climate change has been described as a wicked problem in that it is unstructured, crosscutting and relentless (Weber and Khademian, 2008). Social science has shown that public response to climate change is heavily influenced by social norms rather than rational thinking about scientific evidence (Kahneman, 2011; Kahan et al., 2012). Rather than seeing the educational process as the explanation of a technical problem that is well defined with known solutions, climate change education, with its social and scientific complexity, becomes an adaptive problem (Kania and Kramer, 2011), one where the answer is not known and even if it were, no single entity could bring about the necessary change. Social science researchers have been calling for studies on engaging audiences based on knowledge of social norms and constraints when dealing with wicked problems (Kahan et al., 2012; Brugger et al., 2015; Allen and Crowley, in press). While a polished product might be effective in delivering a clear message in a program about technical problems with defined answers, educational programs about adaptive problems require a dissemination approach that emphasizes the process of defining the message and generating examples and bringing groups together.

In this study we found that the hub that aimed to pull partners into network participation had success with more polished kits and resources, partners were comfortable joining in and benefited from collaboration, but the polished approach didn't actively engage them with the CUSP DNA. Conversely, the hub that pushed the process to its partners with messy examples as

a starting point for discussion supported a collaborative thinking process that led to new examples and deeper thinking about the CUSP approach. We would argue that with climate change and wicked problems as the topic, this type of customization of messy examples to each city context was essential in the uptake of the CUSP DNA in that it helps the network identify the principles behind the approach and then apply it to examples that leverage the network's organizational expertise and that the network partners feel are relevant to the audiences they address. In this way the ideas in CUSP are customized as the program moves into new contexts.

This study is built on two contrasting cases. In New York City, we saw an emphasis on CUSP kit design and subsequent use at a festival as the primary focus. In Philadelphia, we saw an emphasis on collaborative festival presentation as a primary emphasis, while also utilizing existing network member activities with an associated climate message. These two approaches were based on each city hub's interest in kit platform dissemination in an effort to best meet their local context and needs. Several findings emerged through analysis of contextual features in each case.

1. As a result of local institutional goals, the hubs' dissemination activities took the form of either as a "push" or a "pull" network.
2. The messy or polished nature of a kit's role in the implementation effort reflected boundary object theory with varying degree of focus and success, with New York City diving into a shared iterative process around messy examples and Philadelphia taking baby steps toward engaging their network with a broad climate message and polished and familiar kit examples.
3. Ultimately, the CUSP DNA was engaged actively in NYC where time was allocated to deconstructing and reconstructing kits as public experience tools, whereas in

Philadelphia, where kits were already conceived and prepared experiences used to draw public audiences to real next steps that partners had to offer, the network spent little time on creating a shared understanding of the CUSP DNA.

4.1 PUSH/PULL THEMES IN NETWORK ENGAGEMENT

A major difference in the two cases relates to how each hub positioned CUSP work in the network—is the hub aiming primarily to push the process out to the network to build capacity in using ideas institutionally, or to pull the partners into shared CUSP activities to build the network? These stances are specific to adopting and adapting the kit platform and seem to emerge based on influences of the hub institution’s philosophy, capacity, goals, and their network’s interests.

In New York City, due to a commitment to co-design, the kit process was fore fronted as the first step in kit platform dissemination and partners were encouraged to design from scratch, alter and incorporate existing kits into ongoing work. Abriana spoke clearly about the need to push the process to her partners and build their capacity to use the CUSP approach. She wanted the product of the CUSP effort not to be the kits, but to be new understanding of how to cultivate this type of interdisciplinary network.

This stance also fits with the constraints of the human resources allocated to this part of the project. Knowing that her own staff time was limited, she relied on the partners to carry on with the work. She saw her role as a support to the network and expected that role would evolve from initiator to collaborator over time as she launched the various platforms with partner help. In terms of partners who were attracted to and participated in the kit dissemination activities, at

this early point in dissemination, they were all from education institutions that were for the most part familiar with and comfortable taking on new curricula. The shared experience of building kits helped to build a common understanding of what kits can do for the climate change conversation and resulted in new uses and ideas for kits as evidenced, for instance, by the ways New York City adapted “Get to the Game”, identifying and creating multiple changes in its game play based on partner input and experience with audiences.

In contrast, Philadelphia adopted a pull approach—the hub and network cast The Franklin Institute’s role as convener and coordinator of CUSP resources. Their success in activating the network is evidenced in how their locally-prominent brand pulled partners into collaborative experiences, be they festivals, meetings or social events. The kit platform and especially festivals seemed to contribute to an important evolution from CUSP as concept to the realization of a publicly active network. Kits and festivals were appealing because they made the CUSP approach visual and experiential and, led by TFI, they offered a recognizable brand to the CUSP approach. John characterized his approach to the kit platform and network development as “baby steps”. For him, each collaborative activity would build partner participation initially through education and social events for the network. For the kit platform, he continued this approach by pacing the implementation to give partners a chance to use kits with the public, to experience some success, and then build their interest and confidence in using kits over time, before they even considered making kits from scratch. These shared and repeated experience have resulted in positive energy from partners about belonging to CUSP.

In the New York City push mode, the festival as a second experience did not draw a wide participation from the network, rather partners took the shared kit building experience back to their own work. The network members attracted to the kit platform were educators with existing

audiences. They seemed to be interested in focusing on how to adapt these materials to better reach those audiences rather than on how to recruit more audiences from a festival setting to their work. While in Philadelphia's pull mode, with kit building as a second-level experience, partners were not as focused on how to structure experiences to draw out the climate and solutions connections. They all had solution steps to offer and promote, but did not have shared time to delve into what the design of an engaging CUSP activity entails. They picked up on the active, attractive aspects of kits but not as much on the personal relevance and multiple outcomes important to the CUSP approach.

4.2 BOUNDARY OBJECT PROCESS

We framed the study around boundary object theory and found that when the dissemination approaches elicited boundary object features there was more active engagement with the CUSP learning principles at the heart of the climate change education model. Boundary objects helped to move a group toward active engagement, opening up conversation and meaning making across members.

In NYSCI's kit-building-first approach, network members were asked to critically engage with a set of existing kits from Pittsburgh that were in various stages of development. They then, as a group, discussed features of the kits they found compelling or and aspects that could be improved. With this shared list of features, they were able to build new prototype kits, moving from abstract ideas to concrete objects and experiences to help public audiences think about the systems change required in addressing climate change. In Philadelphia's festival-first approach, network members were provided with background information on an upcoming, shared event

and then asked to peer-critique hands-on activities that each partner already used with the public and think about the organization of the shared festival space to generate the biggest public connection to the climate change topic.

We found the process-oriented approach did engage network members in both cities but to varying degrees. In New York City, the network engaged in focused discussion of audience needs and interests as they considered the use of kits with families with preschoolers, teens, and communities where English was not the primary language. In terms of kit features, New York focused on community-specific references, identifying better ways to focus kit experience by moving from regional to specifically local sports references. Upon critiquing the prototype kits, they then developed kits that were open-ended to specific content but nevertheless attentive to the systemic nature of climate change and to generating non-shaming experiences for kit users. This active engagement in building and designing kits aligned well with both NYSCI's institutional mission and to the reality of the resources they had to expend on network activities.

The Franklin Institute, with more resources and an interest in a more visible CUSP effort, presented the learning principles in a Philadelphia-specific way. They created a simple, solutions-focused climate message, "Preventing and Preparing for a Hotter, Wetter Philadelphia". Given this shared message, partners were asked to identify a kit (CUSP or their own) that connected to their work and to create a statement that tied to this CUSP messaging. This structure supported partners and ensured participation did not require undue extra work. At the Chat and Chew, CUSP staff presented videos and tip sheets on successful facilitation of learning experiences and ways to address climate change conversations, followed by an opportunity to critique each other's activities. TFI was cognizant of the need to develop their network and delivering just enough new information to draw partners along in the process.

Learning principles may have guided the CUSP approach, but the “hotter, wetter” message was less complicated to convey. The Philadelphia network developed a shared plan for a festival and activities, finding connections between: extreme weather events, and local green infrastructure, air quality monitoring, storm sewer design, carbon mitigation efforts, and energy efficiency in the home.

In this way elements of the CUSP approach were accessible in both city networks with partners focused on climate change, local examples and city system connections. However, the New York City experience of reflecting on kit design and audience experience led to the incorporation of learning principles in their own work. After the full dissemination experience, New York City partners were more apt to connect the use of kits to their personal work because of its ability to bring audiences into the climate change conversation in proactive and problem-solving ways (participate), they connected it to system work they were doing around green infrastructure, air quality, and broader environmental systems concepts (interconnectedness), and through that focus were very interested in specific local examples (relevance).

After the dissemination in Philadelphia, partners talked more about the sense of network and its connection to the hub institution than in the actual activities. They appreciated the power of collaborative presentation in helping them reach broader audiences, but differed in their ideas about what makes for the best connection to that audience. One partner was frustrated by the rapidity and lack of meaty discussion around a kit experience. Another felt that the CUSP approach did not scare people into action. And a third was concerned about his sponsors’ and funders’ reaction to the climate message. While the festival approach did not emphasize deep engagement with the learning principals in the CUSP approach, it did encourage broad and diverse participation in CUSP Climate Cities at festivals.

When bringing this work back to the content of wicked problems, in particular climate change education, this study identifies the need for a sustained engagement with new approaches to communication. Over time, the chance to discuss, practice and revise are important to integrating the new approach into ongoing work. Framing experiences with boundary theory helps to keep the focus on what people in the room (or public engagement) know and experience. This collaborative identification of how local knowledge varies across context, for instance what does it mean to teens, to families with preschoolers, across content expertise, is essential to opening up the climate change conversation, rather than delivering an easy to swallow educational pill.

Taking on the DNA is a process. In NYC, Abriana dove headfirst into the kit building process, but struggled some with aspirations for a coordinated festival effort as partners went back to incorporate CUSP into their own work and communities. Her partners shared ideas about when and how festival formats might work for them as climate change education moments but working together in this dispersed network didn't always make sense. Philadelphia brought the network along into a collaborative presentation and built up a sense of confidence in partners that there is something here that supports each organizations' work. In partner interviews and in a kit workshop that was held after the period of this study, Philadelphia CUSP partners activated their potential into kinetic engagement with the CUSP DNA, these committed partners who were convinced about the power of the Climate City, now began to dive into what makes a kit CUSPy.

In closing, we note that this study represents a snapshot in a trajectory that describes how each city began the process, why they chose that route and what happened. The evolving nature of networks is documented (Fligstein & McAdam, 2010; Innes & Booker, 2010; Lima, 2010; Kania & Kramer, 2011), and as such, this study is concerned with how new ideas are introduced

and initially taken up by networks rather than ideas about how a network “should” take up a curriculum in “shrink wrapped”, standardized ways. We found that dissemination processes are not uniform, but contextual. Rather than products, the right process tools give networks what they need to fit local goals at any point in the network’s trajectory.

These case studies reveal the power of boundary object framing in structuring dissemination to evoke principled engagement with key features of an approach. Since this study, each city has sustained and evolved their engagement with the CUSP kit platform. New York City CUSP partners have continued developing kit ideas and Philadelphia CUSP partners have attended multiple festivals. The Franklin Institute subsequently worked with Carnegie Museum of Natural History to plan and hold a kit workshop for their network in the style of workshop that New York City held.

As we consider the rapidly evolving nature of climate change and its impacts, the flexible rapid iteration processes of CUSP and the sustained support of a collaborative network are two powerful tools in keeping the conversation open and evolving. Using boundary crossing experiences allow us to draw from multiple experiences as we work to generate as many possible solutions as possible to this pressing global issue. While some informal science education experiences can be designed and implemented to a variety of contexts with minimal to no professional support, in both of our case studies the sustained support of the hub and network as they follow their local collaborative trajectories is essential to unpacking and reconstructing relevant, local examples and connecting them to ways to get involved.

Study into the evolution of project dissemination over a longer period of time, reflective of real-time changes in networks as they build common experience and relational trust are needed. This would help us understand in more detail when to apply various tools in a particular

context to best support the balance of interest in participating, value for the effort required, and sense of success in the outcomes with the public and partner members individual work, be it collaborative or institutional.

APPENDIX A

GLOSSARY OF TERMS

A. CUSP Project Terminology

CUSP: Climate Urban Systems Partnership, NSF funded climate change education project.

CUSP Resource Partner: Research institutions that support the content and learning aspects of the project: Columbia University, Center for Climate Change for climate content support and University of Pittsburgh Center for Learning in Out of School Environments for learning research on aspects of the project implementation and dissemination.

Partner Cities: Locations for CUSP programming design and implementation: Philadelphia, New York City, Washington DC and Pittsburgh.

Hubs: CUSP is led by The Franklin Institute in Philadelphia, PA in partnership with NYSCI of New York City, NY, National Geographic Society of Washington DC, and Carnegie Museum of Natural History, Pittsburgh. Hubs coordinate funds from the grant, convene network members and develop a specific educational approach for the project. Each hub is led by a professional with a background in education, science, and/or community organizing.

National Collaboration/ Collaborators: Resource partners, hub and project evaluators. This is the project team that develops and implements the overall connectivity of platforms and efforts.

CUSP Platforms: Each city does the heavy lifting on one educational approach to climate change education and then shares the findings and process with the other cities. By the end of the project each city will have an integrated set of approaches to use with network and public. The platforms are: Philadelphia, neighborhood approach; New York City, digital approach; Pittsburgh, temporal approach; and Washington DC, community of practice approach.

CUSP Networks: City-specific clusters of organizations cultivated by each hub, that share an interest in understanding and collaboratively communicating climate change messages to their audiences/stakeholders. Members range from government departments, advocacy groups, informal science education institutions, community agencies, public utilities (like water or transportation), to various service providers.

CUSP Network Members/Partners: Individuals and the organizations they represent in each city. Individuals come from a variety of professional backgrounds, representing a variety of interests in CUSP activities. Organizations may send one or multiple individuals to various CUSP activities, collaborate on CUSP efforts with expert guidance, communications, or otherwise support CUSP efforts.

Public: Individuals, families, groups that attend festivals or meetings and are exposed to network member organizations facilitating CUSP experiences. Some public audiences are directly

connected to network members and some public audiences are cultivated through outreach efforts at festivals.

CUSP Evaluators: GRG and The Franklin Institute have program evaluators who monitor the national partner network across the four cities, resource partners at the national level, and the public experience of the platforms in each city.

B. Study Design Terminology

CUSP Educational Approach/CUSP Approach: Partners in a city develop and deploy learning experiences for public audiences that embody the CUSP learning principles.

CUSP Learning Principles: embedded in each educational design (Allen Crowley, in press).

- *Relevance:* Addressing people's interests and/or hyper local examples of how climate change impacts local city systems and impacts the public.
- *Participation:* At the public level, design interactive kit examples to engage people in exploring variables of climate impacts and city system level choices. Opportunity to do something to respond.
- *Interconnectedness:* Understanding how impacts of climate change impact multiple systems and responses are also interconnected with other goals.

Boundary Object Theory: A frame for dissemination design and analysis (Star and Griesmer, 1989; Star, 2010; Akkerman & Bakkar, 2011). Boundary objects externalize and coordinate thinking generating shared definition of problem space and solutions and allow different communities of practice to develop shared practice toward around a specific set of ideas (in this case, CUSP Learning Principles).

Temporal Platform: Kits and festivals are the focus of a community based temporal approach.

Network members reach members of the public who are gathered at pre-existing events, such as festivals or community meetings, through the use of engaging, portable, climate change activities presented singly or in sets by network partners. This platform was developed in Pittsburgh beginning in 2012 and this study focuses on its dissemination to each partner city in 2015.

Kits/Activities: small portable examples of local climate change impacts, designed as interactive experiences to allow public to explore connections between several city level variables around a particular climate impact (i.e., higher temperatures → urban heat island, relationships between hard surfaces, green spaces, and human health and comfort).

CUSP Kit Design Features:

-Thematic elements:

Topics useful to a wide array of organizations (boundary crossing)

Topics are focused on interaction between:

Personal experience and interests

Local climate impacts

City Systems connections

Possible next steps to join a larger group in addressing solutions.

-Experience elements- kit design presents

Mechanism: A way to draw people in to using kit-a familiar game play, model, or role-playing approach-a quick start to “what you get to do” with this kit

Key variables: Suggestive of issue but not perfect, leaving room for “what you might add” detail to make the example relevant to your situation

System not individual focus: Element of chance in starting condition- not what do you drive but spin the wheel to pick your vehicle- shift emphasis to “what would make it easier to behave sustainably in this city”, rather than isolating or shaming current individual behavior

Opportunity for grounded conversation about the example, prior experience with the impact, possible solutions, between members of visiting group and a local sustainability expert/facilitator who offers a next step opportunity

Multi and cross-age involvement-Using kit is interesting to those doing and watching...the doing reveals something about the system that can be discussed as it happens – kits work for all ages as primary users or observers

Solutions Focused- Picture a better future rather than what we give up, local pride in effort

-Facilitator elements

Portable: light-weight fit in a box or bag

Easy to set up: reset for next person and take down,

Written Materials: facilitator guide

30 second to 5 minute engagement (with capacity to go 20 minutes)

Pairing- borrowed in sets to emphasize different ideas.

- Other design features for audience and venue

Reusable Materials: Little to no disposable materials

Familiar easy to acquire materials: DIY look, easy to build one at home

Appealing to look at

Space requirement: Operate on a 3x6 table generally

Signage: climate change title, getting started directions

Dissemination of Temporal Platform: A series of experiences with partner cities to pass on the core ideas of the kit and festival platform in ways that are most fitted to each city's needs and resources. Experiences are designed through a collaboration with the hub staff person in each city, the dissemination researcher (Steiner), and the Temporal Platform hub staff person from Pittsburgh, activities include:

Planning Meetings: Hub and researcher (sometimes PGH hub staff person) talk by email and phone and occasionally in person, about potential kit focused- network meetings, workshops and festival plans.

Kit workshops: Network engagement, led by researcher and Pittsburgh hub staff person with several aspects used in different combinations based on city interest:

Kit Round Up: To expose a partner city network to the idea of kits, the facilitation team sets up approximately 15 existing kits from Pittsburgh in various states of development. Network participants are offered a guidebook and asked to try and critique the kits. This open exploration time, with support from the researcher and hub facilitator and sometimes the host city hub staff, lasts for about 30 minutes and is followed by a group discussion, led by the researcher with Pittsburgh Hub staff taking visible notes on large paper or a projector for all to see. From this discussion the group identifies key features of CUSP kits, some ways they are different from current festival experiences the group offers, and suggestions for making kits a better fit to their context.

Networking: Within the network meeting design several opportunities are taken to give network members a chance to interact, introduce each other, share ideas, and collaborate on designs. These experiences are designed to build network connectivity by surfacing shared interests.

CUSP Overview: At the start of a network meeting about kits and festivals, the hub host or researcher provides a brief overview of the CUSP project, project goals, and Educational approach i.e., the learning principles and how they are embodied in the platforms, to ensure everyone in the room understands the scope of the day's activity.

Prototyping: After a kit round up, some networks chose to move right into the design of new topics for local use. The prototyping workshop builds on the group consensus of key CUSP kit features, moves to a topic identification activity, groups network members by shared interest in a topic, introduces members to the wide array of materials on hand in particular to mechanisms that could be used to draw people into an activity- for instance game pieces to indicate roles or turn taking, or materials that help to turn concepts and flat ideas, into three dimensional models. Groups then explore materials and work collaboratively to create rapid prototypes of possible kits, and the researcher stops groups along the way to share ideas, challenges to the design and possible solutions.

Future Planning: At the end of a network meeting the host hub staff lead a discussion about where to take the ideas discussed or developed in the meeting next and to identify what kinds of resources, network partner roles, and hub roles would support those goals.

Network Meetings: Regularly occurring meetings of network members with a variety of meeting topics planning, professional development, and networking. In this study network meetings are the context for introducing the kit platform to the city network.

Festivals and CUSP Climate Cities: Individual organization tabling with organizational kits or CUSP kits, or collaborative tabling with kits in a ‘Climate Change City’ with the goal of creating a critical mass of interconnected climate impact examples (and network partners representing solution strategies) to push a broader message of climate change. Climate Change Cities were initiated in Pittsburgh and quickly adopted by all the cities as the way to approach festivals.

Reflection: The role of researcher intervention as part of the process. Interviews, debriefs, written reflections all support participants in stopping and considering the work being done. It was a big part of PGH progress has a role in this study as well.

Successful Dissemination/Uptake: How a particular network takes on core ideas of the festival and kit platform.

A. CUSP learning principles

1. Relevance
2. Participate and
3. Interconnectedness

And the extent to which these principles emerge from network engagement with the festival or kit design process when positioned as a boundary object.

B. Boundary Object Features

4. Convening diverse partners around a topic of interest

5. Coordinating partner thinking to identify a shared problem space
6. Developing a shared practice in working on the problem

Local Context: The hub organization resources, staff expertise, interests, and relationships with partners; the local partner resources, staff expertise, interests, and relationships; the hub's understanding of city's policies and local interventions and interests that impact the potential design of a successful CUSP intervention.

Boundary Spaces: a conceptual space between communities of practice that offers opportunity for innovation, problem identification, and solution strategies by drawing on diverse expertise and resources. In part due to working through the challenges of aligning vocabulary, frames of references, and interests. For CUSP, this is the network meeting.

Boundary Objects and Processes: Tools and activities to help diverse groups in boundary spaces align vocabulary, surface issues/problems, and share frames of reference. For CUSP this relates to kit use and kit building activities and festival planning and implementation.

Iterative Design: The process of developing a quick prototype, testing it with peers or public audiences, suggesting/making changes, and revising prototypes to test again. Focus is on everyday materials, quick changes, and reflective conversation about what worked or not and why or why not. Grounded in the experience level of the facilitators so that designs progress as partners to facilitation skill development.

APPENDIX B

KIT AND ACTIVITY DESCRIPTIONS

CUSP Pittsburgh Kits

Choices in Your Neighborhood

Access to resources and sustainable choices in a neighborhood contribute to climate change.

Participants see how their neighborhood's choices stack up to others across Pittsburgh.

Topics: Built Infrastructure, Ecology, Energy Use, Food, Land Use, Transportation, Water

Climate Adaptation in Empty Spaces

Climate change is expected to bring hotter summers and more severe rainfall events to Pittsburgh. Participants act as landscape architects to redesign a vacant lot while considering different solution strategies.

Topics: Built Infrastructure, Ecology, Extreme Weather, Land Use, Temperature Increase, Water

Complete Streets

Carbon dioxide released from transportation contributes to climate change. Participants design a city street and consider the balance between alternative transportation, traffic, and carbon

footprint.

Topics: Ecology, Energy Use, Transportation

CUSP Climate Change Playground

Multiple CUSP Kits and organizations under one festival tent allow visitors to make connections between different city systems and multiple solutions. Organize your own Climate Change Playground!

Topics: Built Infrastructure, Ecology, Energy Use, Extreme Weather, Food, Land Use, Temperature Increase, Transportation, Water

Documentation and Imaging

Brinno Time Lapse Construction Camera, GoPro Camera, GigaPan Robot

Topics:

Energy Matters!

Carbon dioxide released from burning fossil fuels contributes to climate change. Participants experience the power and possibilities of fossil fuel-free wind and solar energy in the city.

Topics: Built Infrastructure, Energy Use

Everybody Walk the Climate Graph

Climate change is expected to bring hotter summers to Pittsburgh. Participants walk a century of climate temperature data to gain an understanding of long-term global climate patterns.

Topics: Temperature Increase

Extreme Events

Climate change is expected to bring more severe rainfall events to Pittsburgh. Participants experiment with green infrastructure options to ease the pressure on city sewer systems.

Topics: Built Infrastructure, Ecology, Extreme Weather, Water

Feel The Power!

Carbon dioxide released from energy production contributes to climate change. Participants generate power to light a city building and experience the difference in energy efficiency between LED and incandescent bulbs.

Topics: Built Infrastructure, Energy Use

Hidden Cost Café

Carbon dioxide released from food production contributes to climate change. Participants create their own meal and experiment with the carbon footprint of their food choices.

Topics: Energy Use, Food, Land Use, Transportation

It Takes Energy to Get to the Game

Carbon dioxide released from transportation and food production contributes to climate change. Participants run the bases to discover the climate impact of their game-day choices.

Topics: Transportation

The Great Climate Race

Climate change is expected to bring hotter summers and more severe rainfall events to Pittsburgh. Participants become snails and make choices that help them prepare for the challenges of climate change in their urban environment.

Topics: Extreme Weather, Temperature Increase

Tiny Slimy Carbon Keepers

Protecting urban ecosystems maintains natural balances in the carbon cycle and reduces city contributions to climate change. Participants become salamanders and eat organisms that disrupt the carbon cycle in the forest's leaf litter zone.

Topics: Built Infrastructure, Ecology, Land Use

Tree Machine

Climate change is expected to bring hotter summers and more severe rainfall events to Pittsburgh. Participants experiment with technological and natural solutions to make life better for city residents.

Topics: Ecology, Land Use, Temperature Increase, Water

Urban Heat Islands

Climate change is expected to bring hotter summers to Pittsburgh. Participants explore causes of high and low surface temperatures in cities and discuss solutions to keep Pittsburgh cool.

Topics: Built Infrastructure, Land Use, Temperature Increase

What about Pittsburgh?

Carbon dioxide released from transportation contributes to climate change. Participants explore examples of how other cities approach transportation issues and imagine the possibilities for Pittsburgh.

Topics: Built Infrastructure, Energy Use, Land Use, Transportation

CUSP Philadelphia Kits

1) READY ROW HOME: PREPARING FOR A WETTER PHILADELPHIA

With scientists predicting increased heavy downpours for Philadelphia due to climate change, one might ask, what does this really look like, and what can be done about it? In this activity, participants simulate heavy downpours on a model Philadelphia block to see how traditional methods of dealing with heavy rain may no longer be sufficient to protect against flooding, polluted drinking water, harm to wildlife, etc. Participants are then given the opportunity to add “green infrastructure” (trees, rain barrels, vegetation, etc.) to their blocks, and see how these new elements perform in heavy rain, and how they might be used in their own communities.

2) READY ROW HOME: PREPARING FOR A HOTTER PHILADELPHIA

Climate change means Philadelphia is getting hotter; so much so that scientists predict we could experience as many as 3 additional weeks of days over 90° by the 2020s. All that heat not only makes us sweaty and uncomfortable, but can also lead to serious health risks. To make matters worse, the materials that cities are typically made of (brick, concrete, blacktop, etc.) are particularly good at absorbing and holding-on to heat from the sun, creating what’s called an “urban heat dome” that raises temperatures even more. In this activity, participants can see first-hand what a dramatic difference certain materials have on raising or lowering a city’s

temperature. Equipped with Infrared Thermometers and a miniature city block under a heat lamp, participants introduce new items like light colored building materials, trees, and vegetation, to see what effect these items have on cooling down a neighborhood.

CUSP Philadelphia Partner Activities and Climate Connections

(as submitted by partners to TFI)

Clean Air Council: What's That Smell?

The only way to decrease outdoor air pollution is to monitor sources. The Council gives you the tools and support to know exactly what is coming out of nearby smokestacks, junkyards and illegal dumping hubs with the necessary contacts to report these sources. We also offer simple solutions like black out curtains and dehumidifiers in the one place you can control, your home.

Resource Exchange: What is Reuse?

Reuse is an important step in helping to prevent a hotter, wetter Philadelphia because its effects are twofold. Reusing materials helps cut down on the need to manufacture new products. The manufacturing of new products is responsible for a large portion of the CO₂ emissions. When we reuse products we help lessen the need for new products. Reusing materials also prevents them from going to landfill and that's the main objective of the Resource Exchange. We don't like to see reusable materials get thrown into landfill when creative people could find a perfectly good use for them. Landfills are the largest man made contributor to greenhouse gases on the planet. The less stuff we throw away, the less of an impact our trash has on the environment.

Pennsylvania Horticultural Society: Why Are Trees Your New Best Friend?

Planting and caring for trees, especially urban trees is really cool...Literally, TREES ARE COOL... Trees act as mini air conditioners, cooling their neighborhoods and the planet. They also protect our water supply by holding stormwater, make people feel calmer and happier, and clean our air by absorb particulate matter. Becoming a Tree Tender and planting and caring for trees are ways YOU can help prevent climate change!

GreenTreks/The Franklin Institute: Is Your Row Home Ready? As a homeowner or a renter, you can employ a variety of things (called Best Management Practices) that can help mitigate the effects of climate change. (More frequent rain of longer duration). Some are very simple such as putting planters in front of your house, or getting a tree planted on your street. Some are more complicated, such as installing a rain barrel or flow through planter, but there are agencies in the city that can help--for free--such as the PWD or PHS.

Fairmount Water Works: Do I Live in a Watershed?

As Philadelphia experiences warmer days and increased rainfall due to the effects of climate change, this activity will explain to visitors that Philadelphia Water Department looks to the 21st century solution to managing stormwater through its Green City, Clean Waters activity.

Federation of Neighborhoods, Could eating local food help us prevent at hotter wetter Philadelphia? Teen staff from local gardens provide seedlings for home gardens and illustrate how local gardens reduce our carbon foot print by limiting transportation and processing costs, with a card sort game.

Energy Coordinating Agency: How do Air and Energy Work in Homes?

The same air sealing practices that will keep cold air out in the winter will keep hot, moist air out during the summer. Our summers will keep getting hotter and wetter, so these practices will become more vital each year. By preventing infiltration of this air, along with pests, proper home sealing should increase interior air quality, preventing molds and mildews. Finally, good practices around saving energy reduce your carbon footprint, and free up money you currently spend on energy bills.

APPENDIX C

NETWORK MEETING AGENDAS

A. New York City Agenda for Kit workshop (3/24/15)

NYSCI workshop plan

March 26, 2015 | 10 am- 2 pm at NYSCI,

6-10 participants including NYSCI, 2 facilitators, 1 GRG observer, 1 CUSP photographer

Workshop Goals

Provide a PD experience for NYSCI CUSP ULN that:

1. Brings group through an idea-generation cycle resulting in initial prototype kits to test and develop.
2. Models a process useful to other aspects of communication work.
3. Supports selection of design approaches for ULN uses of their kit prototypes with public (tabling, festivals, other)

Key Materials

Workshop guidebook, evaluation form, prototyping materials, CUSP kits

2 Presentations: *Cusp Kits & Climate Impacts* and *Implementation Approaches*

Mechanism, materials and nametag stations, whiteboards or big paper, and markers/pens for notes.

Agenda

9:45-10:30 a.m.	Kit Roundup
10:30-10:45 a.m.	Let Me Introduce you to...
10:45-11:10 a.m.	Kit Features We Care About
11:10-11:30 a.m.	Kit Topics We Care About
11:30-12:15 p.m.	Lunch and CUSP/Climate Kit Prototyping Talk Resource Station Presentation
12:15-1:20 p.m.	Group Prototyping!

1:20-1:50 p.m. Next Steps: Kit uses from tables to playgrounds to...?
1:50-2:00 p.m. Post Workshop Evaluation
4:00-6:00 pm Post workshop debrief with planning team (possibly earlier/later)

B. Philadelphia Chat and Chew - Network Meeting in Preparation of Science Festival (3/13/15 email).

Philly CUSP Science Carnival Meet Up April 8, 9am – 11am

9:00am – 9:20am Arrive/Breakfast
Get a sense for who is here, how they interact. Sketch out room...

9:20am – 9:30am A little about the day... (overview of layout, etc.)
Kinds of points made, interactions with group.

9:30am – 9:50am Showcase I

- Half the exhibitors demo activities, the others rotate through at own pace
- Chart paper and stickies at each booth, for “I really liked” and “Maybe try...”

Capture pictures of each kit and each poster board with suggestions. Two segments

Take notes on interactions, nature of discussion, features people notice most...any climate/city solutions talk? Any talk about the public and how they would engage? Verbal suggestions are they comfortable giving/taking critique? Interest in using kits across orgs?

Section 1- what orgs/kits presenting?

Showcase 2- What orgs/kits presenting?

10:20am – 10:40am Brainstorm of any ideas to make space more cohesive (record if possible)

Content (any city solutions/climate talk) Suggestions from group about layout?

10:40am – 10:55am A note on handling common climate questions... (Samantha & Jennifer)

10:55am – 11:00am Farewell

APPENDIX D

OBSERVATION PROTOCOLS FOR NETWORK MEETINGS

New York City kit workshop observation protocol:

1. Where? Philadelphia New York Pittsburgh Washington DC Other:

2. When? Date: _____ Start time: _____ End time: _____

3. Approximately how many total attendees at this event? _____

POST-EVENT: Please rate the general *commitment* of the attendees to the CUSP activities.

- Little to no commitment
- Moderate commitment
- High level of commitment

General notes, observations, and clarifications:

9:45-10:30a.m. Kit round up and slide show (as people arrive)

Engagement **Examples (i.e., energy of the starting session)**

	None	
	Some	
	Most	
	All	

Comment cards filled out? Yes No

Which kits participants are most excited about and why: Participant comments/actions (e.g. additions mentioned)

10:30-10:45a.m. Let Me Introduce You To...

Engagement

Examples (i.e., group's energy)

	None	
	Some	
	Most	
	All	

Interests represented:

Audiences served:

10:45-11:00a.m. Debrief on the Kit Round Up

Engagement

Examples (i.e., energy, participation)

	None	
	Some	
	Most	
	All	

Mentioned:

- Topic connections
- Potential city system connection
- Visitor experience
- Constraints of where and how kits are used
- Other things mentioned about the kits
- Next steps

Other things mentioned about the kits:

Reactions to kits

11:00-11:30a.m. Kit Brainstorming

Engagement

Examples (i.e., energy, participation)

	None	
	Some	
	Most	

	All	
--	-----	--

What participants want the public to experience and think about when considering the issue:

What participants would want the public to do about the issue:

11:30-12:15p.m. Lunch at tables and CUSP Intro talk

Engagement		Examples (i.e., interest CUSP presentation and discussion)
	None	
	Some	
	Most	
	All	

Notes on group discussions:

12:15-1:20p.m. Prototyping!

Engagement		Examples (i.e., table dynamics, idea generation)
	None	
	Some	
	Most	
	All	

How do ideas arise?

What spurs thinking?

Any sense that materials play a role in shaping ideas?

Where do people get stuck?

What aspects of the workshop help people get back or stay on track in their process

1:20-1:50p.m. A Discussion: Kit Uses? From Tables to Playgrounds to...?

Engagement Examples (i.e., discussion and contribution of ideas)

	None	
	Some	
	Most	
	All	

ULN vision and interest for kits? (i.e., What will they develop? How will they implement? With whom will they implement?)

1:50-2:00p.m. Post-workshop evaluation survey

Number of surveys administered _____ Number of surveys completed _____

2. Philadelphia Network Meeting Observation Protocol

Event Name: Franklin Institute Chat and Chew

1. Where? Philadelphia New York Pittsburgh Washington DC Other:

2. When? Date: April 8, 2014 Start time: 9 am End time: 11 am

3. Approximately how many total attendees at this event? _____

POST-EVENT: Please rate the general *commitment* of the attendees to the CUSP activities.

- Little to no commitment
- Moderate commitment
- High level of commitment

General notes, observations, and clarifications: (Condensed for Appendix)

9:20am - 9:30am A little about the day... (overview of layout, etc.)

Engagement Examples (i.e., energy of the starting session)

	None	
	Some	
	Most	

	All	
--	-----	--

Participant comments/actions (e.g. additions mentioned):

9:30am – 9:50am Showcase I

Engagement		Examples (i.e., group's energy)
	None	
	Some	
	Most	
	All	

Interests represented in kits:
mentioned):

Participant comments/actions (e.g. additions mentioned):

Which kits participants are most excited about and why:
 No

Comment cards filled out? Yes

10 – 10:20 am Showcase II

Engagement		Examples (i.e., group's energy)
	None	
	Some	
	Most	
	All	

Interests represented in kits:
mentioned):

Participant comments/actions (e.g. additions mentioned):

Which kits participants are most excited about and why:
 No

Comment cards filled out? Yes

Capture pictures of each kit and each poster board with suggestions.

10:20am – 10:40am Brainstorm of any ideas to make space more cohesive

Engagement

Examples (i.e., energy, participation)

	None	
	Some	
	Most	
	All	

Mentioned:

- Topic connections
- Potential city system connection
- Visitor experience
- Constraints of where and how kits are used
- Other things mentioned about the kits
- Next steps

Other things mentioned about the playground set up:

(What participants want the public to experience and think about when visiting the playground?
How climate conversation enters in?)

10:40am – 10:55am A note on handling common climate questions... (Samantha & Jennifer)

Engagement		Examples (i.e., energy, participation)
	None	
	Some	
	Most	
	All	

Comments

1:50-2:00p.m. Post-workshop evaluation survey

Number of surveys administered _____

Number of surveys completed _____

APPENDIX E

Table 10: CUSP Study Participants

City	Partner	Organization	Organizational Type	Org / person CUSP involvement	Diss. Network meeting	Diss. Festival	Interview
NYC	Abriana	New York Hall of Science (NYSCI)	Museum and CUSP hub	4/4 years	yes	yes	yes
NYC	Amanda			4/2 year	yes	yes	
NYC	Joshua			4/4 years	yes		
PHIL	Janet	The Franklin Institute (TFI)		4/3 years			
PHIL	John			4/3.5 years	yes	yes	yes
PHIL	Elena			4/3.5 years	yes	yes	
PHIL	Jennifer			4/2 years	yes		
PHIL	Samantha			4/2 years	yes		
NYC	Ella	Queens Library Discovery Center	Public Library with science-specific programs	1/1* years	yes	yes	yes
NYC	Paul	Queens Community House	Settlement house with dispersed community programming	1/1* years	yes		yes
NYC	Andrew			1/1 years	yes		

Table 10 (continued)

NYC	Emma	We Grok It	Community focused citizen science education program	1/1 year	yes		yes
NYC	Sophia	Trust for Public Lands	Green space advocacy and community development group	1/1 years	yes		yes
NYC	Alexis	Brooklyn Children's Museum	Children's museum	2/1* year		yes	
NYC	Caitlin	Queens Zoo	Wildlife Conservation Society	3/2 years	yes		
NYC	Tyler	Brooklyn Zoo	Wildlife Conservation Society	3/2 years	yes		
PHIL	Michael	Energy Coordinating Agency	Energy efficiency services for low income communities	1/1 year	yes	yes	yes
PHIL	Jackson	Clean Air Council	Clean Air Advocacy group	3/2 years	yes	yes	yes
PHIL	Hannah	GreenTreks	Environmental education	3/3 years	yes	yes	yes
PHIL	Barbara	PA horticultural society	Regional gardening education and service provider	3/3 year	yes	yes	
PHIL	Amanda	The ReSource Exchange (Re)	Reuse store and education provider	1/1*	yes	yes	
PHIL	Teens	Federation of Neighborhood Centers (FNC)	Community Development jobs, gardening and programs	3/1 year		yes	
PHIL	Brandy	Philadelphia Water Department/Fairmont Water Works	Utility	3/1* year	yes	yes	

* dissemination was first engagement with CUSP

APPENDIX F

FESTIVAL OBSERVATION PROTOCOLS

SCIENCE CITY CUSP DATE

Duration:

- - - - - + + + + +

Stage	Activity Name
Initiates? Facilitator/ Visitor	
Engagement Visitor... Facilitator... Visitor Questions Does, Notices...	___ Uninterested ___ Look & Go ___ Look & Chat ___ Highly Involved ___ Looks ___ Touches ___ Tries ___ Notices ___ Repeats ___ In Group Talk ___ Lectures ___ Poses Questions ___ Answer Questions ___ Prompts Inquiry

Conversation	
Activity/Process	__ S __ V
Climate Message	__ S __ V
City Systems	__ S __ V
Personal Connection	__ S __ V
Main Topic	__ Activity __ Climate Message* __ City Solutions* __ Personal Connection

Other Observations: (Visitor affect, interesting comments, etc.) *special note of CC and CS talk.

Evaluator: _____ Date: _____ Page _____ Group Composition: #A: _____ Age C M __ F __ #C: _____ _____ Group Type: _____
--

Interview Participant(s):

- 1) Have you been to Climate City? What was it about? ...
- 2) How would you describe that activity to a friend? What you did...
- 3) What does that activity show that is important to know? (What can people learn from that activity?)
- 4) If you were interested in that topic, how could you get more involved?

5) What did you like best about it? What was challenging?

6) What would make it better?

APPENDIX G

Table 11: CUSP Partner Network Members

(Study subjects highlighted in grey)

Location	Organization	Type	Year Org Joined CUSP	Total Years
NYC	Conservation and informal education organization	Wildlife Conservation Society (and Bronx Zoo)	2012-2015	3
NYC	Cultural institution	The Civilians Investigative Theatre	2012-2015	3
NYC	Cultural institution	Queens Museum of Art	2012-2015	3
NYC	Informal education and conservation organization	Wildlife Conservation Society (and Queens Zoo)	2012-2015	3
NYC	Informal education and conservation organization	Queens Botanical Garden	2012-2015	3
NYC	Urban agriculture and informal education	BusRoots	2012-2015	3
NYC	Local government	Department of Environmental Conservation	2012-2015	3
NYC	Local government	Urban Park Rangers	2012-2014	2
NYC	Cultural institution	Brooklyn Children's museum	2013-2015	2
NYC	Media/Informal education	DecadesOut	2013-2015	2
NYC	Informal education/policy	Human Impacts Institute	2013-2015	2

Table 11 (continued)

NYC	Community development	Citizens Committee for NYC	2013-2015	2
NYC	Commercial Service Provider	Greensulate	2013-2015	2
NYC	Local government	NYC Cool Roof	2013-2015	2
NYC	Informal education and policy	Sane Energy Project	2013-2015	2
NYC	Foundation for health and informal education	The Sallan Foundation	2013-2015	2
NYC	Informal education and community development	Two Bridges Neighborhood Council	2013-2015	2
NYC	Informal education and service provider	White Roof Project	2013-2015	2
NYC	Informal educator	Laura	2013-2014	1
NYC	Community organizer	Amy	2013-2014	1
NYC	Informal educator	Fiona	2013-2014	1
NYC	Local government	New York City Dept. of Environmental Protection	2013-2014	1
NYC	Policy and Media	350.org	2014-2015	1
NYC	Informal education museum	Brooklyn Botanical Garden	2014-2015	1
NYC	Formal ed sustainability	Cafeteria Culture	2014-2015	1
NYC	Informal education and conservation	Friends of the Highline	2014-2015	1
NYC	Informal education and conservation	Gowanus Canal Conservancy	2014-2015	1
NYC	Informal education and conservation	Madison Square Park Conservancy	2014-2015	1

Table 11 (continued)

NYC	School system	New Visions for Public Schools	2014-2015	1
NYC	Informal education and community development	Queens Community House	2014-2015	1
NYC	Informal education	Queens Library Discovery Center	2014-2015	1
NYC	Informal education and conservation	Rockaway Waterfront Alliance	2014-2015	1
NYC	Informal education and community development	Solar One	2014-2015	1
NYC	Media- informal education	The Adaptors	2014-2015	1
NYC	Informal education and conservation	Trust for Public Lands	2014-2015	1
NYC	informal education; social and environmental justice	We GROK It	2014-2015	1
PHIL	Community development	Asociacion Puertoriquenos en Marcha	2012-2015	3
PHIL	Informal education, museum	Chemical Heritage Foundation	2012-2015	3
PHIL	Informal education and community development	Federation of Neighborhood Centers (FNC)	2012-2015	3
PHIL	Media/Informal and forma/informal education	GreenTreks	2012-2015	3

Table 11 (continued)

PHIL	Community development	New Kensington Community Development Corporation	2012-2015	3
PHIL	Policy on energy and environment	PennFuture – Next Great City Campaign	2012-2015	3
PHIL	Informal education horticulture	Pennsylvania Horticultural Society	2012-2015	3
PHIL	Local government	Philadelphia Mayor’s Office of Sustainability	2012-2015	3
PHIL	Service provider utility	Philadelphia Water Department	2012-2015	3
PHIL	Informal education and conservation	Philadelphia Zoo	2012-2015	3
PHIL	Commercial service provider	SEPTA	2012-2015	3
PHIL	Informal education museum	The Academy of Natural Sciences of Drexel University	2012-2015	3
PHIL	Urban agriculture and informal education	The Food Trust	2012-2015	3
PHIL	Academic and advisor	University of Pennsylvania	2012-2015	3
PHIL	Policy and outreach	Clean Air Council	2013-2015	3
PHIL	Health care service provider	National Nursing Centers Consortium (a PHMC affiliate)	2013-2015	3
PHIL	City water utility and outreach	The Fairmount Water Works Interpretive Center (FWWIC)	2013-2015	3
PHIL	Building development	Delaware Valley Green Building Council (DVGBC)	2012-2014	2
PHIL	Health, Professional Nursing Association	Public Health Management Corporation, National Nursing Centers Consortium	2012-2013	1
PHIL	Academic	Bryn Mawr College	2014-2015	1

Table 11 (continued)

PHIL	Academic	Drexel University	2014-2015	1
PHIL	Energy Conservation equity and efficiency services	Energy Coordinating Agency	2014-2015	1
PHIL	Informal education and conservation	Fairmount Park Conservancy	2014-2015	1
PHIL	Energy utility sourcing service	Groundswell	2014-2015	1
PHIL	School	J.S. Jenks Academy	2014-2015	1
PHIL	Community development and urban agriculture	Mill Creek Farm	2014-2015	1
PHIL	Informal education and community development	Norris Square Neighborhood Project	2014-2015	1
PHIL	Informal education and conservation	Overbrook Environmental Education Center	2014-2015	1
PHIL	Informal education and community development	Philadelphia Higher Education Network for Neighborhood Development (PHENND)	2014-2015	1
PHIL	Local government	Philadelphia Parks & Recreation	2014-2015	1
PHIL	Policy for human and environmental health	Physicians for Social Responsibility	2014-2015	1
PHIL	School	Richard Wright Elementary School	2014-2015	1
PHIL	Informal education and conservation	Riverbend Environmental Education Center	2014-2015	1
PHIL	Commercial, green roofs	Roofmeadow	2014-2015	1
PHIL	Informal education and conservation	Schuylkill Center for Environmental Education	2014-2015	1

Table 11 (continued)

PHIL	School	String Theory Charter School	2014-2015	1
PHIL	Informal education and conservation	The Resource Exchange	2014-2015	1
PHIL	Academic	Thomas Jefferson University Hospital	2014-2015	1
PHIL	Urban agriculture and community development	Triskeles	2014-2015	1
PHIL	Government	U.S. Fish & Wildlife Service	2014-2015	1
PHIL	Government	USDA Forest Service	2014-2015	1
PHIL	Media	WHYY	2014-2015	1

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