

The Informal Science Education Landscape

A Preliminary Investigation

John H. Falk, Ph.D.
Scott Randol, Ph.D.
Lynn D. Dierking, Ph.D.
Oregon State University

Introduction

No goal is more important to America than building a learning society in which every citizen has the desire, abilities and tools to fulfill his or her quest for knowledge and engagement, including knowledge and engagement in the critically important fields of science, technology, engineering and mathematics (STEM). Although traditional formal educational organizations play an important role in supporting STEM learning, there is growing awareness of the contextual nature of learning which assumes that attitudes toward, and knowledge and understandings of STEM are more likely to be shaped by an individual's direct and personal experiences, needs, expectations, and culture (cf., Falk, Storksdieck & Dierking, 2007; Sturgis & Allum, 2004; Turner, 2008; Wagner, 2007). This perspective places a greater emphasis on the contributions played by the vast network of informal science education entities—including, but not limited to science museums of all kinds, community-based organizations with mandates for informal STEM learning, STEM-oriented television, film, books and the Internet—which are ideally suited to support the public's ever-expanding desire, and at times need, for free-choice STEM learning, across their lifetimes and throughout the day.

In part to help fulfill this potential, the National Science Foundation (NSF) funded the Center for the Advancement of Informal Science Education (CAISE), designed to create mechanisms to facilitate participation in, and leadership within, the free-choice STEM learning community. This research study, conducted by Oregon State University, one of the Co-PI organizations helping to lead CAISE, is an initial effort to explore and document the current “landscape” of the informal science education community. Our goal in this study was to identify areas where CAISE can most strategically provide support for community-building and foster communication among the diverse universe of organizations involved with informal science education. The study was based on the premise that in order to create a dynamic, grassroots community, one first needs to understand who identifies with and currently participates in that community, as well as who currently does not. Also important to understand are the broad questions and issues various members of this community believe they face and the tools they perceive they require to improve their practice and support their work.

Theoretical Framework

The theoretical framework for the research was a *Community of Practice* (CoP) approach, a construct which describes the processes of social learning that occurs when people who

have common goals interact while working to accomplish those goals. A CoP is defined as “a unique combination of three fundamental elements: a *domain of knowledge*, which defines a set of ideas and issues; a *community of people* who care about this domain; and the *shared practice* that they are developing to be effective in their domain” (Wenger, McDermott, & Snyder, 2002, p. 27). Shared practice suggests similar ways of talking about the work at hand, solving problems, getting things accomplished or finding and processing information. If the multiple individuals and organizations that make up the ISE community are truly a CoP, we would be able to describe them as a group of people who share common goals, for example a concern or passion for STEM, and engage in shared practice through regular social interaction with each other as they strive towards meeting those goals; in particular through the vehicle of informal education. A “true” CoP is much more than a common set of products, information or skills though. To create, nurture and sustain a dynamic community, members must participate in active relationships over time (Lave & Wenger 1991; Wenger, 1998) and organize around issues that matter to members of the community (Wenger, 1998).

The CoP construct was originally conceptualized as a way to describe and understand relatively small, narrowly delimited domains, such as apprenticeships between midwives in the Yucatan. As this construct has been used as a way to frame larger, more complex communities, researchers have developed the notion of *Multidisciplinary Communities of Practice* – situations in which individuals from several different professional communities or disciplines overlap and share information, tools and resources to advance a common goal. Although arguably large, multidisciplinary communities are much less common than single disciplinary communities of practice, it is clear that they are growing in importance as the world is becoming ever more interconnected and there is a growing appreciation for the multidimensionality of most issues of importance. By its very nature as a complex, multi-dimensional community, the informal science education (ISE) community would need to be thought of as a *Multidisciplinary Community of Practice*. In the case of ISE, members specialize in communicating to the public through virtually every strategy known; just to hit the highlights these include exhibitions, print, film, broadcast and on-line media, lectures and individual-to-individual. Each mode of communication involves a unique expertise and comprises its own discipline. These disciplines, though disparate communities themselves, have the potential to come together in order to serve the common goal of helping inform the public about STEM via out-of-school mechanisms.

The distinction as a multidisciplinary community is important because there are differences in how and to what extent the various sub-communities within ISE may choose to participate. For example, there are some sub-communities, such as science centers, for which ISE is probably considered the very core of what they do; it may even be the primary reason for their existence and thus already be an integral part of their day-to-day thinking and operation. In other sub-communities, ISE may be more ancillary or on the fringe of what they do. That is, informing the public about science through informal education may be an important goal however, not their only or even their primary goal. In these communities, some or much of their time may be dedicated to

activities such as research, conservation or education in schools that would not always be considered ISE-focused.

To deal directly with this critical distinction we will be using different terms and meanings to describe participation in the ISE community than those commonly used in the CoP literature. In CoP research, levels of participation are differentiated along a trajectory ranging from peripheral engagement to active engagement to core participation. Peripheral engagement refers to a novice member who is participating for the first time or does so infrequently, active engagement refers to members who participate and/or contribute frequently in a long-term capacity, but not in leadership roles, and core membership refers to a member who is a sustained participant, defines her/his professional identity related to this participation, and whose participation contributes both to her/his own evolution and that of the CoP (Lave & Wenger, 1991).

We will use the terms “ancillary” and “central” to describe participation in this CoP. Unlike the traditional terms described in the previous paragraph, ancillary and central are not associated with the experience nor expertise of the individuals or communities involved, but rather the degree to which ISE is fundamental to the work they do. We also explicitly state that there is no judgment associated with a community’s level of participation in the ISE community. Participating as an ancillary member does not mean that the significance, quality, dedication or impact of the participation is less than those communities that identify with ISE more centrally. Of course, there is a desire, even a mission on the part of CAISE, to build connections between sub-communities within ISE and to help members identify with ISE in more integral ways. However, there is an appreciation that this will depend upon the needs and focus of that sub-community and CAISE’s ability to forge on-going and sustained relationships that meet individual sub-communities’ needs. Implicit also is the potential that as the understanding of the value of ISE increases nationally, groups that currently perceive ISE as ancillary to their goals might choose to make ISE more central.

The other important note is that the unit of analysis for this study is the professional community, not the individual. Some individuals in an ancillary community may spend all of their time doing ISE work; likewise there are individuals in communities in which ISE is central who are not involved in ISE activities at all. Categorization of professional communities is not meant to describe every individual in that community, but rather the general role of ISE in the community as a whole.

Another important premise of CAISE and this study is the focus on the *processes* of building a community of practice; as well as any *products* that might result. Given this direction, it is critical to invest time and resources into understanding and utilizing the how’s and why’s of building and sustaining learning communities and networks. Considerable research has been conducted on the theory and practice of networks and community building (cf., Bonabeau, 1999; Lev, 2001); conclusions suggest that successful networks do not merely happen. They require study and continuous care and feeding. This means that there is a critical role that a leadership organization can play in helping to provide this care and feeding. That said, all evidence suggests that effective

CoPs primarily grow organically, from the bottom up, energized by the needs and interests of community members rather than through top-down efforts. Leadership needs to be representative of the community at large, particularly in a *Multidisciplinary Community of Practice*, rather than representing only a few sub-communities. And finally, an effective community of practice also needs a system of continuous feedback and input from its members, as well as organic systems to facilitate communication, and when useful, the development of products for dissemination that emerge from the needs and values of the community members.

The CoP construct has been widely used within a variety of disciplines and situations and perhaps not surprising, a whole range of related constructs have been generated. These , include Communities of Action, Communities of Circumstance, Communities of Inquiry, Communities of Interest, Communities of Position and Communities of Purpose. These varied constructs refer to specialized circumstances, in which individuals or groups might come together as a community, e.g., to satisfy a specific interest, purpose, inquiry, action or position. Each is usually thought of as a relatively ephemeral association, a coming together of normally disinterested/unrelated parties in order to solve a specific issue, e.g., a product design team made up of members of the marketing, graphics, engineering and sales departments to develop a new product line (Community of Interest), an on-line support group brought together by a particular illness (Community of Circumstance) or a group rallying around the candidacy of an individual (Community of Action). A reasonable question which will be addressed later in this report is whether the ISE community could best be conceptualized and nurtured as a permanent multidisciplinary CoP or equally validly as one or more of these more ephemeral entities.

Finally, is it important to note that Community of Practice is not the only theoretical framework through which the ISE community could be analyzed; and in some cases CoP may not even be the best framework. For example, a neo-institutional theorist might categorize the community as an organizational field. As defined by DiMaggio and Powell (1983: 143), an organizational field consists of "those organizations that, in the aggregate, constitute a recognized area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organizations that produce similar services or products." The assumptions and approaches that underlie institutional theory are quite different from CoP and it is quite possible that an institutional theory lens could also provide insights into the ISE community. However, we designed the interview protocol and questions utilizing the CoP framework and thus in this report chose to analyze and interpret the data through that lens.

Research Goals and Design

This initial research effort was designed to support two overarching goals:

1. Determine the current state of the ISE community and the degree to which it functions as an effective multidisciplinary CoP.

2. Provide the background knowledge necessary to support decision-making that would help CAISE leadership determine how best to leverage their finite resources in support of the ISE community.

To accomplish these goals the study explored the “landscape” of the informal science education community to determine what the ISE community of practice currently looks like and what potential community building might be possible. We attempted to shed some initial light on the following issues:

- How do (presumed) ISE professionals self identify within their professional community including what missions, goals and motivating factors influence their sub-community’s work?
- What challenges do the various sub-communities of ISE face and how and to whom do these sub-communities make the case that what they do is important?
- From whom do they seek funding and how do they perceive and position their sub-community with respect to ISE?
- For those who do identify with, and participate in the ISE community of practice to any degree at present, in what ways do they participate?
- Is participation central to their work or ancillary?
- For those who do not identify with, or participate in the ISE community of practice at present, why don’t they?
- What are the conditions that might influence greater participation in the future?
- What advantages or disadvantages might CAISE provide ISE professional sub-communities?
- What types of structures or resources could CAISE provide that might benefit a sub-community and its members, and potentially motivate sub-community members to consider participation in the ISE community as more central to their work?

Methods

Data for this study were collected through in-depth telephone interviews with education leaders and professionals from diverse professional communities related to communicating science to the public. A list of potential people to interview was assembled by the research team and CAISE advisory committee; the list included individuals from a wide variety of groups involved in the development, production, delivery, funding, and support of informal science education activities internationally. The final interview list included representatives from: Youth Community Organizations, Adult Community Organizations, Science Centers, Botanical Gardens, Natural History Museums, Zoos and Aquariums, Environmental Organizations, Public Television and Radio, Journalists, Health Organizations, After-School Science, Science Societies and Large Format Film (for a complete list refer to Appendix A). In order to gain an unbiased view of the field, we developed selection criteria that allowed us to include individuals who were diverse in terms of the focus of their work, expertise, size of the organization(s) they represented and their geographic location. We also included individuals from Europe, Canada and Australia. Most importantly, we attempted to

select individuals who were prominent within each of the target sub-communities; individuals who could credibly represent their communities. Suitable candidates included association executive directors, organizational directors and deputy directors, national funders and nationally recognized professionals.

In order to be true to the CoP approach and ensure that opinions transcended the “usual suspects” we also attempted, as much as possible, to select individuals who were not in the inner circle of NSF ISE. That we purposefully tried to exclude in this initial study the core group of individuals who regularly apply for and receive funding from NSF ISE as these individual would be the most likely to perceive ISE as central to their work. To provide a sense of the magnitude of this core group relative to the larger community we offer the following hypothetical analysis. In any given year there are probably 100 to 200 individuals with current NSF grants. Thus we would assume that over a 5-year period the pool of individuals, including Co-PIs, who have received NSF ISE monies, would be on the order of magnitude of 1,000 individuals. A subset of these individuals receive NSF ISE support almost continuously over many years, others are connected to NSF ISE for only the duration of a single grant. Either way, this is group of roughly a 1,000 individuals comprise what we would call the “usual suspects” as they are intimately knowledgeable of the NSF ISE program and the rhetoric and assumptions that underlie the program. There is a second circle of individuals; people who have not recently or ever directly received support from NSF ISE but are knowledgeable about the program. They may be indirect recipients of NSF ISE support (e.g., partner organizations or advisors) and/or they may potentially aspire to be part of the core group. We estimate that there is an order of magnitude more individuals in this second group than in the core group – approximately 10,000 individuals. *This was the group from whom we drew our sample.* Finally, rounding out the ISE community Falk has estimated that there are probably two orders of magnitude more individuals involved in some way with ISE – roughly 1,000,000 professionals – most of whom are assumed to be only remotely aware of and/or involved with NSF ISE funding efforts. These are the professionals that collectively CAISE hopes to serve.

Since the design of the study was exploratory and intended as a qualitative, hypothesis-generating study, interview questions were open-ended in nature and a small sample size was selected so that a detailed examination of each person interviewed and their community could be conducted. The goal of each interview was to better understand how individuals from a variety of communities described and positioned themselves and their particular community with respect to ISE, identify what the major challenges in their community are, and explore how CAISE can or might support their efforts. A major portion of the interview was dedicated to gathering information regarding the person’s view of their professional communities. This included questions about their community identity—how they self identify: 1) the missions, goals and motivating factors of their community; 2) the hurdles to meeting their goals; 3) how they make the case that what they do is important and to whom they make that case; 4) where they go to get funding; and 5) how they perceive their community in relation to ISE. Following these questions about community identity, those interviewed were given a brief introduction to CAISE and asked about the advantages or disadvantages that they perceived to CAISE, as well as

suggestions for the types of structures or resources CAISE could provide that would benefit their community and its members. In compliance with IRB procedures, participants were provided with general information about the purpose of the study, both as part of the invitation to participate and in the introduction to the interview. In order to eliminate any bias that participants might have, information about CAISE and its funder were not made explicit until the end of the interview unless this information was specifically requested. A copy of the interview protocol is included as Appendix B.

Results

Thirty-five individuals were contacted via email and invited to participate in an interview. Three declined due to time constraints, three agreed to be interviewed, but a time could not be scheduled and four never responded to the request. We have no reason to believe that the individuals who failed to be interviewed were motivated by a lack of interest in the topic of the interview. In total, twenty-five interviews were conducted. Phone conversations utilizing the interview protocol described above lasted on average 45 minutes.

Community Identity

When asked, without prompting, to identify the professional community or communities of which they are a part, only about 10% (3 of 25) mentioned Informal Science Education specifically. The most common type of response was given by about half of those interviewed and related to the person's institutional identity (science centers, museums, botanical gardens, etc). Some typical responses were:

“Science Centers, the community of not-for-profit CEOs and other communities such as science and math educators.” ~ Science center director.

“Aquariums and zoos – the museum community in general. Non-governmental organizations, conservationists and non-profits.” ~ Director of a global network of zoos, aquariums, and museums.

“The museum community...evaluation and research communities, academics. Consultants in the field.” ~ Director of Audience Research for a national museum.

“Public affairs community, informal education including public education videos and documentary films.” ~ Independent film-maker

“Primarily, the environmental education community, but also communications – marketing and branding.” ~ President of a national foundation.

“Youth development community, informal science community, political science and public policy communities.” ~ Director of Research for a national youth organization.

Various forms of “educator” (science educator, environmental educator, educator in general) were mentioned by a third of those interviewed. Other responses included answers such as: after-school provider, youth development, executive, scientist and broadcaster. When asked specifically though, all twenty-five reported that their professional community has some overlap with the ISE community. Nearly half of those (12) were quite emphatic that most or all of what they do could be considered informal science education stating that they were “definitely” or “absolutely” a part of the ISE community. One person interviewed (representing science writers) felt that there was some overlap between their field and ISE, but “not a lot” and stated that they provided services for the ISE community but were not a part of it. Some characteristic responses follow:

“We were among the founders of ISE and are daily practitioners. It’s not all we do, but a big part.” ~ Director of a national youth organization.

“Yes, just by definition, we are a part of ISE. Radio is informal – it is how adults get educated; it’s their source for information.” ~ General Manager of a public radio station.

“My organization is part of ISE. There are a lot in our community who would not call themselves educators who are doing what we are talking about. There is a lot of school stuff too though” ~ President of a national foundation.

“Yes, most definitely. Documentary films are a motivating factor for people to seek more science education. We reach people in their homes to provide a basic introduction to issues and demonstrate the scientific method. That can lead to further learning in museums or other places. We can show them where to go to learn more.” ~ Independent film-maker.

At the end of the interview, those interviewed were asked to rate how closely they self-identified with a list of different types of educators (1 being *Not at All* and 5 being *Very Closely*); the strongest associations were with the communities of ISE and Public Educator (Table 1).

Table 1. Mean rating of self-identified relationship to educator-related terms.

Community	Mean Rating
Informal Science Educator	4.12
Public Educator	4.08
Free-Choice Learning provider	3.28
Public Service Provider	3.24
Science Educator	3.24

A majority of those interviewed (15 of 25) consider themselves as educators; many of those who said that they were not educators stated that while many in their field are educators, they themselves played a more administrative role within their organization.

Interviewees were overwhelmingly in agreement (22 of 25) that institutions within their professional communities have educational missions. Indicative of responses were the following:

“Education is one of the last great mechanisms to improve society – it’s a pathway to a better life.” ~ University educational researcher

“Yes, missions are increasingly education-centered. It used to be social and civic development, now they are more education focused.” ~ Program director of a youth development organization.

“Education plays a central role – all of the museum is education. Every job in a museum should have an education focus.” ~ Science center director.

“Not totally, our community has a lot of academics; they all teach, but they do research as well. The education division definitely does.” ~ Executive Director and CEO of a science society.

The three people interviewed who did not give a definitive ‘Yes’ to the question each qualified their answer by saying: 1) “we have an education mission, but not a school mission;” 2) “... *education* is a loaded term – our role is to inform; to raise awareness;” and 3) “there are many researchers in our community, but certain segments do education.” A representative from the broadcasting/media community stated, “We do education with a small ‘e’. We don’t give people facts, we entice them into the world of science – make it exciting, interesting, dramatic and beautiful.”

The missions and goals shared by those interviewed centered largely on improving society, including improving decision-making skills, helping to create a science literate population, improving quality of life, and helping people stay healthy. Some examples included:

“We are trying to raise awareness of issues. The biggest motivating factor is to promote science literacy – theatres choose films to achieve this.” ~ Film association president.

“To illuminate society, to improve society and the environment. This is the ‘only and all’ of what science centers are about.” ~ Science center CEO.

“To create knowledgeable global citizens and to encourage young people into STEM careers.” ~ Executive Director of a children’s museum.

Several made the point that knowing about science is critical to everyday life – both for quality of life and for being a responsible citizen. One said, “In this age, our lives depend on knowledge. We need air clean enough to breathe, quality prescription medications, traffic lights that are programmed to keep people safe – everything relies on science and technology.” Informing and inspiring the public by raising awareness, increasing interest

and making connections between STEM content and the everyday lives of the public were very common responses. Encouraging youth to consider STEM careers and helping to promote stewardship were also mentioned by several of the individuals interviewed.

Those interviewed indicated that they most need to make a case for the importance of what they do to policy-makers and funders; as one put it, “to those with money and those with power.” The public was also named frequently. Typical responses included:

“City officials, corporate sponsors and other funders, and the public” ~ Director of a global network of zoos, aquariums, and museums.

“We need to make the case to the state and federal government, to policy-makers, to the people who don’t come, but are interested, and the research community – academia – they mostly get it, but not entirely.” ~ Audience Researcher in a national museum.

“To funders, federal and private, and to future professionals – we need to let people know that there is a career here.” ~ Executive Director, national environmental association.

According to those interviewed, the most effective arguments supporting their existence tie back to their institutional missions and relate to improving people’s lives, fostering the next generation of STEM professionals and contributing to an informed and scientifically literate citizenship. Many stated that although examples that demonstrate these impacts are most persuasive, such empirical evidence is often hard to come by. In many cases though, simple information such as numbers served and demographics can be effective in making the case.

There were many similarities in where professional communities seek funding; federal sources (NSF – ISE in particular, Department of Education, Department of Defense, Environmental Protection Agency, etc) were mentioned 31 times (most people listed many funding sources). Corporations and private foundations were each mentioned by many (12 and 14 respectively); private donors were listed by just over a quarter and state government was named by two.

The most frequently mentioned hurdle to meeting the goals of the community was lack of resources – primarily funding. Another common theme was the “fragmented” nature of the community or the lack of a “united front.” In order to make changes in policy and/or practice, several of those interviewed felt that the ISE community needs to coalesce around similar ideas and goals. A flavor of responses can be seen in the following quotes:

“Money, and not enough resources to rigorously prove impact; everything is still anecdotal. The lack of unity is also a huge hurdle – we need to work better together and for the same ends.” ~ President of a national foundation.

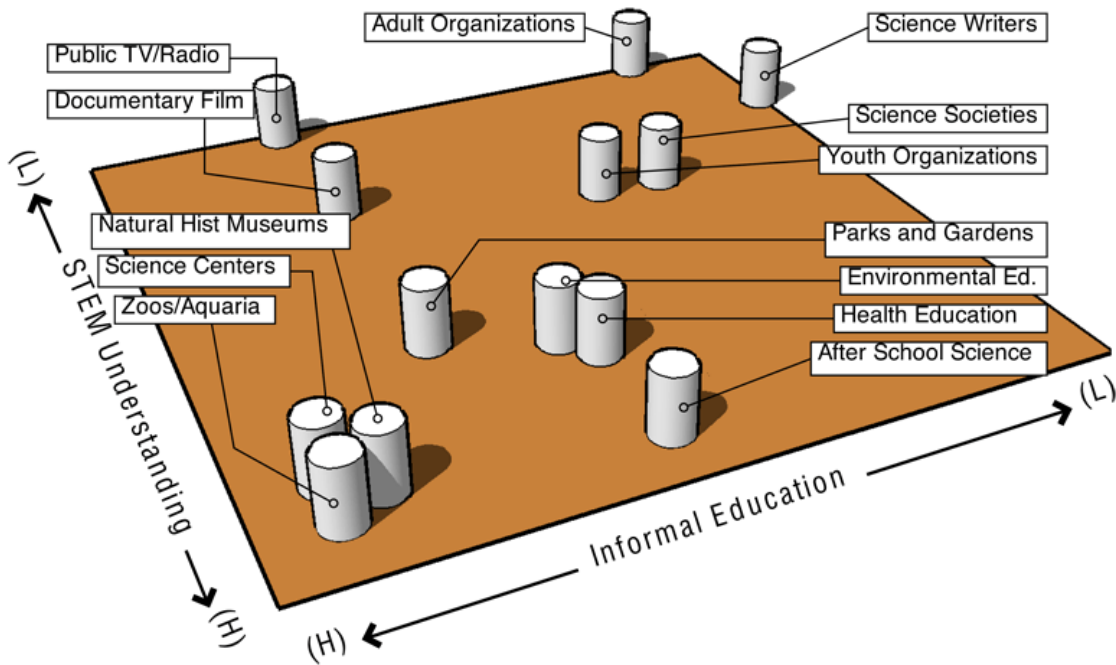
“The biggest hurdle is funding, but also the competition for leisure time. There is a fine line between entertainment and education, and people self select away from science.” ~ Science museum director.

“Sustainable funding. The fragmented community, we need a common identity – we all need to get under the same banner. We need one field, not seven little ones.” ~ Program Director of a youth development organization.

“Limited time and resources and the total lack of federal priority. There is also the assumption that health education information is being provided by others (parents, church, school, etc) no one is taking responsibility.” ~ Director of Education for a health education center.

Based on these interviews we have attempted to visually represent these data by *qualitatively* arraying the 13 communities sampled within a two-dimensional space as seen in Figure 1. Identity as informal educators is represented on the X axis and identity with the goal of promoting public understanding of STEM is represented on the Y axis. Since Figure 1 is based upon a qualitative interpretation of a small sample of the community, i.e., the opinions of one to three individuals per community, it is important to appreciate that it is a VERY preliminary representation of the ISE community; caution

Figure 1. Two-dimensional representation of current ISE Landscape as a function of identification with informal education and public understanding of STEM.



NOTE: Axes are qualitative scales representing “High” (H) to “Low” (L) importance.

needs to be used in making generalizations. However, there are some interesting aspects to note. For example, there is a strong cluster at the lower left corner – high identification with both informal education and the goal of promoting public understanding of STEM – this cluster includes Natural History Museums, Science Centers and Zoos and Aquariums. There is also a cluster at the top right – relatively low identification with both informal education and promoting public understanding of STEM – this cluster includes adult organizations and science writers, and also potentially youth organizations and science societies. Parks and Gardens, Environmental Education organizations, Health Education Organizations and possibly After School Science providers (Note: the individual sampled represents a group that focuses specifically on STEM, and so results should not be interpreted as broadly representative of the entire “After School” community) form a potential third cluster that is more in the midrange of identification with both informal education and promoting public understanding of science.. Public TV/Radio and Documentary Film form a fourth and final cluster, which as a community, identifies more with informal education, than the promotion of public understanding of STEM given that science is only one of many topics that they might focus on in their work.

Vision of CAISE

After hearing a brief description of CAISE, participants were asked about the possible advantages and disadvantages of such an organization, and were asked to identify specific structures or resources that CAISE could provide that would benefit their community. Those interviewed were overall extremely positive about the creation of CAISE and perceived many ways in which CAISE could benefit their specific sub-community and/or the ISE community at large. Most of these benefits fell into two categories: 1) CAISE as community builder; and 2) CAISE as a champion for ISE.

A majority of people interviewed (19 out of 25) perceived CAISE in an important community-building role. Some examples of these comments include:

“Provide opportunities for collaborative research, across institutions. Give us tools for helping to understand the visitor. Create forums for people to build networks – to share the stuff that they can apply on a daily basis – and resources for busy educators.” ~ Senior Vice President of a professional association.

“Help create opportunities for joint initiatives and venues for learning within the community. Set up a network for sharing best practices and developing partnerships.” ~ Vice President, adult membership organization.

“We need opportunities to talk with other folks; a way to share advice and critiques from experts and specialists from other communities.” ~ Science center director.

Overall, research participants felt that CAISE could foster the ISE community by serving as a venue to share content, practices and expertise; develop partnerships with others and

define common measures of success. It could also assist the community by helping to clarify, and potentially simplify what many see as an “unnecessarily complex” funding environment; including, but not exclusively, at the NSF.

A majority (16 out of 25) of those interviewed also felt that CAISE could play an important role in championing ISE nationally, in particular constructing and publicizing evidence-based arguments for the importance and impact of informal learning opportunities and helping make formal education settings “permeable” to ISE providers. This could be accomplished by conducting and/or interpreting research on how participating in ISE opportunities contributes to science learning and raising awareness of the benefits of ISE. Within the category of CAISE as champion, those interviewed said the following:

“Funders and policy-makers need to constantly get the message that science education is important. Science doesn’t have a charismatic advocate – a celebrity or someone – to lobby for us. Get the trendy people talking about science” ~ Head of Science for a public broadcasting company.

“It [CAISE] could help in constructing a good case for science education, and in publicizing it widely.” ~ Science center CEO.

“CAISE could provide more information and research on the importance of ISE, and how ISE can be complementary, not compared to or competing with, schools.” ~ Executive Director for a health education center.

“You [CAISE] could do research – we need to measure how one ISE experience leads to more experiences and how that collections of experiences impacts people.” ~Director of Research for a national youth organization

Conclusions and Recommendations

This initial research effort included two overarching goals: (1) Determine the current state of the ISE community and the degree to which it functions as an effective CoP and (2) Provide background knowledge necessary to support decision-making that would help CAISE leadership determine how best to leverage their finite resources in support of the ISE community.

Current State of the ISE Community

We interviewed a diversity of individuals, each of whom was considered a leader within one of thirteen different types of professional communities; arguably all are involved with informal science education. Without prompting, the vast majority of these individuals self identified themselves first and foremost as being part of their immediate professional community (e.g. science center professional, writer, environmental educator,

etc). When prompted though, a majority acknowledged that at some level they are also part of a larger community called informal science education. In this latter regard, nearly all interviewees felt that the communities they represented closely associated with the goals of ISE and nearly half were quite emphatic that most or all of what they do could be considered informal science education. However, the various sub-communities represented in our sample position themselves differently with regard to the ISE field. All communities sampled perceived to varying degrees an overlap between the practice of ISE and the work that they do. Some saw themselves as “daily practitioners of ISE,” while others perceived that they are “a cog in the wheel of where people get their information regarding science” and still others envisioned ISE as only a small part of the much larger or more general efforts of the community with which they are engaged.

One way to visualize the ISE community space is to disaggregate the two dimensions of ISE -- “promoting STEM understanding” and “practicing informal education” as we did in Figure 1. Utilizing this perspective, we can see that some communities currently perceive themselves as tightly committed to the central tenets of an ISE CoP, for example the Science Center, Natural History Museum, and Zoo and Aquarium communities, while the Science Writer, Science Societies, and Adult and Youth Communities currently view ISE as more ancillary to their work. The remaining groups such as the Broadcast Media, Documentary Film Makers, After School Science, Parks and Gardens, Health Education and Environmental Education communities currently perceive themselves as somewhere in the midrange on those two dimensions.

Based on the findings in this report, it is fair to conclude that currently the ISE community as a whole is not functioning as an effective multidisciplinary CoP. However, there are sub-communities that are. For example, the organizational cluster that includes Science Centers, Natural History Museums and Zoos and Aquariums perhaps could be said to be functioning as an effective multidisciplinary ISE community of practice. These three sub-communities currently have a strongly shared sense of mission and subject matter focus, there is a cohesive community of people who care about this domain, and there are many commonalities of practice that are shared between the three sub-communities. As evidence of this, there is a significant subset of members of these different communities who regularly attend the same conferences (e.g., ASTC, AAM, NARST), read the same journals (e.g., *Visitor Behavior*, *Science Education*, *Curator*, *Museum Education*) and there is cross-hiring between the three sub-communities. However, participation in these shared social practices considerably decreases the further one moves beyond this “science museum-like” cluster.

That said, across the array of sub-communities sampled there were many examples of shared practice (e.g., seeking funding from federal sources that support ISE such as NSF, NOAA, NASA and EPA) and ways of talking about the work that is done (e.g., citing how many people participate in their non-school programs, how their ISE efforts affect public knowledge and attitudes towards STEM). It is probably fair to say that amongst the individuals with whom we talked, no one categorically excluded themselves from the ISE community, with the exception of one individual who perceived herself, and by extension, her community, as being outside of the ISE community. She described her

community as being the film/entertainment business with science communication / education as merely a convenient means to an end rather than a critical reason for existing. As with all of the research participants in this study, how representative this particular individual was of the broader community he was selected to represent will need to await further study.

Although each of the representatives of the various sub-communities we talked with positioned themselves quite uniquely with regard to ISE, there were four striking and important similarities between all groups:

- There was considerable agreement in the importance of promoting public STEM understanding and literacy.
- There was widespread convergence around the value of free-choice learning and commitment to the practice of informal education.
- By and large each sub-community seeks funding from the same pool of resources.
- Each sub-community uses very similar evidence and arguments for making the case for the value of what they do.

Based upon this admittedly preliminary and very exploratory investigation, there appears to be evidence that many of the pieces that are necessary for ISE to become a true *multidisciplinary community of practice* are in place. These include a shared sense of mission (promoting public understanding of science), a variety of similar beliefs and practices (these include educational, fund-raising and promotional activities), and a group of committed professionals who share a commitment to the mission of science education and buy in to the value of out-of-school (i.e., informal) education as an important mechanism for accomplishing that mission.

Having said this though, based upon the evidence presented above, *we assert that the ISE community is not currently an effective multidisciplinary community of practice. We also feel we can say that ISE has the potential to become a true and robust multidisciplinary community of practice.* However, to become a true community of practice, participants from across the various sub-communities within ISE must learn and advance through regular interaction and communication within the community. Although interactions regularly occur within each of the sub-communities that are part of ISE, there is currently little boundary crossing and linking of communities across the ISE field. This raises the question of why these practices are currently not happening, what has prevented ISE from spontaneously becoming an effective multidisciplinary community of practice? There could be at least two explanations.

Explanation One is that in there was no historical, sustained need for there to be a multidisciplinary community called informal science education; and by extension, it is unlikely for there to be such a need in the future. Although there have always been short-term motivations for collaboration and communication across sub-communities, e.g., a grant proposal or promotional effort, these needs have been and can continue to be accomplished within existing networks and models of social interaction (e.g., personal networks and ephemeral working agreements). Despite the growing public appreciation

for the value of free-choice learning and a mutually shared goal for promoting public STEM understanding, the various sub-communities of ISE do not possess sufficient shared needs to justify the added expenditure of time and energy necessary for becoming a fully functional CoP; the value that would be added by more permanent relationships is not there.

Explanation Two is that existing sub-communities have not become a more robust CoP because they lack an overarching vision that enables them to see significant value in such a community. In other words, it is not that sub-communities would not be able to perceive value in being a CoP, but rather they did not historically, nor do they currently, understand the specific value represented by such a community. It is analogous to observing a community of health workers who failed to utilize sterile practice because they did not yet understand the germ theory of medicine. The decision not to engage in sterile practice resulted from a lack of understanding of the benefits that sterile practice could afford them and their patients. Arguably, it is possible that an analogous deficit in understanding currently exists within the ISE community.

Major outcomes of the current study were the ability to frame these two scenarios and research findings, and the ability to highlight the importance to the future of CAISE of determining which of these two scenarios comes closest to the truth. For example, if the first scenario seems most plausible, it is essential to explore whether other models such as the theory of organizational fields or more ephemeral communities, such as communities of interest or communities of action, or some other yet-to-be-identified theory, would better frame any approaches that CAISE undertakes. However, if scenario two is closest to the truth, then approaches that foster, nurture and sustain a multidisciplinary community of practice, will be critical. Unfortunately, the data collected in this current study cannot resolve this decision because the research was exploratory and not designed with this purpose in mind. However, the current study does provide a clear framework for the next steps that CAISE should take, in the short term and in the long term.

Next Steps for CAISE

Short-Term Perhaps most importantly, the results of this study provide support for the immediate value of an entity like CAISE. Almost unanimously, research participants perceived one or more roles that an organization like CAISE could play to support their community in its work. In particular, there was considerable agreement around two immediate roles: (1) improving communication within and across the ISE field and (2) championing the importance of informal science education.

Establishing opportunities for individuals both within and across sub-communities to communicate was the most frequently mentioned way that CAISE could benefit the ISE field. There was an expressed hope that these increased communication opportunities would help support cross-fertilization of ideas and sharing of useful resources. Research participants voiced a need for a central repository of the “wealth of information and experience” that exists within the ISE community. Specifically, ISE professionals are looking for an archive of research findings, tools for understanding audiences and

measuring impact, information and assistance with funding proposals, a “best practices resource center,” and forums for sharing ideas.

Those interviewed encouraged CAISE to continue to try and position itself as a communication nexus by creating structures and resources that encourage the sub-communities to connect and communicate with each other. In this way CAISE can help enable disparate parts of the community to have access to new and useful ideas, and potentially feel a greater sense of connection to each other. According to participants in the study, these opportunities would help “strengthen overlaps, build bridges and create support for each other.”

Second, individuals perceived that CAISE could help fill an immediate and important function as a champion for informal science education. In particular, a significant number perceived that a concrete way in which CAISE could play such a role was by being a conduit for collecting, distilling and promoting evidence of the impact that the ISE community contributes to the public good. CAISE could help to promote the value of ISE both as a collective entity, as well as by communicating about the individual actions of its separate members. By compiling, synthesizing and disseminating a strong case for ISE, CAISE has an opportunity to play a leadership role, communicating to policy makers and the public that many players beyond the schools significantly contribute to the public’s understanding of STEM and in doing so, directly improve the quality of society.

The preliminary “landscape” image of ISE provides an initial roadmap for CAISE to utilize as it focuses on these two short-term activities, by helping the executive team better understand the opportunities and challenges of engaging current sub-communities in its efforts. This preliminary landscape study should help CAISE identify targets of opportunity and possible areas of resistance from current community members, as well as sub-communities which might be natural partners in certain ventures and those who might be more challenging to engage. Equally important, it helps to clarify what additional questions need to be investigated in the next round of research in order to support long-term strategic decision-making.

Findings from this study also provide clear direction for enhancing this current study and suggesting a second round of follow-up landscape research. First to enhance the current exploratory study and further refine the preliminary “landscape” image of ISE, we will utilize the upcoming PI Summit as a forum in which to collect more data, this time from the group of individuals we dubbed the “usual” suspects – the core group of individuals who currently have NSF funding. These data will be analyzed and interpreted and written up in an addendum document to this report.

In Year Two we recommend conducting a second phase of research with a much larger sample to determine:

- 1) The reliability of the preliminary “landscape” image of ISE suggested by Year 1 findings (this report and the addendum).

- 2) Which of the two possible scenarios for why ISE currently does not appear to be an effective Multidisciplinary Community of Practice is the most plausible explanation?

The CAISE actions outlined above the Year 2 research plan are all short term “tactics” that CAISE could and should actively implement over the next two years.

Long-Term Long-term strategic directions for CAISE are less clear than the short-term tactical directions described above. What we do know is that CAISE has finite resources, so in order to be effective it needs to use those resources judiciously and strategically. Thus, a major decision point for the future of CAISE revolves around whether to invest its finite resources in trying to help the ISE field become a vibrant, effective Multidisciplinary Community of Practice or actively supporting multiple, more ephemeral entities such as a series of ISE Communities of Action, Communities of Inquiry, Communities of Interest, Communities of Position or Communities of Purpose (or perhaps some combination of these). As we pointed out earlier, at least in part, the answer to this strategic question revolves around the two possible explanations for why the ISE community currently does not function as a Multidisciplinary Community of Practice – lack of a real need or lack of an understanding of the real value.

If *Explanation One* —a lack of real need within ISE to function as a Multidisciplinary Community of Practice — is the most plausible explanation, then strategically CAISE would be well advised to focus on supporting a series of short-term actions, questions, interests, positions and purposes around which communities of need can coalesce. Such an approach might include:

- *Convene a series of issue-related conferences defined by a bottom-up expression of interest by sub-communities.*

Comparable to the currently planned NSF ISE PI Summit, CAISE would convene a series of two-day conferences that would be designed to bring together individuals from across the ISE community in order to learn about specific topics or problems of interest. Much like the current Inquiry Groups, these meetings would be designed to quickly identify and help to satisfy specific widely perceived needs and questions within the community.

- *Sponsor issue-related workshops and other similar forums at national conferences.*

In parallel with the above activity, CAISE could be a sounding board for ISE-specific issues or concerns within the community, using existing national meetings as a venue for vetting and formulating actions. There will always be specific issues or concerns that arise that apply to more than one sub-community of ISE. CAISE could play a leadership role in helping to broker conversations about these between sub-communities.

- *Serve as a national clearinghouse for evidence for ISE impact.*

Strong empirical evidence of the impact of ISE experiences would serve the community well as it/they make a case to funders and policy-makers about the importance of lifelong STEM learning experiences and the lives of individuals improved through such experiences. In collaboration with partners such as *informalscience.org* CAISE could serve as a national clearinghouse for information on the impact of ISE efforts. CAISE could also help to disseminate these findings beyond the ISE community, again involving partners such as the Visitor Studies Association and OSU's Free-Choice STEM education graduate program.

- *Become a national resource and information nexus for ISE.*

As described above, a key strategic role for a CAISE that functions as a resource to ISE Communities of Action, Communities of Inquiry, Communities of Interest, Communities of Position and/or Communities of Purpose would be to provide a nexus in which to find out the latest news, resources and opportunities within the community. Even if ISE never exists as a fully functioning Multidisciplinary Community of Practice, it will always have a need for intercommunication and awareness amongst its participants; CAISE can play a crucial function in meeting this need.

However, if *Explanation Two* – ISE does not function as an effective Multidisciplinary Community of Practice because current participants are largely unaware of its value – proves to be a more plausible explanation, then the strategic direction for CAISE over the next several years would be quite different. Such a strategic approach might include:

- *Create an identity for ISE both inside and outside the community.*

A fundamental step in this process will be to invest considerable resources in making the case to the various sub-communities that there is value in all uniting under a single ISE banner. Accomplishing this will require “convincing” those within the various sub-communities of ISE that there is an ISE paradigmatic equivalent to the “germ theory of medicine” example – in other words, that functioning as a single multidisciplinary community at least in part would be valuable enough to invest the time, effort and resources in doing so. Part of the challenge is that many other multidisciplinary communities, the scientific research community for example, began as a single large community out of which smaller and more specific communities (e.g. biology, chemistry, physics and so on) grew. In these cases, individuals identify on relatively equal levels both with their sub-community (physicists) and the larger community (scientists). In contrast, the sub-communities that make up ISE have developed and practiced successfully without a unifying umbrella community. Providing a compelling rationale for change will be challenging but an essential ingredient in order to overcome the current inertia against coalescing around a shared sense of community.

One encouraging sign, again using an example from the scientific research community, is the fact that with increasing pressure to be innovative and with the growth of large,

complex research challenges such as global climate change, many scientists are working in multidisciplinary ways, some for the first time, some forming dynamic relationships between sciences long functioning in silos. The need for multidisciplinary problem-solving has resulted in inclusion of widely disparate sub-communities. For example, social scientists are beginning to participate as regular and permanent members of research teams attempting to tackle “hard” science research efforts because it is appreciated that human dimension factors are important. In a separate example, in virtual learning communities of teachers there is now evidence that members of a professional CoP can function effectively as a large, distributed community spanning multiple organizations, activities and purposes, drawn to one another for professional *and* social reasons (Haythornthwaite, 2002; Renninger & Shumar, 2002; Schlager, Fusco, & Schank, 2002). There is also evidence that these distributed communities result in improved practice. A study of on-line CoPs in a number of large corporations found that such communities work best as catalysts for innovation and learning when they exist outside of institutional constraints, involve multiple organizations and are multidisciplinary in nature (Cothrel & Williams, 1999). Although these latter examples are virtual communities, they demonstrate that it is possible to develop strong, distributed learning communities that improve practice and perhaps focusing on the benefits of being innovative and improving practice would be a convincing argument for creating an ISE identity that includes these varied sub-communities.

- *Create a more positive, highly visible public image.*

Once an identity is created that resonates with the various sub-communities, or perhaps as part of creating the identity, people beyond the ISE community need to become more aware of the presence and value of the community – what it does, who it serves and arguably most importantly, the significant benefits it contributes. Most professionals in the ISE community believe they make an important contribution to society, but most in society, in particular policy makers, are relatively unaware of the significant contributions made by the ISE community as whole. This task would involve taking the mandate of “champion” seriously and making that task a very high priority.

One essential aspect of being an effective champion is to facilitate ways for the community to speak with a single unified voice. As a leader and promoter of the ISE community, CAISE could not only help unite the sub-communities practicing informal science education, but also help provide the community with a stronger, more unified message and in the process increase the likelihood that ISE would have a more prominent seat at the proverbial table. When speaking to policy-makers, public officials and politicians, CAISE could bring power to that table, by voicing the needs and concerns of the community as a whole.

- *Play a leadership role in defining a research agenda for ISE.*

In addition to working towards an increased awareness for ISE within the population at large, following this strategic direction would suggest that CAISE should actively work towards enhancing the ISE community’s status with the academic social science

community. A key strategy for accomplishing this will be to develop a comprehensive and credible research agenda for the ISE field. If ISE is merely a loosely affiliated collection of sub-disciplines, then no overarching research agenda is actually needed, however if ISE is a fully functioning multidisciplinary community, then a single comprehensive research strategy, one recognized and acknowledged by academe, is essential.

In conclusion, the question of how to position CAISE strategically over the long-term remains unclear. However, findings from this study suggest that there is much that can productively be accomplished while awaiting answers to these strategic questions. The individuals we interviewed clearly recognized an immediate, important role for CAISE in supporting, sustaining and potentially helping to create a dynamic ISE community able to more effectively promote STEM learning through informal education practice.

As with all research, the current study, raised as many, if not more questions than it answered. However as indicated, we are prepared to address and “test” some of the important issues that it raised in the next round of research this coming year. Additional feedback on these issues can and should be addressed in other, less empirical ways through various online forums, conversations at professional meetings, the *briefCAISE* newsletter, the Steering Committee and of course informal interactions of staff and advisors with people in the field. This initial landscape study quite clearly suggests several productive pathways for CAISE to move down in the next year or two while it awaits further feedback from the field.

Of course, the temptation will be to try to move in both strategic directions since it can be argued that these two pathways are not mutually exclusive. However given the finite resources of CAISE, we believe a choice should be made. We recommend that the Executive Committee, with appropriate input from the larger community, and of course further data from a Year Two Landscape study, move towards a decision on which of these two courses will best meet the goals of CAISE and benefit the ISE community. We believe that one course needs to be emphasized, allowing the other course to be accomplished as best as possible as time and resources permit. To try and achieve both these strategies fully will result in a defused focus for the project and a squandering of limited resources. We believe the future of ISE is bright and that CAISE can play a major catalytic role in supporting that future. CAISE will best play this role if it has clarity of purpose and focuses its energies.

References Cited

Bonabeau, E. (1999). Making sense of networks: Biological and physical networks.
<http://www.psych.lse.ac.uk/complexity/Seminars/1999/report99may.htm>

Cothrel, J., & Williams, R. (1999). On-line communities: Helping them form and grow.
Journal of Knowledge Management, 3(1), 54-65.

- DiMaggio, P.J. & Powell, W.W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48 (2), 147-160.
- Falk, J.H., Storksdieck, M. & Dierking, L.D. (2007). Investigating public science interest and understanding: Evidence for the importance of free-choice learning. *Public Understanding of Science*, 16(4), 455-469.
- Haythornthwaite, C. (2002). Building social networks via computer networks: Creating and sustaining distributed learning communities. In Renninger, K. A. & Shumar, W. (Eds.). *Building virtual communities: Learning and change in cyberspace*. Cambridge, U.K.: Cambridge University Press.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.
- Lev, B. (2001). Intangibles: Management, measurement and reporting. Washington, DC: Brookings Institution Press.
- Renninger, K. A. & Shumar, W. (2002). *Building virtual communities: Learning and change in cyberspace*. Cambridge, U.K.: Cambridge University Press.
- Schlager, M.S., Fusco, J. & Schank, P. (2002). Evolution of an online education community of practice. In Renninger, K. A. & Shumar, W. (Eds.). *Building virtual communities: Learning and change in cyberspace*. Cambridge, U.K.: Cambridge University Press.
- Sturgis, P. & Allum, N. (2004). Science in society: Re-evaluating the deficit model of public attitudes. *Public Understanding of Science*, 13, 55-74.
- Turner, S. (2008). School science and its controversies; or, whatever happened to scientific literacy? *Public Understanding of Science*, 17, 55-72.
- Wagner, W. (2007). Vernacular science knowledge: its role in everyday life communication. *Public Understanding of Science*, 16, 7-22.
- Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York: Cambridge University Press.
- Wenger, E., McDermott, R., & Snyder, W. M. (2002). *Cultivating communities of practice*. Boston: Harvard Business School Press.

Appendix A

Study Interview Sample

Youth Organizations

- Forum for Youth Investment
- Girls Inc.
- National 4-H Council

Adult Organizations

- AARP

Science Centers

- Liberty Science Center
- Headwaters Science Center
- Lawrence Hall of Science
- Exploration Station

Natural History Museums

- Australian Museum
- Canadian Museum of Nature

Zoos & Aquariums

- Association of Zoos & Aquariums

Gardens & Arboretum

- American Public Gardens Association
- National Park Service

EE organizations

- National Environmental Education Foundation
- The Ocean Project
- Albert I Pierce Foundation

Public TV/Radio

- BBC
- Wyoming Public Broadcasting

Film-makers

- Giant Screen Cinema Association
- CineGroup

Writers/Journalists

- National Association of Science Writers

Health Organizations

- National Association of Health Education Centers

Science Societies

- American Chemical Society

Afterschool

- Coalition for Science Afterschool

Appendix B

Study Interview Protocol

Thank you for taking the time to speak with me today. We are conducting a study to better define the landscape of professional communities that are involved in communicating science to the public. You were contacted because you are regarded as a leader in your field, and we are looking to you to help us better understand more about your professional community and more about what you do. We would like to conduct a short interview, asking you questions about your work. Interviews typically take about 30 minutes – there are no known risks involved in participating; however, there are no direct benefits to you either. Your participation is totally voluntary. You may elect not to answer any question I ask, or end the interview at any time. Do you have any questions? Will you take part in the interview?

1. I would like to begin by asking you to identify the professional community or communities you see yourself as part of.
 - a. When you go to a cocktail party, how do you describe what you do?
 - b. Who do you consider your colleagues?
 - c. What journals do you read/write for?
 - d. Where do you go to get funding?
 - e. What are the key buzz words in your community that are important to use when seeking funding?
2. Do you think that the community/communities you belong to think of themselves as having an educational mission? Explain.
3. Do you consider yourself an educator? Explain why or why not.
4. How does your community/communities contribute to communicating science to the public? If not science, what, if anything, are you trying to communicate to the public?
5. What is your community trying to accomplish through these endeavors?
6. What are the motivating factors behind providing these services to the public?
7. What would you say are the big issues your professional community is trying to address or goals you think it is trying to meet relative to the public? Where does communication of science and technology fit into this?
8. In your opinion, what sorts of things are preventing your professional community from fully meeting its public communication goals, or getting done what it wants to do in this area?

9. What are some aspects around communicating in general and communicating science to the public in particular that your community is particularly good at? What are some areas where you could improve?
10. To whom does your community need to make the case that what it does in the area of public outreach/education/information [however they describe what they do] is important? Policy-makers? Funders? The Public?
11. How does your community make the case that what it does in the area of public outreach/education/information [however they describe what they do] is important? In your opinion, what arguments/evidence are most persuasive? In your opinion, what arguments/evidence are least persuasive?

I am part of an organization called CAISE, the Center for the Advancement of Informal Science Education which was recently funded by the National Science Foundation. The purpose of CAISE is to develop an infrastructure to support and improve the practice of informal science education by building a community of practice and advocating for broad issues of concern to the Informal Science Education community including research, funding and public awareness. As part of CAISE we will be developing a web site and monthly newsletter, organizing workshops and conferences, studying and documenting the critical and emerging issues in the field and providing fellowships and mentoring opportunities for those new to the field. The CAISE project defines Informal Science Education very broadly, including such things as: film and broadcast media, science centers and museums, zoos and aquariums, botanical gardens and nature centers, digital media and gaming, public health efforts, local, regional and national environmental education efforts, and adult, youth, community and after-school programs.

12. Do you think your community is part of the Informal Science Education community or not? [Explain] Where do you see overlaps?
13. What might some advantages and disadvantages of CAISE be to your own professional community?
14. What structures, resources, etc could CAISE provide that would benefit your community and its members?
15. Finally, I want to ask how closely you, personally identify with several professional communities. On a scale from 1 to 5 with 1 being *Not At All* and 5 being *Very Closely*, how do you personally identify with each of the following groups?

Informal science educators	1	2	3	4	5
Science educators	1	2	3	4	5
Public service providers	1	2	3	4	5
Public educators	1	2	3	4	5
Free-Choice learning providers	1	2	3	4	5