The Case for Informal Science Education

ISE Summit 2010 | Surrounded by Science
Washington, D.C. March 3-5

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This is one of a series of documents covering the ISE Summit 2010. For more visit **insci.org**

Spark!

These illustrated, online posts about informal science education projects appear on the CAISE Web site, contributing to a picture of the field.

http://insci.org/sparks

Documentation

Catherine McEver
The Bureau of Common Sense
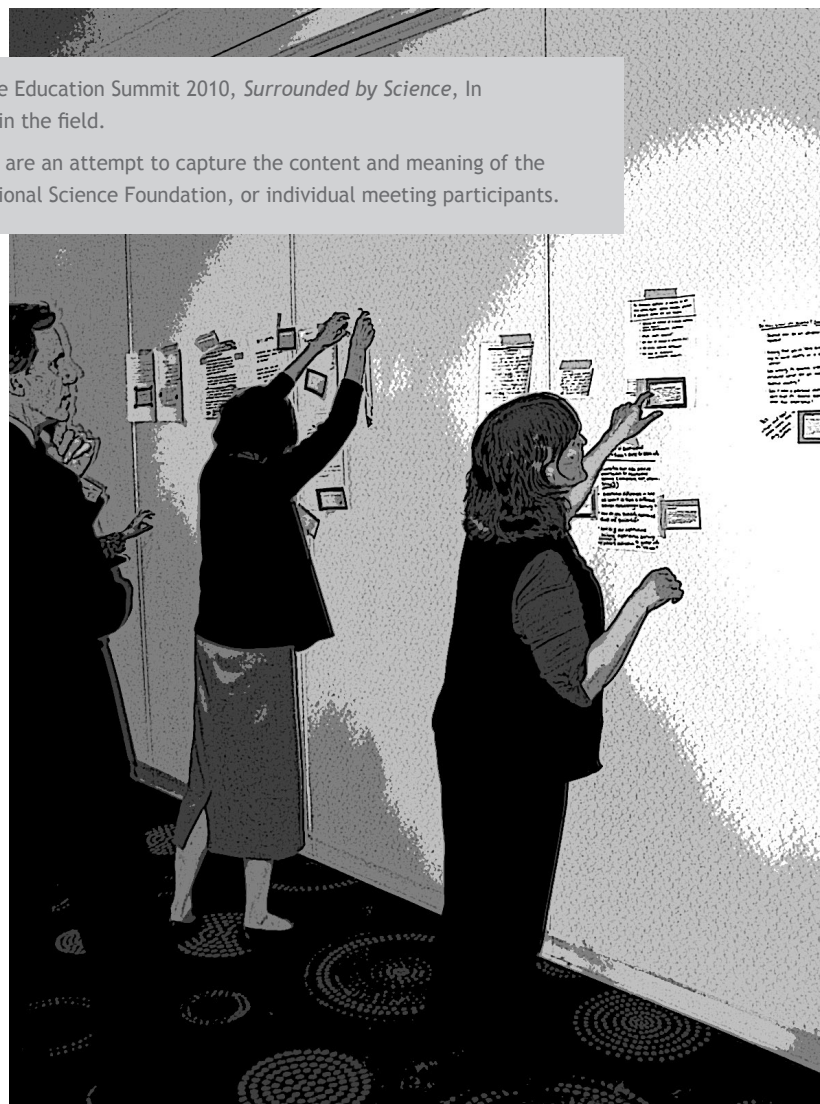
Cover and above: Summit participants delve into key policy, infrastructure and learning issues in informal science education

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The Case for ISE

Introduction

Learning from Inquiry Groups

Al DeSena
Program Director, Informal Science Education, Division of Research and Learning, National Science Foundation

This part of the program is a prelude to having you become actively involved, and the following presentations serve as a transition to the break-out discussions. This session is also beneficial for us at the National Science Foundation, and hopefully it will be beneficial for a number of other federal agencies that are represented here, some of which you will be hearing from later in the summit. We have an awful lot to learn about how to do things better, both individually, collectively and organizationally.

One of the things that CAISE has done over the last couple of years is to establish what are called Inquiry Groups. If you visit the CAISE Web site you will find the reports that these Inquiry Groups have produced on public engagement and a variety of other topics. I want to take this opportunity to let you know that there are three new reports that are available on the Web site. One has to do with the connections between formal and informal education, an effort spearheaded by Bronwyn Bevan and a host of other professionals in the field. Another focuses on the extremely important topic of

accessibility, and was led by Christine Reich from the Museum of Science and involved a number of ISE professionals from around the country. The Visitor Studies Association and Beverley Serrell have produced a major report that is also available to you. Over the course of time, these activities and reports are instrumental in helping us think about the future and the kinds of impacts that we want to have as we continue to grow and to professionalize the field.

What has happened over the past year is the establishment of three Inquiry Groups that have a little different focus, and you will hear the details from them. I just wanted to give you a perspective from my point of view and NSF's point of view. In a sense, we are still trying to get a handle on who we are and what kinds of impacts we are trying to have. These are conversations that we have frequently at the Informal Science Education program at NSF because we need to be strategic in our thinking about what we are trying to achieve through the programs that we fund around the country.

As I mentioned during my earlier remarks, the things that happen at NSF are in many ways reflective of the things that are happening already, but that we need more of and should happen in the advancement of conversations in the field. For example, many times we get a

For reports from Inquiry Groups and other resources go to

http://insci.org/resources

Al DeSena

proposal and no one program officer comes near to having the expertise in order to evaluate the proposal fully. As a result, we have taken the approach that while there may be one NSF program officer for a funded project, we have adopted a formal process of consulting with one another, both within our own program but also within other parts of NSF and outside the agency, as we identify needed expertise in various areas. The very kind of thing that you already do is reflected in our own internal operations, and we're hoping that more of that kind of interaction will happen.

Part of this is intellectual connections. For example, because we receive proposals across a wide range of contexts, we might see something going on in the television arena, perhaps a study of what children understand about energy, that could be very beneficial to what is going on in a science center or children's museum. But because the two aren't in touch, nobody knows what is going on and no connections have been made. A lot of these intellectual connections can and should happen. However, it is more the collaborative connections, in the sense of trying to find ways in which the projects that we are funding and that you develop can increase the impact they have, both on the publics that they are trying to reach and on the professionals trying to improve knowledge and practice over the course of time.

A lot of what CAISE is doing, from my point of view, is helping to stimulate opportunities for intellectual connections and for individual

and organizational collaborations to improve the level of innovation and impact that we all want to have. In that context, CAISE has developed these three Inquiry Groups, which have been working over the course of the last year in preparation for this meeting in particular. Many you have been involved and we are appreciative of your efforts, much of which have been voluntary. NSF program officers have also been sitting in on these groups as part of that dynamic I mentioned about our work being reflective of the field and listening to what is going on, as well as trying to prod new ideas and collaborative efforts that we think are so important.

Fulfilling a Mission; Finding an Identity

John Falk
CAISE Co-PI, Sea Grant Professor of Free Choice Learning, Oregon State University

Roughly a year-and-a-half to two years ago the leadership of CAISE was trying to figure out what we were going to do to meet our twin goals as a center for strengthening the level of communication within this field as well as promoting informal science education in terms of the role that it plays in sustaining STEM education in this country. We were looking at our understanding of the field as it became clear to us over that period. We had a lot of information and had begun to realize that there are not just thousands, but potentially upwards of a million professionals working in this area of informal science education, supporting the STEM literacy

John Falk

of the American public. We also conducted research regarding the landscape, as David Ucko mentioned earlier, and talked to a lot of leaders within the STEM professions, the science center community and museum community, and the natural history museum community. We talked to science journalists, health professionals, environmental education folks, youth program professionals, adult education professionals—a whole range of the types of people that you saw on a slide in Bruce Lewenstein's presentation on the history of informal science education [*see ISE Summit 2010 document "Setting the Stage"*].

We also took advantage of the ISE Summit held about two years ago and talked to all of the PIs attending that summit. We asked them to tell us how they identify who they are. Lo and behold, almost nobody said, "I am an ISE professional." Virtually everybody self-identified using a specific profession: science journalist, exhibit developer, television producer, and the like.

When we asked them, "What about this informal science education stuff?" they said, "Oh yeah, yeah, we do that too." In trying to build this community, that sense of identity of being part of a larger enterprise was not there. There were two things that almost everybody we talked to shared. First, they realized that there were others in this community doing things they perceived to be valuable and useful to their own work. The other thing that was repeatedly said by virtually everyone we talked to was, "I don't get no respect around here." People were

saying that the public at large, and policy makers in particular, don't always appreciate the important role that ISE plays in the life of the citizens of this country, despite the fact that there is a growing body of evidence that might suggest that most of the public learns most of their science not in school but outside the schools.

As a group, we decided that leading up to this summit what we would try to do in the short term was focus on that second area. We wanted to help the community, broadly defined, make a case for informal science education. As Al DeSena mentioned, as we thought about this we realized that making that case for informal science education was actually going to require three big ideas.

We needed to think about where all of those places are that the public learns science. There is this vast, often invisible infrastructure, with all of the kinds of media and entities that you folks represent as the support staff for that infrastructure. What is the nature of that infrastructure? What does it look like and how do people use it?

We also realized that in the process of using that infrastructure, there are a series of policies at local, state and national levels that affect the degree to which that infrastruc-

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Building on Inquiry

This ISE Summit 2010 builds on a three-pronged inquiry that aims to produce a compelling, evidence-based picture of the informal science field today—the richly complex infrastructure that supports science learning outside of school, the policies that support and constrain opportunities in informal science education, and the nature of the learning that results across the lifespan and in many cultural settings.

Informal Science Education Infrastructure
It's been called an "invisible infrastructure"—the rich diversity of places and pursuits that ignite our curiosity and support lifelong learning about science. The Infrastructure Inquiry Group has initiated an ISE community-wide story-collection project to help build a national portrait of where and how people develop interests and build their knowledge of science and technology, broadly defined.

Informal Science Education Policy
What policies advance—or constrain—work in informal science education? The Policy Study Inquiry Group is identifying and exploring major policy issues in different sectors of the field.

Learning in Informal Settings
The CAISE Learning Inquiry Group has explored in depth the "six strands of learning" described in the National Research Council report *Learning Science in Informal Environments* and evidence of "learning moments" from NSF-funded projects.

ture can be successful or is, in fact, limited in its effectiveness. What are those policies and what are their impacts on ISE?

We also realized that in the process of using that infrastructure, supported by those policies that are in alignment, the public learns an awful lot of science, technology, engineering and mathematics over their lifetime. What is the nature of that learning? What does it look like and how is it best supported?

To help seed the conversation that we are all about to have over the next couple of days, we

appreciated that we needed to do our homework and get some additional information on policy, infrastructure and learning. We started these three Inquiry Groups to try and find some initial foundation for the conversations that we are about to have. The goal in these Inquiry Groups was not to solve the problems, it was to seed the conversations that we are going to have during this summit so that you may all bring your own expertise and ideas to the table, and to provide a foundation and a common basis on which to base those conversations.

Sheila Grinell

A Starting Point for Discussion

Sheila Grinell, who serves as a consultant to science-based cultural institutions, explains the link between these Inquiry Group presentations and the break-out discussions that will follow. During the break-out sessions, 27 topic cards were used as a beginning focus, with 9 topic cards from each of the three Inquiry Group focus areas. Those topic cards are reproduced here at the end of each Inquiry Group presentation. Working in a series of small group configurations, participants pursued topics of interest in a series of stages:

- Identifying a topic for further discussion and identifying what is interesting, problematic or ripe about it.
- Posting the topics and discussion notes on the wall for review by the larger group. Topics were then clustered into themes by facilitators and reflectors.
- Reviewing themed clusters of topics and prioritizing those in terms of topics of great interest they would like to discuss further.
- Pursuing those topics of interest in new group configurations and identifying the opportunities and threats related to that themed cluster of topics.
- Reviewing and rating the posted "opportunity" sheets from other groups, identifying which opportunities are most actionable for their own work and/or have the most traction for the future of the field of informal science education.
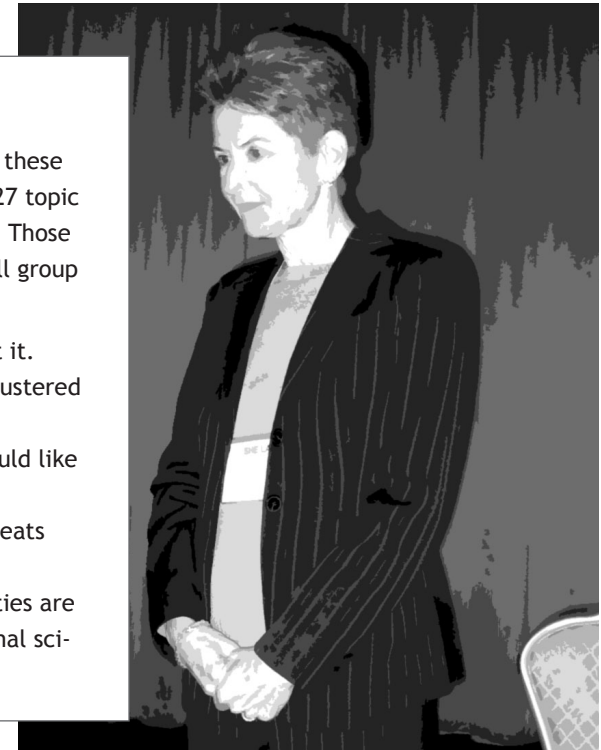
Understanding the Informal Science Education Infrastructure

John Falk
CAISE Co-PI, Sea Grant Professor of Free Choice Learning, Oregon State University

The members of the Infrastructure Inquiry Group come from across the country and across this discipline, and I want to thank them for their participation.

> **Big Picture**
>
> • Across a lifetime the average American will spend more than 95% of his/her life learning outside of school.
>
> • Even children, over the course of a year, will spend roughly 80% of their waking hours outside of school.
>
> • Most people learn most of what the they know outside of school – including STEM.
>
> • The public uses the vast "invisible" ISE infrastructure of museums, community groups, books, broadcast media and increasingly the Internet to learn STEM.

Here we have the big picture. Across a lifetime the average American will spend less than 5% of their lives within the formal education setting. The vast majority of learning that people do is outside of school. A little-known fact is that by the time they are eighteen, school children will have spent less than 20% of their waking hours in a classroom, so even for children, most of what they are learning about science, technology, engineering and math occurs outside of school. To accomplish this, the public uses this vast "invisible" infrastructure in order to support that learning, and the people in this room are part of that infrastructure.

> **Overview**
>
> • Our Inquiry Group was charged with trying to better understand the scope and scale of the ISE "infrastructure" – the rich diversity of places, media and resources that support the public's lifelong learning about science, technology, engineering and math.
>
> • Our goal was to begin to tease apart the nature of the infrastructure – What does it look like and how does the public use it?

> **Infrastructure Inquiry Group**
>
> • John H. Falk (Co-Leader), Oregon State University
> • Carlos Manjarrez (Co-Leader), Institute for Museum & Library Services
> • Janis Dickinson, Cornell University
> • Kantave Greene, Jackson State University/CAISE Fellow
> • Rose High Bear, Wisdom of the Elders, Inc./CAISE Fellow
> • Cindy Kitchel, John Wiley & Sons
> • Beth Kolko, University of Washington
> • Robert Logan, National Institutes of Health
> • Scott Randol, Oregon State University, U.C. Berkeley
> • Madlyn Runburg, Utah Museum of Natural History/CAISE Fellow
> • Leona Schaubel, Vanderbilt University
> • Wendy Wheeler, Innov. Center for Community and Youth Development
> • Donele Wilkins, Detroiters Working for Environmental Justice
> • Susan Zelman, Corporation for Public Broadcasting

Perspective

- Historically virtually all efforts to under-stand and describe ISE have happened by looking at the "nodes" of the infrastruc-ture – e.g., who visits science centers or watches a NOVA special or what someone learns from an after-school or community based program.

- Consequently, little is known about how individual members of the public "stitch-together" the multiple resources within a community to support their STEM learning.

John Falk

Our Inquiry Group was designed to try to understand something about that infrastructure. Over the years, we have actually learned a lot about how the public learns science through informal science education, but virtually all the research that has been done has looked through the lens of the "nodes" of informal science education. We have done a lot of research on what people learn from watching public television. We have done a lot of research on what people learn when they participate in a community group activity related to science. We have done a lot of research related to why people go to museums and what they learn from museum exhibits, science centers, aquaria and zoos.

We wanted to look through the other end of the telescope. We have never really looked at how the public actually uses all of these resources to stitch together their understanding of science, technology, engineering and mathematics. Our goal was to tease apart this infrastructure and really try and understand something about that.

What We Did

- We decided to start with people and follow their efforts to learn about science and tech-nology – "bottom-up" rather than "top-down."

- The Everyday Science exercise was conceived as a "crowd sourced" model for gather-ing information on the types of science and technology activities diverse members of the public engaged in; what resources they used and how the use of the those resources evolved over time as they became increasingly sophisticated learners.

Instead of starting from the top-down, as has often historically been done, we decided to start from the bottom-up. We wanted to talk to people. We wanted to literally interview as many individuals as we possibly could around the country and ask them, how do you learn about science? What is that science you've learned? Given our limited resources as a volunteer group with a very short timeline and virtually no budget, we couldn't form a very elaborate study.

We came up with what was very much a "crowd sourced" model, entreating everybody, including you folks, to go out there and talk to friends, neighbors and relatives—not the usual suspects or just those you know are interested in science, but to anybody—and ask them a series of questions. Lo and behold, when you ask them, you might just discover that there is an area of science, technology, engineering or mathematics that they are interested in. Carlos will now talk a little about the details of what we did and what we found out.

Carlos Manjarrez
Associate Deputy Director, Research and Statistics, Institute of Museum and Library Services

I'll start by listing some of the specific questions we asked, which were all open-ended.

What We Asked

- What area or topic of science or technology (in which you feel reasonably knowledgeable)?

- How you first became interested?

- Sources used to learn about topic?

- Have ways you've learned about this topic/area changed over time?

- Advice you'd give to someone else interested in topic?

- Demographic questions (age, occupation, zip code)

One of the big pros here is that this is an inductive, open-ended process that allows the broadest response possible. We are not limiting the definition of "informal science" to *a priori* categories established on our end. This kind of analytic, inductive process is particularly effective when there is no strong theory to drive the inquiry, nor a tremendous amount of past practice or tested instrumentation.

Because it was a voluntary, find-somebody-to-interview process, it was obviously is bound by the limitations of a convenience sample. Many of us have a fair amount of formal education,

and our networks are probably going to be dominated by people with a fair amount of formal education. One of the things we didn't ask, and something I'd like to push for the next time, is the formal education of the respondents. We know that a lot of information-seeking is conditional on how much formal education you have, and the way you go about seeking informal science education is going to be affected as well.

Who is Represented

- 169 interviews conducted as of Feb. 20th

- Respondents from 26 states (most from WA, NJ, NY)

- Respondents primarily students and white collar workers

There were 169 interviews as of February 20, with respondents from twenty-six states. They were primarily students and white collar workers and the majority of respondents were between twenty and thirty years of age.

Interviewees Age
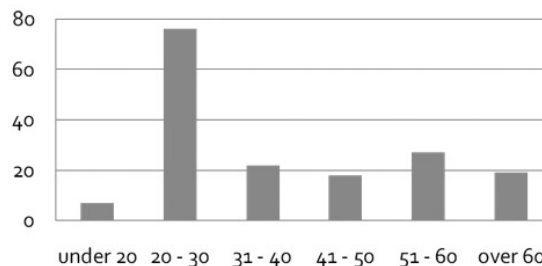
Pros and Cons of the Approach

+ This process allowed for broadest possible response options; did not limit "informal science" into categories set by the investigators

+ Analytic induction is a particularly effective way to classify events and actions when there are few established markers (e.g. tested classification schemes, strong theory)

- Bound by limitations that come with a convenience sample

- No data on formal education of respondents

Carlos Manjarrez

Broader Classification of Science/Technology Topics

Below is a frequency distribution of the topics that people mentioned. You see gardening, biology, computers, health, cooking and nutrition. Those were some of the larger responses, down to marine biology, plants and architecture as we move down to the fine print.

We regrouped those into some larger categories at left, and technology was one of the larger groupings followed by animals, health, space and gardening.

What about the learning resources that people talked about? Here is another frequency distribution of the learning resources that

Frequency of Science/Technology Topics Mentioned by Respondents
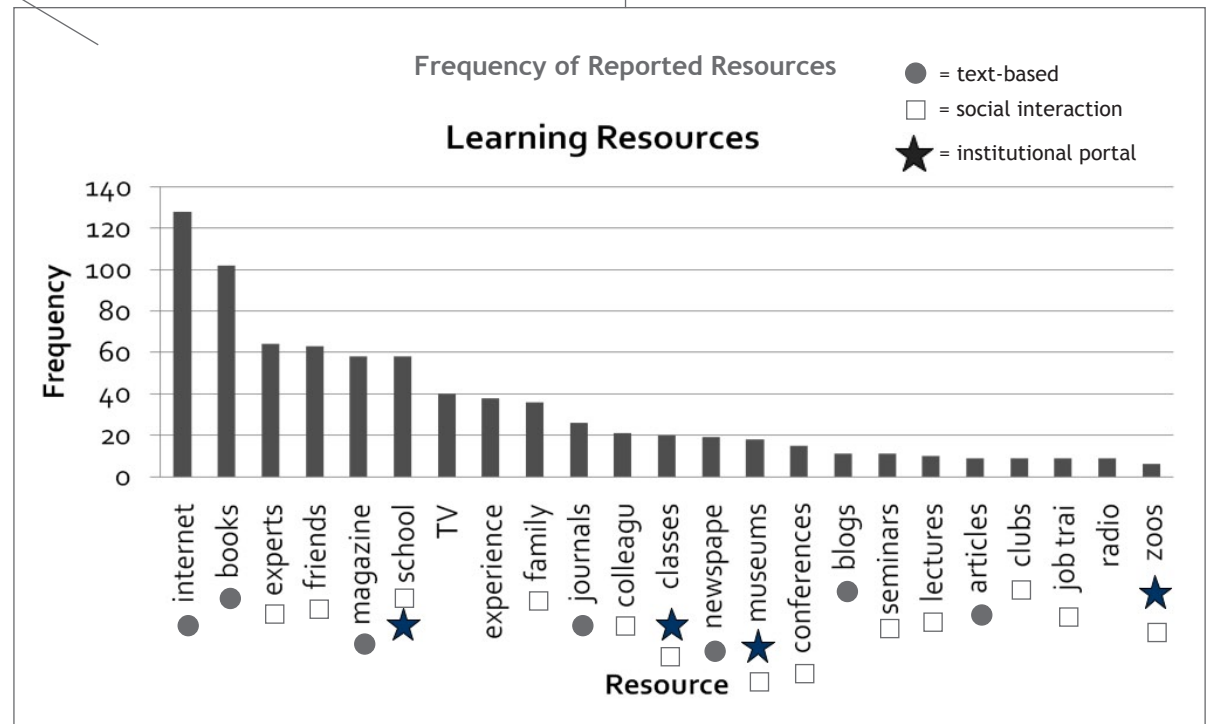
people mentioned. You'll see that most of these are text-based, at least fifty percent: Internet, books, magazines, journals, newspapers, blogs and articles. I want to direct your attention to another important fact: A huge number of these require social interaction. This involves talking with experts and friends. It involves school (talk to a teenager and you will realize that school is definitely a social experience). It involves family, colleagues, classes, museums and conferences. Obviously, learning about science through informal science education is an inherently social process for people. That was on the forefront of their minds and they brought it forward when we talked to them.

One thing that did not come up as much was the institutional portals through which the informal learning happened. The institutions were not at the forefront of their minds as a reference right away when they were talking about the informal science learning process in which they were engaged. They of course mentioned schools, classes, museums and zoos, and many of the other sources they mentioned flow through institutions, but I think it's important to recognize that from the respondents' perspective, they did not think of institutions as resources. They thought of resources and, in some cases, institutions.

This is just a little taste of some of the information we collected. In the sidebar at right are some of the topics that we hope you can talk about later. I think these last two points raise important challenges, particularly

Frequency of Reported Resources

● = text-based
□ = social interaction
★ = institutional portal

Learning Resources

when you think about the way we produce knowledge and the research that we do. Evaluation research and evaluation studies really grew up and matured out of research on learning in formal settings. One of my teachers, Tom Cook, a psychologist, really wrote the book on quasi-experimental design. I think it's also reflected in the research methodologies that have been developed. Think, for example, about ratio analysis. It's hard to think of a more radically analytic research method, where we are isolating an individual and all of our assumptions are based on the independence of the observations, and we are trying to identify a

Take-aways from the Data

• Modal topics are technology and natural history

• Text-based resources predominate

• Many of the resources mentioned require social interaction

• Institutions were not mentioned regularly as a resource.

  - Institutional settings mentioned: schools/ classes/lectures, museums/zoos, conferences

I also want to pick up on the fact that it is a social interaction. I implore each and every one of you to get involved in this interview process. We need all of your help in changing the demographic distribution of this sample away from those twenty to thirty-year-olds. I'm going to guess that the median age of this group is not twenty to thirty years old. We need all of you to participate in this process so that we can hopefully have somewhere between 500 to 1,000 interviews that we can use to make sense of what this infrastructure looks like.

Those who have conducted these interviews have reported that the process itself for the interviewer is as important as the process for the interviewee. It is an enlightening, wonderful experience to go and talk to the general public. Don't talk to your colleagues, talk to your mother, to the brother-in-law that you never talk to, and ask them about the science and technology that they are interested in and how they have pursued learning about that in the course of their lifetime. It is an energizing and exciting experience.

Additionally, if we can get this to catch fire and thousands and thousands of people across the United States become involved, one of the things that we will do is not only collect data for this project, we will actually begin a ground swell of appreciation within the country. As people talk about how they have learned science they will realize by and large it wasn't in school, and that is really important to this community. • John Falk

discrete impact on a particular individual. What does that mean when we are thinking about learning as a social process, where interaction is a fundamental component of learning, and learning happens not just because of what I take in as an individual but because of what my neighbor takes in, because of what the class takes in? We are just starting to really wrestle with some of the legacy of the methodologies that have been developed over the years and to deal with the fact that learning happens within classrooms or in certain settings nested within other settings, nested in turn within other settings, so that there is elaborate hierarchical linear modeling that is being done. There is much more thought about the context. I think that is one of the places where this group of people really may have the lead and an opportunity to maintain the lead in thinking about learning as a social process and really push the research methodology.

John Falk
CAISE Co-PI, Sea Grant Professor of Free Choice Learning, Oregon State University

There was one other finding I wanted to highlight. At the moment, well over 200 people have responded and currently, the median time that people reported being involved in the science issue that they identified as being key to their understanding was twenty-four years. Bear in mind that because of the distribution of our sample, the median age was 35. Basically, our respondents reported that they started with a STEM topic of interest to them at a very young age, which they have pursued over the entire course of their lifetime. This is really important to appreciate.

Finally, as you think about this presentation and the two that follow, we want you to think about the following.

Things to Think About

- How would these findings reinforce and/or challenge what you already thought you knew about the ways Americans learn STEM?

- In what ways do these findings reinforce and/or challenge the ways you and your colleagues currently go about trying to support the American public's STEM learning?

- How could you use findings like these to build a case for the importance of Informal Science Education in America?

Infrastructure Topic Cards

Used as a focus for break-out group discussion.

Infrastructure Card 1
The data from the infrastructure investigation suggested that respondents utilized a very wide array of resources in their quest for science and technology understanding. Does the current informal infrastructure adequately support this quest? What barriers, if any, currently limit the public's efforts to obtain quality/useful STEM information and support? How would you apply this finding to your own work?

Infrastructure Card 3
The data from the infrastructure investigation indicate that respondents define the nature of science and technology very broadly to include everything from cooking and auto mechanics to nature appreciation and the love of gardening. What opportunities does this afford us, in terms of our position as science educators? Are there threats in this? How can we best capture this widespread interest and at the same time insure that we remain true to our commitment to STEM as a set of core ideas? Does this finding have policy and/or learning implications?

Infrastructure Card 5
The data from the infrastructure investigation indicate that many respondents become deeply engaged in learning about science and technology over their lifetimes, often becoming very knowledgeable. How does your organization/project currently support or impede this kind of deep STEM learning? How could we as individual organizations/projects and a field more effectively encourage and scaffold our audiences' learning beyond initial engagement?

Infrastructure Card 2
The data from the infrastructure investigation revealed that respondents are increasingly utilizing the Internet as a primary resource in their quest for STEM understanding. How does your organization/project currently use the Internet and other digital media? How could we as individual organizations and a field more effectively meet the public's needs?

Infrastructure Card 4
The data from the infrastructure investigation suggest that the public's STEM learning is often quite social; respondents cite friends, family, and neighbors as important contributors to their learning. How does your organization/project currently support or discourage this kind of social networking? How could we as individual organizations/projects and a field more effectively complement this particular type of learning among our audiences?

Work groups reading through and selecting topic cards of interest for further discussion

Topic Card Ranking/Use

The ranking of the most commonly chosen infrastructure topics for triad work groups. "Ranking" is rank related to all topic cards used (e.g., 1 = most used). A "vote" is the number of small groups in which the card was selected for further discussion (i.e., not thrown on the discard pile after the first 15 minutes of the break-out session). A number of cards have tie scores.

Analysis by Crowley & Bell, UPCLOSE

Card #	Ranking	# of Votes
7	1	13
3	9	7
4	9	7
9	12	6
5	16	5
2	17	4
8	17	4
1	26	2
6	26	2

Infrastructure Card 6

The data from the infrastructure investigation included a number of interviews with STEM professionals. The data revealed some interesting ways in which these individuals first became interested in their disciplines and currently continue to pursue those interests, including during their leisure time through free-choice learning. How does your organization or project currently support this kind of career trajectory? Is this something that individual organizations and the ISE field should be focusing on more, or should we primarily focus on the general public's engagement with and understanding of STEM? Assuming the answer is not an "either/or" but rather a "both/and," how do we best support multiple levels of demands?

Infrastructure Card 7

One interpretation of the data from the infrastructure investigation could be that, by and large, many in the public see informal and/or free-choice STEM learning as "play." Is this an opportunity or a threat in terms of positioning ourselves as credible science educators? How can we best take advantage of this widespread blurring of the lines between learning and fun, while ensuring that our colleagues within both the scientific and policy communities don't perceive what we do as "science-education lite"? What are the policy and/or educational implications of this issue?

Infrastructure Card 8

The data from the infrastructure investigation reveal a lot about the motivations that drive respondents to engage in STEM-related learning. How does your organization/project specifically address the public's motivation to learn STEM? How could we as individual organizations and a field more effectively and coherently mobilize to support and encourage public interest in STEM? What have you tried that didn't work?

CONTINUE THE INQUIRY!

Infrastructure Card 9

The infrastructure investigation set out to poll a wide spectrum of the American public about their STEM learning. Although we did not collect information about racial/ethnic or socioeconomic identity, there is evidence that the investigation did indeed include responses from a very wide diversity of people. From your own experience, are there groups of individuals whose stories about STEM learning are underrepresented? What are the issues and/or challenges in creating infrastructures that address diversity? What can we learn from different cultural perspectives on STEM about how to design infrastructure?

Posting discussion notes for the topic cards: what was interesting, problematic or ripe
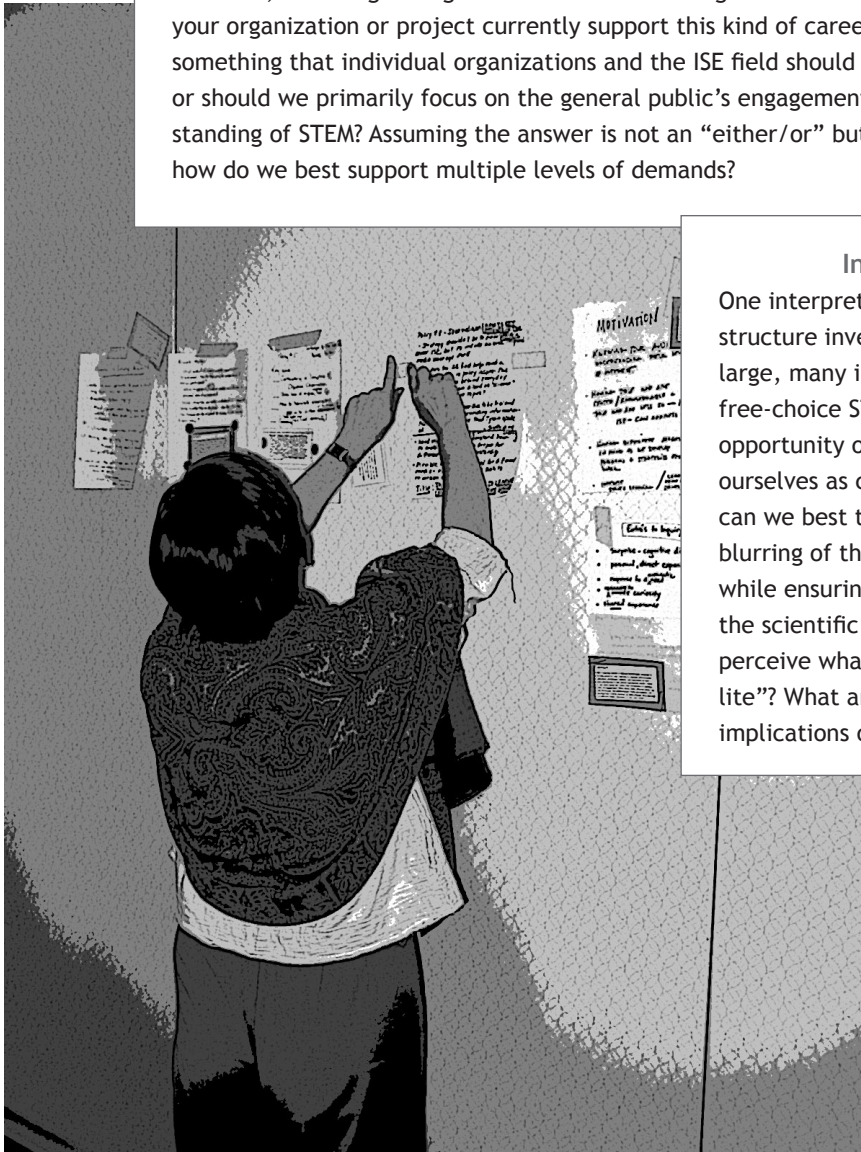
Policy Study Inquiry Group

Saskia Traill
Co-Chair of CAISE Inquiry Group, Director of Policy, After-School Corporation

At The After-School Corporation, we've long advocated for policies and practices that make informal science a part of every child's high-quality after-school experience, so I jumped at the chance to co-lead the policy group. Members of the Policy Inquiry Group come from diverse institutions within and beyond informal science education, or ISE—museums and zoos, aquaria and planetaria, media and journalism, universities, and in my case, after-school.

Our group began just a few months ago, but in that time we have had rich and deep discussions, by phone, at the CAISE base camp, and in one day-long, in-person meeting graciously hosted by Steve Williams of the Air and Space Museum. I can also note that each of the partner organizations in CAISE has taken responsibility for one Inquiry Groups, and ours has received terrific support from the Visitor Studies Association.

Our stated goal was to inventory and comment on policies which affect ISE's capacity for impact. We defined policy as a high-level overall plan that embraces goals and acceptable procedures. Policies could be current or potential, organizational or governmental, and implicit or explicit. When we first talked, we immediately realized the true scope of our conversation and broke down our larger discussion into ten categories. While the categories have significant overlap, we felt that one of them—diversity—was integral to all the others. We also wanted to ensure that issues of diversity didn't seem separate or an afterthought, so we looked for diversity implications within each of the remaining nine.

I should say before I delve into our work that we are still in progress and are looking forward to feedback from you as we refine our ideas and prepare our final report. If you have questions, comments or ideas please contact us.

I should also note that not one person in our group knew about everything that other members described. I think all of us found our discussions to include something of a learning curve, which is a testament, I think, to the breadth of informal science education and the importance of CAISE.

Saskia Traill

Policy Study Inquiry Group

- Alan Friedman (Co-Leader), Visitor Studies Association
- Saskia Traill (Co-Leader), The After-School Corporation
- Lisa Craig Brisson, Visitor Studies Association
- Arthur Eisenkraft, University of Massachusetts Boston
- Ira Flatow, Executive Producer/Host, Science Friday
- Jeffrey W. Kirsch, Reuben H. Fleet Science Center
- Maritza Macdonald, American Museum of Natural History
- Eric Marshall, Cyberlearning Consultant
- Ellen McCallie, Carnegie Museum of Natural History
- Kirstin Jane Milks, Stanford University
- Trevor Nesbit, ECHO Leahy Center/CAISE Fellow
- Charles Petit, Knight Science Journalism Tracker
- Rebecca Nesbitt Prosino, Sci-Port: Louisiana's Science Center/CAISE Fellow
- Jerry R. Schubel, Aquarium of the Pacific
- Dan Wharton, Chicago Zoological Society
- Steven H. Williams, National Air and Space Museum/CAISE Fellow
- Joe Witte, TV Meteorologist

The Goal

Inventory and comment on policies which affect ISE's capacity for impact

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Nine Categories of Policy Issues

(with diversity as a theme throughout)

- Connections to Science
- Content Authority and Credentialing
- Evaluation and Student Assessment
- Formal Educational Systems
- Funding
- Institutions Devoted to Public Understanding of Science
- Journalism, Media and Science Writing
- Linkages to other Large-scale Belief Systems
- Science in Everyday Life/Popular Culture

In each of our categories, we asked the following questions.

Questions Posed

- What issues surround this topic?

- What are the current policies and their impacts and what are the diversity implications?

- What policy changes do we need in this area to have greater ISE impact?

We have not set out to write an advocacy document, but rather a description of the issues that are worth considering and will offer a deeper understanding of the connections of policy to informal science. Along those lines, while we have proposed next steps, we do not mean to generate formal policy recommendations to any government agency or department.

I won't have time to get into all of the areas we've identified, but I thought I'd touch on four. This may not surprise you, but one of the most salient areas of discussion was public funding. We noted that funding has changed dramatically in ISE over the past decade, with increasing support for ISE at universities and research institutions and perhaps a smaller share of ISE funds overall for what I'll call traditional ISE institutions, meaning museums, aquaria, planetaria, and zoos. There are at least three studies underway to investigate

the actual numbers, but assuming the overall trends are there, we observed that they create opportunities but also pose potential threats for current ISE infrastructure.

This funding has spawned a relatively nascent field of informal science educators within research institutions and we find that these people tend to work independent of, or in limited partnership with, traditional ISE institutions such as museums and planetaria. We propose that next steps in this area could include funding coordination of efforts more deliberately, encouraging partnerships with buy-in at the highest level and pursuing sustainable, formalized, mutually beneficial arrangements with dedicated resources on both sides. One good example of this is COSI in Columbus and its work with The Ohio State University.

Let me also describe public funding in the context of other funding sources. These include philanthropic donations by individuals, foundations, and corporations. On the revenue-generating side we have admission fees, birthday parties and other private events, and camps. Institutions have increasingly turned to these types of funding and the result is skyrocketing admission fees, which have negative implications for audience and program diversity. We propose that government funds make low- or no-cost admission more feasible.

We also see that there is a relative lack of operational funding across all funding sources, which results in institutions becoming program-heavy and administration-poor, even

while there are more and more demands on administration. We believe that as a matter of policy, funders might consider the best grants as investments in the whole institution, and offer operating support rather than program support.

The second major area of discussion that cuts across our categories is the set of policies among institutions that are devoted to public understanding of science. These policies, and they could be implicit or explicit, affect what ISE institutions do—their staffing and programming—and their effectiveness in carrying out their missions in informal science education. Together these policies provide a "true north" in terms of how the institution sees its responsibilities in bringing science that is both timely and timeless to its diverse audience. These policies should also serve to guide the institution through the roiling seas of the popular media that confuse science with other factors, social or political, in the news. It is particularly in these cases that ISE institutions have a responsibility to examine issues through the lens of science to clarify what the science tells us, where the science community stands as a community, and how the scientific enterprise works to reduce uncertainty.

We propose as a next step that each ISE institution clarify its policies, both written and unwritten, and ensure that they are widely known and embraced throughout the organization. There was a recognition of the need for professional associations that ISE

institutions belong to such as ASTC, AAM, and AZA to provide policy frameworks and codes of conduct for ISE endorsed by the association and its member institutions. We hope that will be bold in stating the responsibility of ISE institutions to deal with controversial, value-laden scientific issues such as evolution and creationism, the role of humans in global climate change, stem cell research, genetically-modified crops, and many others. Association policies can provide an important buffer for individual institutions against pressures exerted by board members or advocacy organizations, and fight their fear of losing the support of donors, members, and visitors.

The third most salient area connects back to how informal science education deals with, as we put it, "the roiling seas" of our public discussion that often blend or confuse science with other stories in the news. You'll see this discussion in our categories of "media" and "large-scale system beliefs." As many of you know, Tennessee's 1925 Butler Act, made famous by the Scopes Trial, grew from the notion that the teaching of evolution threatened one of the linchpins of religious faith. By extension, the act declared that there was a moral imperative in opposing science that challenged sacred tradition. More recently, scientific findings such as what amount of natural resources can be safely harvested or how to limit human-induced climate change have not been universally welcomed as scientific information but instead are seen by

4 Discussions that Cut Across All Policy Issue Categories

- Public funding
- Commitment to common policies regarding public understanding of science
- ISE and "the roiling seas" of public discussion
- The connection to formal science education

some as "philosophical" threats to economic prosperity.

This is compounded by another trend in the media, and to some extent in ISE institutions and formal science education, that issues must be presented with "both sides." All too often, if a story on a science topic is presented, there is pressure to include a counterpoint, no matter how nonsensical or how non-scientific. There is deliberate blurring of the science/pseudoscience line by those who now seem to take great delight in juxtaposing real science with Nostradamus, ghost hunting, and all things Roswell.

To fight the battle of science versus morality or science versus pseudoscience, we think that an important next step is for the ISE agenda to prioritize the public understanding of scientific processes and discipline of objective observation. We hope that this would strengthen the notion that scientific findings should be evaluated not in comparison to other belief systems but based on their scientific merit.

Another next step would be to encourage ISE entities to disseminate scientific content the way they think it should be told, both to journalists and directly to the public. This will require policies that offer financial and technical support so ISE institutions can make their Web sites and communication strategies more accessible and engaging. Media outreach should offer timely assistance to journalists covering breaking news stories such as natural

disasters like last week's Chilean earthquake or the killer whale attack at SeaWorld. And ISE institutions can cover breaking news themselves, using headlines and short content to draw the public's attention to the in-depth science.

ISE must also make use of social media channels. For example, NSF's Science 360 News Service and the Futurity organization's Web site use RSS, *Twitter*, *Facebook* and *YouTube* to disseminate information from traditional press releases that they've aggregated from research centers. These social media channels are now necessary in the competitive world of real-time information. If you know of other good or well-designed sites or media outreach efforts, I invite you to let us know about them so we can include them in our final report.

Within the media, we have also discussed the unique role that entertainment can play in informal science education and how we should think about policies to encourage stronger use of robust science in TA shows and movies. Consider, for example, that the average American child spends 900 hours in school but 1,500 watching TV. TV is still the main source of science information for a large majority of Americans. And while PBS, Discovery and others cover science and should be actively supported, how might we have a broader outreach than those who actively choose to watch these channels and shows?

In recent years programs like *The Big Bang Theory*, *CSI*, and *Numbers*, have emerged

Saskia Traill

with science underpinnings. These programs attempt to explain STEM content using clever analogies and graphics in digestible 30-second sound bites. For motivational purposes, these TV shows are all superb. The vast interest in forensics courses in schools in the past decade is a tribute to *CSI*. These fictional characters—Charlie Eppes, Sheldon Cooper, Leonard Hofstadter and Gus Grissom—have the power to change the direction of society.

The Federal Communications Commission (FCC) adopted rules to satisfy the 1990 Children's Television Act. Commercial TV stations must air at least three hours per week of programs designed to meet educational and informational needs of children. Those programs have an E-slash-I icon denoting that the program is "educational and/or informational." We recommend considering policies that could denote a science-rich show to make TV a more effective medium for science education.

The fourth and final area I'll touch on is in our connections to formal science education. I doubt I need to describe how important we believe ISE is to formal science education—deepening and enriching classroom instruction, offering teachers meaningful places to learn and update their knowledge of science, showing kids the wonder and excitement that comes from a love of science. And I probably don't need to describe some of the challenges to having a fully integrated and complementary system of formal science and ISE, but I'll quickly touch on a couple.

First, the policy group finds that formal school system policies often inhibit the use of ISE institutions to teach science. In addition, many school systems require that field trips to ISE institutions be paid for by individual schools, often putting students in poorer schools at a disadvantage.

Another challenge we have identified is that future teachers are typically not allowed to fulfill their student teaching requirements through informal science education, at an ISE institution or through after-school programs, where they can grow and develop their content alongside learning about how to teach and building their own love and joy of science. We hope formal education policies and perhaps those regulating the President's STEM initiative might take into account how to use these partnerships between formal education and informal science most effectively.

Those are some of the highlights. I hope I've managed to convey the breadth and depth of our discussion to date and stimulated your interest in adding to our discussion. Again, I invite you to adapt, suggest, disagree, rebut, or otherwise give feedback to any one of us in the Inquiry Group. We look forward to the rich discussion in the next day and a half, and thank you in advance for your thoughtful comments.

Evaluating K-12 vs. ISE Learning

Evaluations of ISE programs and institutions are often based on the same outcomes expected from classroom instruction, that is, on their contribution to conveying information and helping students and teachers meet state or national science standards. If ISE institutions are seen simply as an extension of the K-12 system, we fail to take advantage of their most important contributions—engaging people of all ages in the excitement of scientific exploration and discovery, the importance of the scientific enterprise, and encouraging people of all ages, backgrounds, and capabilities to be involved in science in some way. ISE institutions can and often do play important roles in stimulating interest among young people in pursuing careers in STEM fields. Thus, we must continue to develop more diagnostic evaluative tools that go beyond simple outcomes such as counting the number of people who see a particular exhibit or participate in a particular program. NSF's Impact Categories are a useful contribution to evaluation, but measuring these impacts is still the challenge. This remains an area for fruitful investigation. • **Saskia Traill**

Policy Topic Cards

Used as a focus for break-out group discussion.

Policy Card 1
Content Authority and Credentialing

ISE organizations and projects can play a very significant role in supporting a variety of STEM education efforts, but crafting a policy that fairly determines the credibility of institutions and projects, and what type of support is most appropriate, may be difficult. Some sort of gatekeeping is essential—however, what form should that take, and who should be involved? How can the process resist political, social, and other non-educational pressures? How do you address these issues in your institution/project?

Policy Card 2
Evaluation and Student Assessment

Evaluation and assessment have long been a part of both formal and informal education, but the methods and rationale for which they are undertaken are largely unrelated across the formal-informal divide. What are the policies and expectations of funders and formal education partners for evaluation and assessment that you have encountered in your own work? What collective efforts should be made within the informal sector to respond to those policies and expectations?

Policy Card 3
Formal Education Systems

The National Science Teachers Association has a position statement articulating the need for sustained links between informal institutions and schools. Should informal education institutions develop complementary policy statements regarding the various intersections of formal and informal education? If so, what aspects of the relationship should those policies address and why? Would a statement like this benefit your institution/project?

Topic Card Ranking/Use

The ranking of the most commonly chosen infrastructure topics for triad work groups. "Ranking" is rank related to all topic cards used (e.g., 1 = most used). A "vote" is the number of small groups in which the card was selected for further discussion (i.e., not thrown on the discard pile after the first 15 minutes of the break-out session). A number of cards have tie scores.

Analysis by Crowley & Bell, UPCLOSE

Card #	Ranking	# of Votes
8	1	13
6	6	9
3	7	8
2	12	6
1	21	3
4	21	3
5	21	3
7	21	3
9	21	3

Policy Card 4
Funding

Public, philanthropic, corporate, and individual funding policies clearly affect informal science programs and evaluation in profound ways—for example, in catalyzing or discouraging partnerships between ISE providers and other areas, such as formal education or research science. And within informal science institutions, pricing models, rules about how much funders may influence content, and other policies can all affect the accessibility, quality, and impact of programs. Given the current economic climate, how can we protect ourselves from vulnerability and where are there untapped opportunities for sustainability? What is your institution/project doing?

Topic cluster discussion and identification of opportunities and threats

Policy Card 5
Linkages to Other
Large-Scale Belief Systems

There is an enormous awareness in ISE circles that some widely held assumptions and beliefs about the world often play out in opposition to very robust theories of science. While there is no inherent conflict between belief systems and products of the scientific method, the underlying prejudices and information gaps on both sides of the argument speak to opportunities for, and challenges to, ISE educators to speak to the lack of conflict. Given this atmosphere, should public understanding of scientific processes and the discipline of objective observation become a higher priority on the ISE agenda than scientific discovery? How do you prioritize STEM knowledge, process, and values in your own work?

Policy Card 7
Connections to Science

The ISE ideal of connecting the public with science and scientists is at a critical juncture. Its success or failure partially depends upon understanding current funding trends and policy decisions that either support or hinder connections among existing informal science providers, STEM practitioners and the public. Are there untapped opportunities to strengthen these connections? Have you encountered threats in your work that may weaken them?

Policy Card 9
Institutions Devoted to
Public Understanding of/Engagement with Science

Policies, both formal written policies at different governmental levels and at institutional levels, and informal unwritten policies at institutional levels, have huge influences on what ISE organizations/projects do and how effective we are at doing what we think we do best—involving people of all ages in scientific content, process, and values. But what can we communicate from our evaluations, assessment, and research to help guide and shape policies that will better support our work? And how can we preserve the integrity of our work in the face of shifting policies, such as "Educate to Innovate" or "Race to the Top"?

CONTINUE THE INQUIRY!

Policy Card 6
Science in Everyday Life/Popular Culture

Popular culture is the expression of society's ideas, attitudes and perspectives. Engaging the public with science through popular culture media like movies, television, theater, and social networking breaks the barriers of C.P. Snow's "two cultures" (art and science) and can stimulate people to think about issues in science in a non-threatening, enjoyable environment. Has your institution/project waded into this territory in search of relevance? What policies should guide us from infringing on the field's core values of integrity, authenticity, and trust?

Policy Card 8
Journalism, Media
and Science Writing

Is new media the message? Gatekeepers of media are keeping science off the page and off television (For every 5 hours of news on CNN there is about 1 minute of STEM coverage). ISE policy must include financial and technical support for professional quality ISE outreach media directly to journalists, bloggers, podcasters, etc. What are some strategies for fostering complementary collaboration between your own work, ISE writ large, and media reporters and editors?
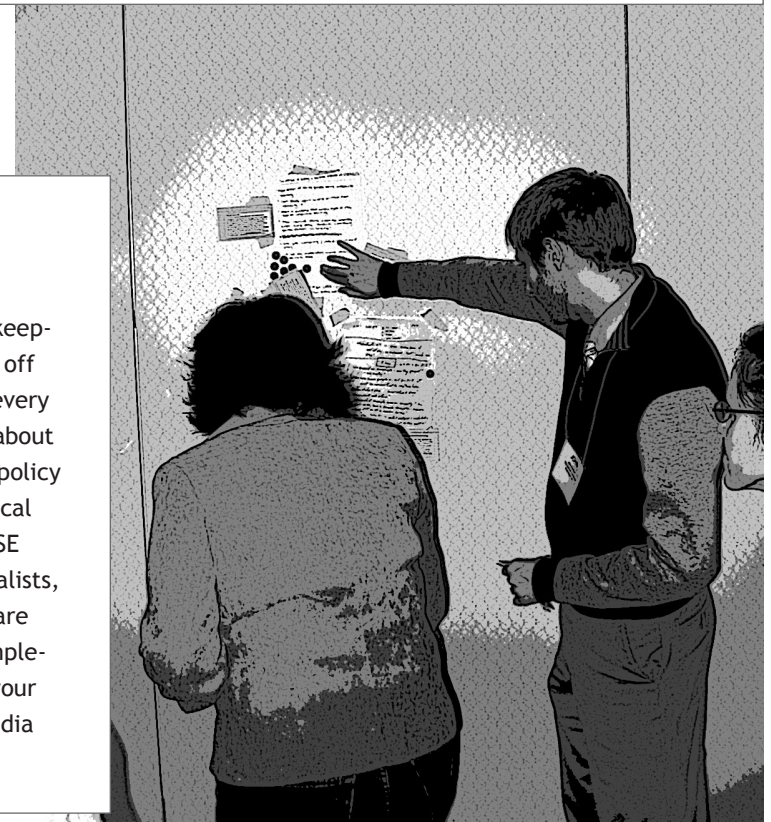
Kevin Crowley

Learning Inquiry Group

Kevin Crowley
CAISE Co-PI, Director, University of Pittsburgh Center for Learning in Out-of-School Environments

Learning

a core and common value
the source of our passion
our secret weapon

The hypothesis of this inquiry group was that learning is the thing that can hold together this new field that we have been talking about. In order for that to happen we have to start coming up with something to talk to each other about. We need a new language, we need some shared examples, we need a shared passion around the thing that we can recognize and support in each other's work.

The Learning Inquiry Group was composed of researchers, practitioners and people interested in policy. We all came together around this question of learning. We were hosted in Pittsburgh by the Carnegie Museum of Natural History and the Children's Museum of Pittsburgh. We talked and wandered the halls of the institutions and looked for examples that we could use to talk about learning. This was all done in the context of this volume from the National Research Council (NRC) that you've heard about several times already during this summit.

The fact that this book came out and focuses on learning in informal settings is a really big

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Learning Inquiry Group

- Kevin Crowley (Co-Leader), University of Pittsburgh
- Philip Bell (Co-Leader), University of Washington
- Jennifer Adams, Brooklyn College/CAISE Fellow
- Megan Bang, TERC
- Sam Dean, Exploratorium
- Lynn Dierking, Oregon State University
- Richard Duschl, Penn State University
- E. Margaret Evans, University of Michigan
- Sarah Garlick, Geoscience Outreach Foundation/CAISE Fellow
- Rose Honey, Hopa Mountain, Inc./CAISE Fellow
- Vera Michalchik, SRI
- William Penuel, SRI
- Jrène Rahm, Université de Montréal
- Christina Soontornvat, Austin Children's Museum/CAISE Fellow

- Martin Storksdieck, NAS
- Heather Toomey, Zimmerman Penn State
- Chip Lindsey, Don Harrington Discovery Center

Pittsburgh Team
- Jamie Bell, UPCLOSE
- Lisa Brahms, UPCLOSE
- Karen Knutson, UPCLOSE
- Marti Louw, UPCLOSE
- Ellen McCallie, Carnegie Museum of Natural History
- Mary Ann Steiner, UPCLOSE
- Sam Taylor, Carnegie Museum of Natural History
- Jane Werner, Children's Museum Pittsburgh

National Science Foundation
- Al DeSena, ISE, DRL

deal. When you think about how the NRC works, you know that this was a two-year process that involved a panel of experts getting together, examining evidence and having witnesses come and read papers and offer testimony in an attempt to identify evidence that we can all agree on. So here is this very carefully considered volume that finally answers the question, "What is informal learning?" Right?

Well, not really. This is the first thing this inquiry group came up with. This is an NRC book, and what we have to understand is that it doesn't answer the question of what learning is and what we should do with it. This book offers a consensus of what we know right now, what the evidence says that we can all agree on, but we have to take this further. The book is not intended to be read to answer questions, the book is to be read to get conversations started, to stimulate brainstorming in the field, to surface disagreements so that we can make progress towards answering the really hard questions: What is learning? How can we design for it? How can we assess it?

You have heard earlier in this summit, during David Ucko's presentation, about the strands that are talked about in this book. These strands are not learning theory and they are not a design recipe. These six strands are an organizational device for us to think about how to bring together all of the literature from disciplines that really haven't spoken to each other. So when you hear the word "strand," the term is useful, but you shouldn't take that as

the thing we need to know about learning in the end when all is said and done. The book should be read by everyone. It serves as a common starting point around which we can start pursuing further questions. So the first message is: Read the book. It is actually pretty good.

A lot of us started thinking this was one of those dull consensus studies, but there was a lot in there that surprised us as a group. There were things in there that we didn't know. There were things in there about which we didn't agree. It stimulated some really interesting conversations. We recommend reading the book with these questions in mind: What surprised you? What is something you learned? Something you disagreed with? Something you really think is important for the future of the field?

For two days at the meeting, we first did a version of the same type of timeline for the field of informal science education that we are assembling here at this summit, to see whether or not we could agree on what the history of the field looked like. We met in small book club groups to discuss

A book club approach

- NRC books are consensus of what we know, not what we need to know.
- "Strands" are not a theory.
- "Strands" are not design recipe.
- It should be read critically. It's a common point around which we can start asking questions.
- What surprised you? Something you learned? Something you disagreed with? Something you think is important for the future of the field?

Four big ideas

- Learning is a common bond
- Learning requires an ecological approach
- Learning can only be thought about time and place
- We are a field of learners

the book, and we wandered around the host museums and tried find ways to use ideas from the book to help enrich our understanding of learning.

I want to briefly tell you about four big ideas that we want to bring to the field and that we hope people will get excited about and talk about. Those of you who have been in the field for a while know that sometimes in our history, "learning" was a dirty word. It was the thing we were *not* about. Schools were about learning, we were about something else. We were about things like interests, empowering people, self-efficacy, motivation, productive dispositions towards science and technology, resiliency,

identity, attitudes, excitement. Those are wonderful things, and those are the things I think we can all agree on that characterize the strongest examples of informal science education.

The thing that this book does, and does very effectively, is show us the evidence, arguments and relevant theory regarding how we get past the idea that all of these things are not actually about learning. The book, and a big function of those strands described in the book, shows that the knowledge that we are so used to considering as a positive aspect of learning is motivated by, is connected with, is intertwined around experiences with these other features which are highlighted in informal learning environments.

Our hope is that this is really fertile ground for new learning science theory. There are powerful examples out there, represented in the work that you do, of some of the best ways, the most powerful ways that human beings learn, and how they learn about science. If we start understanding and unpacking those and inviting in psychologists, sociologists, anthropologists and those from the learning sciences to think about our problems with us, it is not just going to improve our practice, it is fundamentally going to alter what we as scientists understand about human learning.

Another big idea is this ecosystems approach that you have heard a couple of people talk about already during this summit.

interest
resilience
motivation
excitement
self-efficacy
empowerment
LEARNING
identity
attitudes
productive dispositions

This is a picture of a garden.
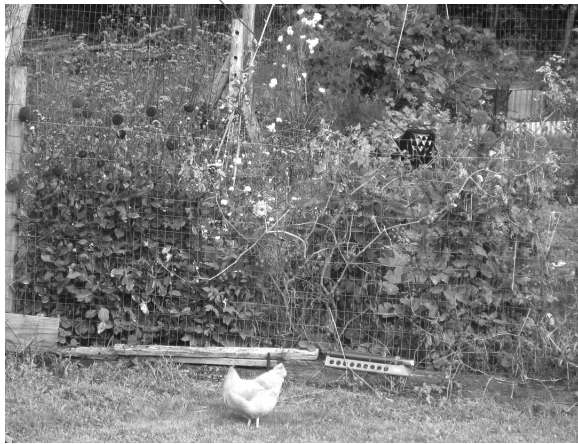
I chose to show you a garden and not a forest or a meadow because a garden is intentional. It is planted, it is planned, and you can see a chicken at the bottom of the picture. Each of these things are individual elements, each have their own logic and explanation, but they live together in a system that interacts. It interacts in ways that are sometimes unpredictable and always important.

So if we can look at the infrastructure for learning and start understanding what it looks like when we get out of our own environments and our own problems, and start from the perspective of the learner, following them across all of these different contexts, we can see that we are part of an infrastructure. When we think about how we should be moving forward, I think the book is very, very helpful about the fact that we must have an ecological perspective, we must start looking at these

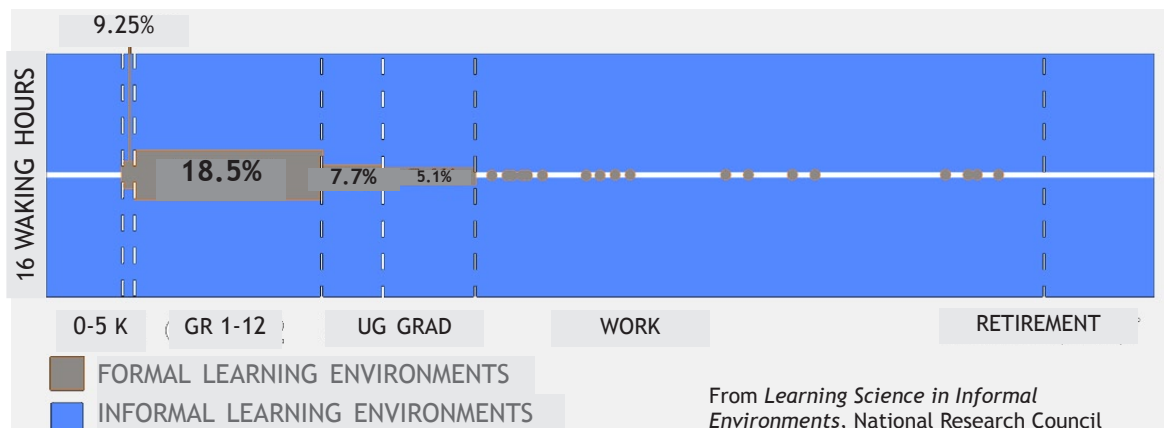other elements and start asking questions about how they interact.

The third big idea is that learning is lifelong, lifewide and lifedeep. It happens over place, it happens over time. You have heard people mention today that very little of our time is spent in schools. Below is a diagram from *Learning Science in Informal Environments*. That line running horizontally is school, and the rest of it is something that I have started calling the "deep blue sea"—this vast area surrounding these little tiny islands.

What is going on in the deep blue sea? Who can help us figure out what is going on in the deep blue sea? We don't have, in the world of education and the world of learning, the equivalent of marine biologists who could answer that question. We have a lot of people who have studied that small chain of islands and they can tell us a lot about those islands.

Kevin Crowley

LIFELONG AND LIFEWIDE LEARNING

9.25%

16 WAKING HOURS

18.5%   7.7%   5.1%

0-5 K   (GR 1-12)   UG GRAD   WORK   RETIREMENT

FORMAL LEARNING ENVIRONMENTS
INFORMAL LEARNING ENVIRONMENTS

From *Learning Science in Informal Environments*, National Research Council

The expertise regarding what we know about that deep blue sea is heavily represented in this room here today. A lot of people agree that the deep blue sea is the uncharted territory for future questions: How should we think about learning there? How should we promote learning there? How should we assess learning there?

There are a lot of questions that we don't know the answers to, but this book provides a pretty clear challenge for how it is that we are going to have to get there. It is a unique new book with a new way of thinking about learning.

I want to highlight those three big ideas in terms of the problem of assessment and the problem of scale, areas in which the book is also very helpful. I'll do this with a personal story that I like to tell. While I was growing up I thought that I didn't like tomatoes. Why did I think that? When I was growing up, tomatoes came from the grocery store and they came in three sizes: big, medium and small (cherry tomatoes).

That's what I thought a tomato was. Why did I think that tomatoes were those things we bought at a grocery store? At left is a chart showing the USDA color classification requirements for tomatoes. The reason I

COLOR CLASSIFICATION REQUIREMENTS IN
UNITED STATES STANDARDS FOR GRADES OF FRESH
TOMATOES

United Fresh Fruit and Vegetable Association in cooperation with U. S. Department of Agriculture Agricultural Marketing Service Fruit and Vegetable Division

GREEN BREAKERS TURNING PINK LIGHT RED RED

thought those things we bought at the grocery store were tomatoes was because this country needed a food production system that works at scale, supplied to every grocery store in the United States. It must be predictable food, it must be edible, it must be safe, and had to have somebody regulating this so that it could be offered at scale. Then we had people, probably in Washington, D.C., in advance, twenty years before I was born deciding what a tomato would mean to me. I appreciate that, but I missed out on the whole tomato thing as a result.

Recently we started gardening, and it turns out that there is a whole lot more to tomatoes than I knew as a grocery store shopper. First of all, tomatoes aren't uniform. They come in lots of different colors, lots of different sizes and lots of different shapes, and they don't taste anything like each other. There is tremendous diversity in the tomato world, but the only way I was able to understand that is because I was able to grow tomatoes myself or buy them from people who grow tomatoes themselves.

The thing we
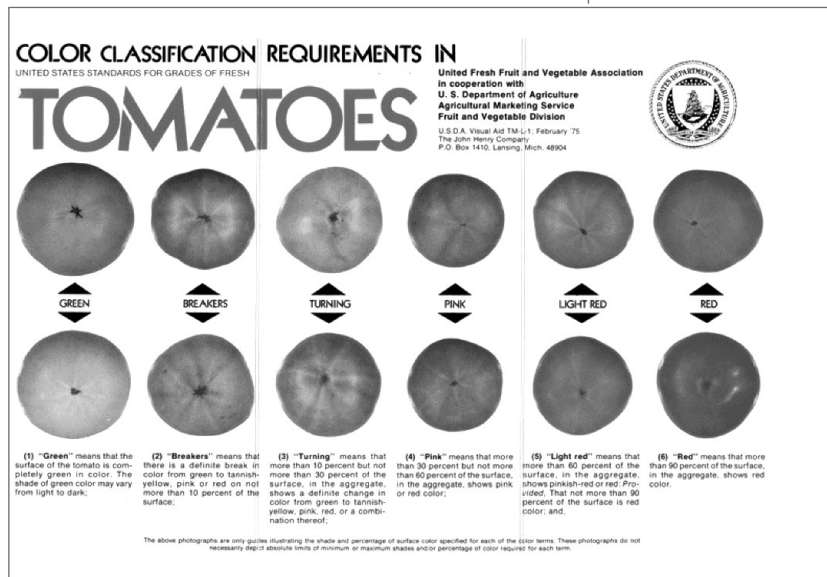
need to remember in informal science is that sometimes we pit ourselves against schools. Schools are good, schools are scalable, schools can be assessed in regular ways, but if we allow conversation about science education in the schools to influence the informal world, we trade off exactly what makes us strong, which is our diversity, our deep local involvement with communities, our attention to things like race, culture, different notions of science and different interests of our learners. This is why people want to be connected with us. They want the tomatoes that we grow locally, they don't want us to look like schools.

- The system works, but is that really all we want from our food?

- Is that really all we want from science learning?

- Is there an appetite for local learning?

So as we think about learning, it's not just trying to think about informal learning that can be assessed in the same way, that can scale across everything. We need to develop, in these ecological contexts, notions of learning that play to our strengths and play to the fact that we are the place where most people bump into science as they swim around that deep blue sea. The book makes a very strong argument that our evaluation agenda should be something that we own, not something that has been thrust upon us, which is going to happen if we

don't get our act together regarding how to measure learning in our context.

we are a field of learners

a core and common value
the source of our passion
our secret weapon

This was our biggest realization as a group. When we sat down and looked at the informal science education timeline, what it told us is that we in this field do not just share a passion for growing learning, we ourselves are people who have pursued learning lifelong. We are a field of learners. We do have common interests and we do want to talk to each other about this. The thing about this book and about learning in general is that we are not going to make any progress unless we actually start having those deep, rich conversations.

We have an opportunity here that other fields don't, which is that we can move very fast, very deep and be very connected because we are all willing to talk to each other, listen to each other, challenge each other and think about what we can learn together. We hope that is the kind of vibe that we can get going during the discussions we have in the course of this summit, and the kind of value that can be a core for the field as we move forward into the future.

Assessment

Learning Topic Cards

Used as a focus for break-out group discussion.

Learning Card 1

NRC's *Learning Science in Informal Environments* proposes in learning strand #1 that "learners in informal environments experience excitement, interest, and motivation to learn about phenomena in the natural and physical world." What do you think about the notion that excitement is a primary driver of engagement? What about other affective states, e.g. ones of arousal, like attentiveness? Does participation and learning from it drive interest, or does interest drive learning? Are affective states important in your own work?

CONTINUE THE INQUIRY!

Learning Card 2

NRC's *Learning Science in Informal Environments* proposes in learning strand #4 that "learners in informal environments reflect on science as a way of knowing....as a social enterprise that advances scientific understanding over time." What have you noticed from your own work about the kinds of informal environments or strategies that are conducive to communicating science process and/or values?

Learning Card 3

NRC's *Learning Science in Informal Environments* surveys and synthesizes some of what we know about learning up to this point in the ISE field's history, mostly from the researcher's perspective. How do practitioners conceptualize and talk about learning? What do ISE practitioners and researchers gain from collaborating? Do you know of current 'sweet spots' where research and practice come together? What barriers have you found to praxis in your own work, and how do you address them?

Learning Card 4

NRC's *Learning Science in Informal Environments* and *Surrounded by Science* propose an "ecological" framework for learning, intended to highlight the cognitive, social, and cultural learning processes and outcomes that are shaped by distinctive features of particular settings, learner motivations and backgrounds, and associated learning expectations. How does this perspective fit with how you think about your own work? Do different kinds of designed spaces or activities invite different outcomes?

Topic Card Ranking/Use

The ranking of the most commonly chosen infrastructure topics for triad work groups. "Ranking" is rank related to all topic cards used (e.g., 1 = most used). A "vote" is the number of small groups in which the card was selected for further discussion (i.e., not thrown on the discard pile after the first 15 minutes of the break-out session). A number of cards have tie scores.

Analysis by Crowley & Bell, UPCLOSE

Card #	Ranking	# of Votes
1	1	13
9	4	12
8	5	11
4	7	8
7	9	7
3	12	6
6	12	6
2	17	4
5	17	4

Groups discuss thematic clusters and record opportunities and threats related to those clusters.

Learning Card 5

In "making the case" for informal science education, there is an assumption that there are identifiable, distinct aspects of learning that occur across designed settings, everyday environments, and in programs. How would you describe the particular qualities of STEM learning in your own work? Does ISE learning vary from designed settings to everyday environments and programs, for example, or in situations where informal isn't also free-choice? What is different about the tools used and/or the roles of learners and educators across informal settings?

Learning Card 7

NRC's *Learning Science in Informal Environments* proposes in learning strand #3 that "learners in informal environments manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world." Why is interactivity important? Do we really have evidence that it is, or is it just a core assumption that we make? Is it under-conceptualized? How do we unpack this?

Learning Card 9

NRC's *Learning Science in Informal Environments* and *Surrounded by Science* describe some of the ways that culture influences learning, as well as some strategies for engaging a diversity of audiences equitably in science learning. What more needs to be unpacked about science as a cultural enterprise and how welcoming it is to people of all backgrounds? How do diverse cultural perspectives inform STEM? For example, what do Native ways of knowing have to offer ISE? Which dimensions of these issues still need to be explored and how?

Learning Card 8

NRC's *Learning Science in Informal Environments* proposes in learning strand # 6 that "learners in informal environments think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science." Is science learning valid if learners don't know it's "science learning"? Do we need a richer version or understanding of 'identity," or even what we mean by STEM?

Learning Card 6

NRC's *Learning Science in Informal Environments* proposes 6 "strands of science learning" that are supported by informal environments. These refer roughly to inspiration, motivation, understanding, experimentation, meta-cognition, social interaction, and identity. Which of these strands do you find useful in communicating the value of your work, and for which stakeholders are they important? What would convince you that any one of these strands of learning had been achieved? What kinds of outcome measures or assessments of them would you like to see?

Participants review the opportunities other groups have posted, and note those that are most actionable for their own work and/or have the most traction for the future of the field of informal science.

This section of the documentation covers a post-break-out session commentary by "reflectors," each assigned to observe one of the six break-out groups, offering their comments and synthesis regarding the group discussions.

Breakout Session Topic Clusters

ecosystems of learning, ecology of learning
lifelong learning, redefining education, engagement
deep blue sea, science in the deep blue sea

science in everyday life, Everyday Science
deep learning through play, The play/learning interface, rescuing play
diversity in programs and audience

social and cultural approaches
reconciling different belief systems
science and culture, science and identity
integrated social learning

Internet opportunities, new media, new ways of learning/new media
cross media collaboration, collaborative connections, tactics for learning
critical junctures in interdisciplinary approaches (e.g., art & science)

Funding | STEM careers | rigorous methodology | What is the best role for CAISE in connecting and strengthening the field?

Synthesis and Reflection

Introduction

Sheila Grinell
Consultant to Science-based Cultural Institutions

As we were preparing to start off this session I was thinking what a real treat it is to be with you in this room. You are all really brave people who do something difficult. You are trying to share science as a way of knowing with people you don't know. On top of that difficult task we asked you to share your visions with each other, and you probably didn't know each other before, though we hope you know each other now, and you rose to the occasion.

After the break-out sessions, our reflectors got together and they told us what you talked about in your various

Sheila Grinell

sessions. The result was these clusters (*bottom left*), which emerged quite naturally. I'm told that the bottom line (funding, STEM careers, and so on) were the topics discussed at the last CAISE Summit two years ago in which the participants were all PIs. Everything above that are topics that you generated during the break-out sessions and that is the grist for CAISE's mill going forward.

I'm going to introduce the reflectors one at a time and ask them to give you their thoughts on your conversations.

Questions: An Invitation to Our Future

Bonnie Sachatello-Sawyer
Executive Director, Hopa Mountain, Inc.

I'm from Boseman, Montana and an organization called Hopa Mountain. "Hopa" is an old English word for hope and means that what is desired becomes possible. We invest in rural and tribal citizen-leaders who are working to improve education, ecological health and economic development.

In the break-out room I attended, the conversation was very rich and varied. While the questions were initially chosen from those on the topic cards, very quickly people started asking different kinds of questions. I want to focus on these questions today because it is questions that are the invitation to our future.

In terms of infrastructure, there were many questions asked around science:

Infrastructure, Science, Inclusiveness

- What is the body of knowledge we call "science"?

- Who is included and identified with this way of thinking about science?

- Who is currently excluded from this way of thinking about science?

- What types of questions might we ask if we looked at science from diverse world views and we respectfully acknowledged the value of other world views?

- How do we deal with those who believe in things that scientists might not? Are these threats—things like intelligent design versus evolution?

- Science is a very elite pursuit, and this is a very elite room. How do we find openings in this elite culture?

- Can we be open to other ways of knowing?

- What would science be like if it were more inclusive?

There were a number of conversations that centered around motivation. People asked some of the following questions:

Motivation

- How do we increase interest in science?

- How do we encourage new scientific pursuits?

- As Neil deGrasse Tyson said, how do we make science more "tasty"?

It was observed that we have many more tools now. There were a lot of rich conversations about how we use the Internet and new media.

There were a lot of questions about opportunity. On one hand people talked about the challenges that come with so many opportunities that we have. We are such a diverse field that it is hard to focus on priorities within the field because we have so many opportunities. We also talked about equality of opportunity.

Equality of Opportunity

- Looking around this room, who is not here that needs to be here?

- As America becomes more diverse and minorities become the majority in this country within thirty years, how do we need to open up and ensure that we have equality of opportunity?

- What kind of infrastructure do we need to create to make that possible?

- What will a multiracial, multicultural identity look like if we are going to create informal learning opportunities for all throughout science?

To this end I wanted to close my remarks today by talking about some things we might want to focus on. There is a lot of important new research that is coming out now about learning and motivation. I wanted to introduce a book that I've been carrying around with me. It's very important, and I want you to consider

Internet and New Media

- How do we get people talking about science across platforms?

- How are we as educators engaged in creating partnerships across these platforms?

- Who do we need to be networking and working with now to ensure that we are developing rich conversations around science across multiple platforms?

Bonnie Sachatello-Sawyer (foreground) and Wendy Wheeler (background)
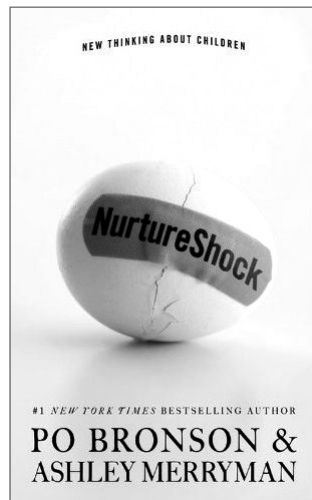
NurtureShock, Po Bronson and Ashley Merryman. Twelve, Hatchett Book Group, 2009.

reading it. It is called *NurtureShock*. It suggests that we need to rethink how we teach children and parents based on current research. .

Secondly, I wanted to talk about the importance of mentoring. Yesterday we talked so much about process, how we do things, but in that process I also see that there is a transition happening. So many questions that were asked were "How?" questions. The fact that they were "How?" questions suggests that we are about to change. This change will be fully realized by mentoring the next generation of ISE professionals, leading to the following questions.

Mentoring the Next Generation of ISE Professionals

- How will we look around us and bring up people who are not here in this room and ensure that they get an opportunity to have a voice in informal science learning?

- How do we mentor those so that they understand this unique club, and how do we break down this unique club so that others can participate?

- How do we mentor that next generation so that when we look around this room twenty to thirty years from now, we see different infrastructures and maybe different ways of thinking about science and our definition of it, and broaden our vision of informal science learning as a result?

Funding, Collaboration and Ecology of Learning

Rob Semper
Executive Associate Director/Director of Program, Exploratorium

There was also an incredibly rich and lively discussion in our group, and there was a rising consensus regarding which topics we should talk about. I am going to focus on three of the topics that came up in our group. There was not very much talk about policy, some talk about infrastructure and a lot of talk about learning. There was a lot of talk about tactics and less talk about strategy, so when I review the topics that came up, I'm going to attach some infrastructure and policy points.

Funding Issues and Accountability

Let me start with a discussion that one group had about the funding issues for our field and how we are going to support ourselves going forward. Looking at the discussion notes, I was struck by the fact that one of the things our field has to grapple with is real issues about accountability, how we talk about what we do and what our impact is, and how we actually make the case for why that impact should be funded.

I was struck by recollections of time I spent on Capitol Hill, trying to get money to get NCLB changed to include money for teacher development that was done at museums. When talking to people on the Hill, including those who did know our field, they questioned, "Why

should we give money to you? How do we know you'll do a good job? How do we know this money will go to a place that will do some good work? Are you accredited? Do you have a system that will let us know that the money will be spent wisely?"

Our field is too allergic to accreditation, to issues of standards, to issues of accountability. I think that's a problem that we're going to have to resolve if we are going to succeed in convincing others to support our agendas. From a policy point of view, I think the question of accountability is critical.

Collaboration and the Challenge of Asymmetry

There was a large group that talked about collaborations: collaboration across media types; collaboration between museums, television, publishing and schools. This notion of collaboration is really critical, and yet it is interesting to me that there is asymmetry in this room in terms of how that collaboration happens. It is because some of our organizations such as science centers and the like have science as a topic of focus, while other organizations like public television stations have many topics as their focus.

As a result, we have CEOs from those science centers here, but the CEOs from public television stations are not here. It means there is an asymmetry in our discussions. Factor in the fact that everything we do now has a parallel or extended existence on the Internet,

which has even less organizational strength, and we have another asymmetry. Where is the representation from the Internet and other new emerging mediums? How do we bridge across this asymmetry in organizations in the work that we do?

Regarding that challenge, I would refer you to the amazing and interesting Partnership for a Nation of Learners initiative that CPB and IMLS had a few years ago that funded museums, libraries and public television in a joint effort. It was interesting to see how that initiative and those projects had to struggle to define the roles of each of the mediums and how they could collaborate authentically together. Perhaps we could benefit from more collaboratives that cross over different mediums.

Moving Beyond an Industry Perspective

The third group I want to talk about is one that discussed learning, the notion of the ecology of learning, and this idea that maybe we should look at the learner as the prime entity of study. I just want to point out how difficult it is for us to look at learning from a non-institutional perspective. What I think we hear often in these discussions is our institutional point of view. It is very natural to think in that way, from an industry point of view. We have to get beyond the industry point of view if we are going to actually have the collaborative discussions we really need.

I want to close by saying that in these

Rob Semper

re • flec • tor

• something that gives back or shows an image of, as in a mirror

• a body, surface or device that casts back heat, sound or light

• one who thinks, ponders or meditates

Julie Johnson

discussions I'm struck by how internally focused they seem to be to our industry. As a field, we need to get outside once in a while, to put ourselves in other people's shoes and try to look at our work from a perspective that is broader than our own particular parochial community work.

Process and Products

Julie I. Johnson
John Roe Distinguished Chair of Museum Leadership, Science Museum of Minnesota

Being a reflector is challenging for me personally because I tend to sense and focus on the process, not the product. I looked through all of the papers from the group discussions and the poster paper notes. Then I got online and looked up the word "reflector" and realized I was doing all of the things described. I want to cast back some of the light, some of the heat, some of the fire, some of the sound that was in the group yesterday. I tried to solicit, to look, to question and to find out what people were thinking. In honoring the wishes of the group, I want to present two types of reflection.

Process Notes

The first is about the process that people engaged in, their lived experience during the exercise. I think that is important because as we work across various sectors, there are processes that are comfortable within particular sectors that won't necessarily translate in other sectors.

With respect to the process, I noticed that

the introductions, the getting to know each other, were very important to the people in the room. So much so that one could say people got behind in the task. However, from their perspective they were building a foundation to be able to have a conversation. People were not able to engage with the questions without knowing a little better the others around the table in some detail beyond a name and place of work. That connection was a very important part of the process for individuals before they could actually get into the steps of the activity.

The second thing of importance was trying to understand exactly what they were doing: what the purpose was, the sequence, whether there was a right way to do it. As someone said, "This is really important. They want us to think about stuff and give them feedback, and I feel I can't do that unless I understand the whole of what is happening."

There was great concern about the quality of the product that would be produced. There was consternation, confusion, frustration. There was laughter. There was joy. There were all of these things happening in the room: the light, the fire, the heat, the sound.

And while this might be expected with a group of strangers interacting for the first time, this disquiet lasted throughout the two-hour process. It never fully went away, the tension was always there: What is right? What is proper? How do I explain to you my view of the world? How does that align with your view and how do we connect these topic cards?

People also wanted to understand the entirety of the information on those topic cards, which was rather dense, and struggled with the tension between how much time to give to understanding the nuances of the information versus those who said, "Let's just throw the cards away and have a conversation."

There was all of that process going on in the room and I think in the end it really benefitted the group because there were some really rich and wonderful things that came out of the discussions.

Product Notes

From the first round of the task a list of topical ideas was generated.

> **Initial Topics**
>
> • Public perception and understanding of science
>
> • Do practitioners base their practice on their gut feeling or some kind of evidence? How do we measure that?
>
> • What types of new media should we be considering?
>
> • Where does journalism, science writing and other media come into play with the work that we do in various ways?
>
> • How do we incorporate play as a way of learning? How do we understand the notion of play as learning?
>
> • How do we bridge dualities and divides?
>
> • What does it mean to redefine education?

Those were some of the clusters of topics that were discussed before we went on to the mind-set of identifying opportunities.

One of the things I was interested in tracking was the policy conversation; however, there actually weren't a lot of them. There was a lot around the learning experience and the learning setting but not necessarily policy. I went back to the group's paper trail and looked to see which policy topic cards were actually selected and used.

The policy cards that got pulled as points of focus during the first round of the task had to do with the topics at right. Those cards formed the basis for some of the discussions that led to the learning environment focus and the process of learning. But the discussion never rose to the level of how policy could have an impact on that.

The final round of discussions focused on six topic areas. In terms of identifying opportunities related to these topics, the one that rose to the top for most people was the following: creating an understanding in general about our content, not just facts. How are we doing that? How should we be thinking about doing that?

Another was promoting lifelong learning in the course of the education system. One group focused on the idea of redefining education, particularly the experience of the education system rather than the infrastructure of the

> **Policy Topics of Interest**
>
> • Evaluation and assessment
>
> • Connections to formal education systems
>
> • Institutions and public understanding of science
>
> • Journalism, science writing and media
>
> • Science in everyday life and popular culture

> **Final Six Topic Areas**
>
> • Lifelong learning
>
> • Redefining education
>
> • Deep learning through play
>
> • Social and cultural approaches
>
> • Engagement
>
> • The best role for CAISE in promoting ISE

Opportunities

- Creating an understanding in general about our content, not just facts: how are we doing that? How should we be thinking about doing that?

- Promoting lifelong learning as part of redefining the education system, with a focus on the learner's experience.

- Motivation: What does it look like? What does it mean?

- Bridging communities: What works? What should we be doing and thinking about that?

- Leveraging nontraditional resources, including people

- Entering ISE into involvement in and support of the growing movement regarding the professionalization of youth workers

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education system. These and other discussions regarding opportunities are outlined at left.

What Is Next/Recommendations

In terms of what comes next, here are some thoughts I have taken from this experience and offer going forward. One is the crafting of spaces and places for dialogue and collaboration across boundaries. This is not a new idea, but it is one that came up repeatedly. We keep acknowledging it needs to happen and now we need to figure out little steps to get there. It may not be all 450 people in this room, it may be smaller groups that connect with larger groups, but this is something that is important.

Regarding the observations about the process, as we do this work across boundaries and across sectors there is this piece about people needing to feel comfortable with their engagement and dialogue, and the more important the shift, the more important it is to know who you are engaging with. How do we allow that to happen alongside the urgency to have other things happen?

Third, as I said earlier, a process that is clear in one domain may not necessarily translate into a different domain. So who are our translators? Who are our translators of process, and who are our translators of products?

Policy Opportunities

Erik Peterson
Policy Director, Afterschool Alliance

I am relatively new to the field of informal science education and wear a policy hat during my day job, so I tend to reflect on policy. What struck me was, here was a group of people that were pretty much strangers, coming from all different backgrounds, different parts of the country, different institutions, from large organizations and small organizations, and yet from my perspective as someone new to this, what jumped out at me was how much people had in common, including the passion and desire to work through these issues. We had a lot of committed conversations.

I think Julie Johnson did a good job of capturing

Erik Peterson

the atmosphere and what sorts of things went on in the room. The topic cards and the task were challenging, but people really found things they could latch on to and talk about.

I am not going to attempt to relate everything that went on, but some of the main topics that the group focused on that jumped out at me are outlined below.

Key Topics

- Interdisciplinary
- ISE at a critical juncture
- Science in everyday life (a policy area)
- New media
- Science and identity
- Science and culture

I went back and looked at where the red dots tended to fall [*a rating system indicating opportunities that are most relevant to a participants' work and/or have the most traction in the field*]. There were a few areas that stood out.

Opportunities

- Art and science and the process of lifelong learning across the disciplines

- Making science more transparent using analogies; catching people within their own contexts

- Tapping in to the vast, unprecedented audiences that are available through new media in a potentially low-cost way and what that looks like—not necessarily being able to control what people are searching for but having some control over what they find

- Using emotions to connect more people with science

- The whole notion of the process of science being transferable between content areas, and an emphasis on that process rather than the content

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Break-out session discussion group

Policy Strategies: Getting away from Content, Focusing on Scientific Process

I spent last evening and this morning struggling with this last point. I think from a policy perspective we are all looking for ways to increase the understanding of what this is, what it is that we all do, and what informal science education is, and this notion of getting away from the content. To be fair, this discussion was in the context of a discussion on culture and diversity and talking about how perhaps, with different populations, you might not be able to appeal to them with certain content areas, but you can appeal to them with the critical thinking and scientific process and try to connect that way.

To me that brought up the policy perspective of always trying to identify something that the broader audience, the policy audience, can latch onto and understand. That transcends for me science education and STEM and talks about skills such as critical thinking, questioning things, taking a step back and really looking at scientific literacy. That transcends all kinds of topics, all subjects and careers and the things that people need to know for life.

I also think the topic of play as the art of science has a lot of potential for talking to policy makers about how we increase the funding and grow this in a lot of different areas.

A Pointillistic Perspective: Tactics Rather than Theory

Rick Borchelt
Director of Communications, Office of Research, Education and Economics, U.S. Department of Agriculture

Learning as a Dominant Theme

I have had what some would say is a very check-ered past in science policy communications for the most part, and a lot of that work has been done at DoD, the National Science Foundation, the National Academies, the White House and the Hill. Much of that work has involved trying to figure out how Congress persons learn about science, and I would trade that job with any of you who work with K-12 any day.

It's not surprising that I have been set the task of talking about the Learning Inquiry Group a bit. I really had a great time in our session

Rick Borchelt, Erik Peterson, Bonnie Sachatello-Sawyer

and talking to people afterwards in the halls and elsewhere, and I have come away with a number of reflections that I am hopeful will not sound disparaging but instead will be constructive.

My first observation is that all of our talks were about learning. Out of fifteen triad groups in our room, a good ten of them were based on the learning topic cards, so we were very learning oriented. Even the people who picked policy topic cards or infrastructure topic cards ended up talking about learning. That really was the key word for the day.

Focusing on Process/Particulars

Overall, the discussions were very focused on process rather than outcomes—the process of learning rather than the outcomes of learning, and how we do the learning. In a lot of ways they worked from what we do and what we think we are doing to what's out there somewhere else as a final outcome, rather than saying what it is that we want to do and then coming back to how we do that. So the direction of the conversation typically was from the very specific and particular, and it was hard to get or find that particular piece scaled up to the generalizable.

There were very atomized discussions about particular tactics, about particular techniques that were very enlightening and form a really important core of the material that we are working with, but they never led to those kinds of overarching concerns that, as a reflector, I

would like to have been able to relate to you now. This is probably not surprising because as I went back and reviewed the attendance list for this summit I noted that there was about a three-to-one split between people whose jobs are tactical, production and technical in a way as opposed to the strategic person at the institution or the agency who needs to be thinking the big, big thoughts about the big, big picture of ISE in general.

We asked very specifically how this was going to affect your job, and not surprisingly you told us how this was going to affect your job. As a result, we have a really great amount of material about the tactics and techniques part of ISE but did not capture a lot of the strategic parts of ISE.

Part of that was because we talked about practices and a lot about strategies, tools and tactics, but the words I didn't hear at all in our discussions were the words "theory" or "concept" or "underlying" or "overarching." That was one of the things that I noticed most strongly in our discussions.

Catch Phrases in Current Use

The closest we came were these very secret terms and I don't know whether this was real or whether this was Memorex. Everybody was talking about the "deep blue sea" and the "ecosystem of learning." These are things that are coming into our conversations. It will be interesting to see in two years whether these terms are still being used and provide an

undercurrent for our discussions.

What Wasn't Discussed: Evaluation, Metrics

I think it is as revealing to note what did not get little red dots as what did [*a rating system used during the break-out sessions indicating opportunities that are most relevant to a participants' work and/or have the most traction in the field*]. Our group gave participants at least three opportunities to put red dots on something around evaluation or metrics and they didn't. A lot of other things are more interesting than trying to do evaluation or metrics and I feel your pain there.

There was a time when I was a struggling high school debate student. We would go out and have these great debates, and in our world the most awful thing you could say was: "You use data like a drunkard uses a light post, more for support than illumination." That was considered a really great one-liner at that time.

In a more constructive way I would say that in our conversations we were using data to support what we were already doing rather than using data to determine what we might be doing, where the field needs to go, where the field should go. It was almost inevitable at these discussion tables that personal experience with something would trump the data or evidentiary base for that thing. I believe we need to have more robust conversations about the difference between evidence-based program interventions and how personal experience enriches that.

Borchelt used a slide of Seurat's Pointillist painting, *A Sunday on La Grande Jatte*, to illustrate his point. Due to copyright restrictions, we have substituted a digitally manipulated image of Borchelt's ear.

Focusing on the Dots

You may be wondering why I have posted this lovely slide of *A Sunday on La Grande Jatte* at the Art Institute of Chicago, which is seven feet by ten feet, done in Pointillist style. That means there are millions and millions of dots comprising this canvas. My impression from the discussions that I've heard at this conference is that we are paying an inordinate amount of attention to the dots and we have very few people paying attention to the canvas.

If I could extend the metaphor, earlier we heard about the NRC report on informal learning. That is a really great art history textbook. It pulls things together pretty well, but it doesn't give you art. Our discussions have really been about technique: What paper are we using? Is it going to craze, is it going to crack? What pigment are we using?

What is the picture? What is the art? What is the theme here? My bottom-line reflection from this break-out session is just that. How do we broaden these discussions to include theory and overarching and underpinning concepts that will drive the field of informal science education and push it forward? I think this is the challenge we need to address.

The Passion to Move Forward

Wendy Wheeler
President, Innovation Center

Learning as a Dominant Theme

My group was a facilitator's dream, and if you are a facilitator you know that means that they wouldn't shut up, which is actually a great indicator of the depth of passion of the discussion, the commitment, and the welcoming of the opportunity to engage in dialogue, so it was a fabulous discussion. A couple of quick facts. We had fourteen topic cards that ended up being selected by the group and posted on the wall and, like Rick's group, more than half of them were about learning. And again, there was the theme of learning throughout all of the cards.

A Search for Common Language/Meaning

Another interesting thing happened once we broke up into six final discussion groups focusing on themed topic clusters. The groups dove into

Wendy Wheeler and Rob Semper

these fabulous discussions, but after about ten minutes several of them said, "Whoah, wait a minute. We need to pull back. We need to have more about who we are at the table (the point Julie Johnson brought up) and what we mean by the language we are using."

What was interesting in those discussions is that they weren't really discussions about a common language, but more a discussion about trying to find common meaning. If you unpack that, where does a discussion on common language go? It helps build a monoculture, a shared discipline of practice. If, instead, you have a conversation about common meaning, that unleashes the hybrid vigor of thoughts, ideas and experience that I think we all love so much in this field. I just wanted to highlight that distinction.

Six Final Topic Categories

Quickly, the six topics that made it to the final cut were as follows.

• The Deep Blue Sea
  Science in the "deep blue sea" from Kevin Crowley's Learning Inquiry Group presentation, and working in that frontier.

• Social Projects and Learning
  This included relevant issues and the promise and passion that John Falk talked about in the Infrastructure Inquiry Group report.

• Diversity of Program and Audience
  Though this was one of the top six final topics categories, when the rubber met the road there wasn't enough interest to have that discussion. You could say, of course, that's because it weaves through everything we do, which is true. But while it is all of our responsibility, it all too often falls into the tragedy of the commons, which is the idea: "Well, somebody else will work on it. It is

important, but it's someone else's job." I think that is something that is important to consider. How do we continue to move the ideas of diversity and inclusion both programmatically and in people and places forward?

- Reconciling Different Belief Systems

This was an incredibly deep discussion about different ways of knowing, different ways of being and how to create diversity of knowing within our work and connect to other ways of understanding. What was interesting about this group was that there was such a deep discussion, they ended up not having many words on paper, though they did come up with a fabulous way of depicting the discussion using an infinity symbol with a heart at the intersection where different worlds meet.

- Rescuing Play

While you may hear talk about the importance of play or play as methodology, this group decided it was going to rescue play. Who knew, right? But what does that choice of verb say? It talks about the passion, the energy, about who we are as people. It wasn't just, "Hey folks, we're forgetting about this play methodology, which educators tell us is a way to learn," their stance was, there is an injustice here—play needs to be rescued! Mammals learn by playing, right? Aren't we cutting off our own PR by not promoting play? Those were some of the ideas coming out of that group.

- Collaborative Connections

This discussion focused on the value of boundary crossing, and the sparks resulting from connecting to others with different ideas.

Final Reflections

As I thought about the discussions during the break-out group, I considered what all of this says and concluded that it says a couple of things. It says a little about our own identity as individuals, our need to be constant learners. What competencies do we need to continue to develop as part of our identity as ISE professionals? Who are we? What is our role? What are our institutions?

The other thing I thought about these discussions is that, for our group at least, this begins to create the space for the conversation that moves the question: What is the case for informal science education? What we have been talking about are the "what ifs." What is the infrastructure? What is the learning? These conversations begin to move it from what is to what can be. So what are the possibilities? How do we unleash that? How do we move forward?

I would put forward the argument that when you see the passion and commitment of this group, another line of thinking and action that needs to be added to that is: How do we take leadership—in our institutions, with the field, with the theory—to move forward to realize our own potential and dream?

Underlying Themes: Passion, the Possible, Justice, Synergy

How do all of these topics fall together? Undergirding these conversations I heard four themes that fueled the discussions. One was that passion, whether it was about rescuing play or being the adventurer in science in the deep blue sea. Another was the vision of the possible. The group that talked about different belief systems was talking about what was possible, what it could be, not so much what is. Then there was the ideal of justice, whether it was a preliminary discussion about diversity or how we can be more inclusive. And finally, there was synergy.

Final Thoughts

Kevin Crowley
CAISE Co-PI, Director, University of Pittsburgh Center for Learning in Out-of-School Environments

On behalf of CAISE and on behalf of the field I would like to thank the reflectors. That was a really interesting set of perspectives. I kind of envy the position you're in because we don't often get a chance to hear ourselves talk about our field and talk about our work. During these break-out groups, you took yourselves out of the conversation and you were able to see the things that we are struggling with. It is hard to have conversations across sectors, and you discovered that. It is hard to talk about how policy, learning and infrastructure can coexist.

I think some of what I have heard is that the things we are not talking about, the struggles we are not taking up, are some of the things that are going to be most important for us to focus on in the future.

I wonder about the thinking of the collective group. The topics of policy, learning and infrastructure were bets that CAISE made—that

Kevin Crowley

Most Popular Areas of Opportunity Generated by the Break-out Sessions

Based on break-out session participants' identification of the opportunities that are most actionable for their own work and/or have the most traction for the future of the field of ISE.

Diversity and Inclusion
Bring communities together to level the playing field and create more culturally inclusive science learning. Increase the number and diversity of people who identify as science learners. Catalyze and sustain ongoing dialogue about reconciling western science with large-scale belief systems, as well as indigenous and native knowledge, sometimes via integration and sometimes via respectful coexistence. CAISE can help by seeding an equity interest inquiry group.

Learning: Lifelong, Lifewide and Deep
Reinvigorate and promote life-long, wide and deep science learning across all ISE settings and in "the deep blue" (i.e. outside of school and work). This includes knowledge, process and values. Further discuss and develop the idea that all of our ISE organizations/programs as an ecology, then each can focus on their own niche within the ecosystem.

Play, "Affect" and Art
Redefine and reposition strategies such as interactivity and reflective play as key ISE strategies for engagement, motivation and identity formation in children and adults. Explore and build on related theory and research, e.g. role of "affect" in STEM learning, as well as the interdisciplinary synergies between science and art.

Traditional and New Media
Pioneer unexplored connections and collaborations between ISIs and mass media, i.e. TV, radio, print, and ISE Web sites. Fully utilize and play a larger role in shaping new media and Internet opportunities to connect audiences to scientists and the tools of science. Address the need for professional development in "media literacy" among ISIs and STEM practitioners and researchers and conversely ISI/STEM literacy among media professionals.

Policy and Funding
Strategically position the field to maximize funding opportunities and influence policy through appropriate, rigorous assessment methodologies and credibility criteria within ISE.

- Kevin Crowley, Jamie Bell, UPCLOSE

the field really needs to figure out how to coordinate those. I heard in the remarks during this session that we know how to solve the problem of what we mean by learning, but we don't know how to solve the policy problem of how to get other people to recognize that and connect that with other ideas of learning and metrics and assessment. It doesn't matter if we solve the learning problem, we're not going get to do it if we are not going to be funded to do it. Similarly, with the infrastructure, we can have big ideas about how to change the world, but if our ideas outstrip the infrastructure, our ability to connect and talk to each other, it doesn't matter how good our ideas are, they are going to wither on the vine.

I heard you pushing the idea strongly of not just remaining within our comfort zones and thinking about our institutions, our approach to science, and how we work with our audiences, but to start wrestling with these bigger questions that affect the ecology of the field as a whole.

The function of the Inquiry Groups was to try to get these conversations started and to have those conversations begin to resonate. We knew it would be hard and we appreciate the struggle that we know it was to get those discussions going. I want to thank you again for the fantastic reflections we've heard about those discussions.

Break-out group in action
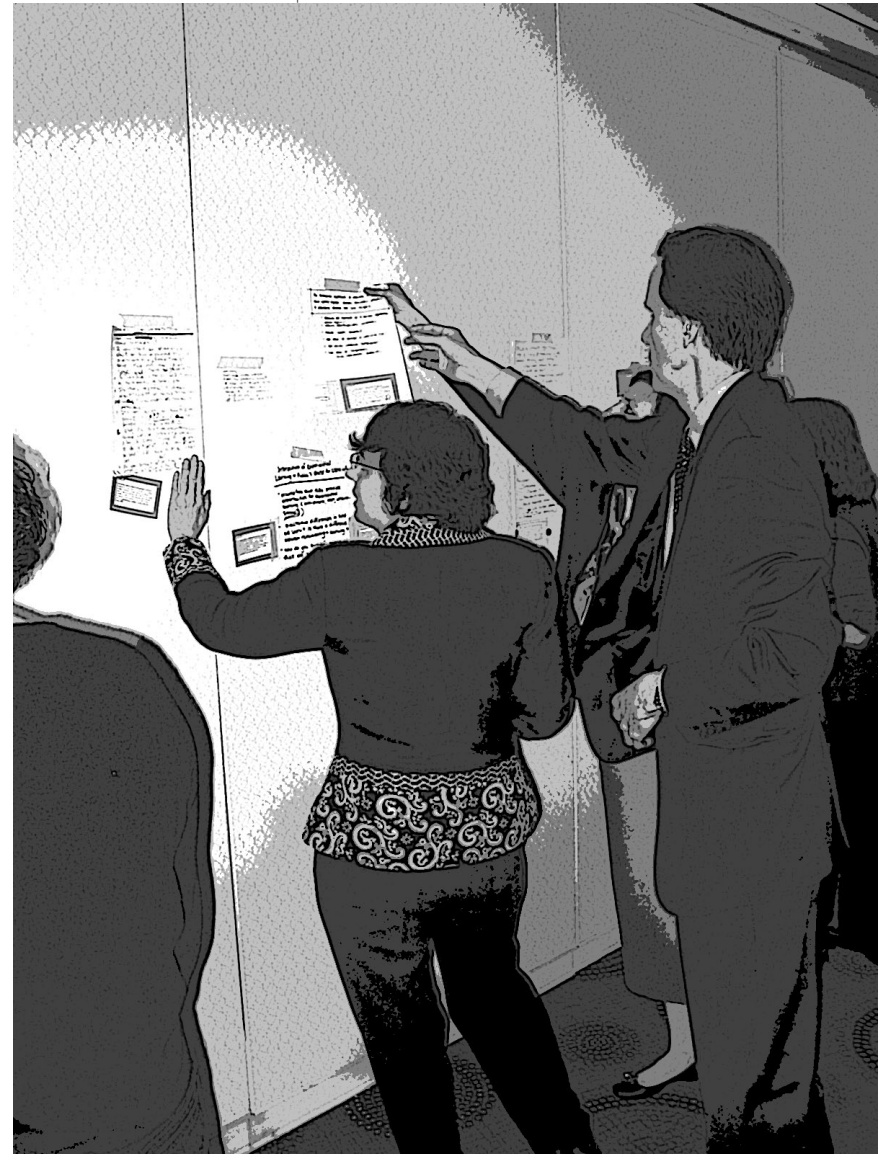
intermission

Posting memories, sketches and snapshots of key events that helped to shape the informal science education field. See the Community Timeline at insci.org.

What should we do?
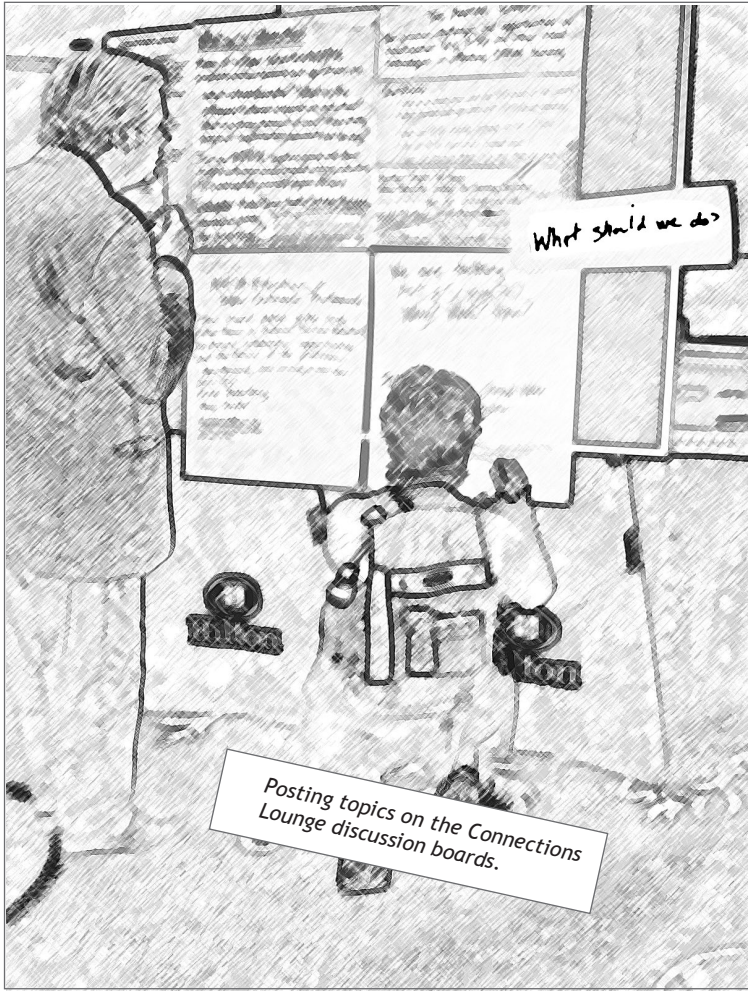
Posting topics on the Connections Lounge discussion boards.

Browsing and discussing posters and project materials