



Final Evaluation Report:  
**Visualizing Change**

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Cover: Science on a Sphere at Aquarium of the Pacific in Long Beach, CA. Photo credit: Aquarium of the Pacific



## New Knowledge Organization Ltd.

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*NewKnowledge is a non-profit research institute working to advance social justice so all people can live life to the fullest in harmony with a thriving biosphere*

## Executive Summary

In 2013, a consortium of informal science education institutions (ISEIs) – Aquarium of the Pacific, National Aquarium in Baltimore, New England Aquarium, and Seattle Aquarium – received a grant from the National Oceanic and Atmospheric Administration (NOAA) to support **Visualizing Change: Training and Tools to Support Informal Educators**. This project aimed to combine NOAA’s comprehensive global datasets with social and cognitive research to develop visual narratives about ocean and climate change. Training in using these tools would build capacity among ISEI interpreters discussing these topics with visitors. The partners planned to disseminate the tools widely through professional networks and professional development activities.

To inform topic selection and approach, the leadership team reviewed social science research about public responses to climate issues, and climate science resources. The final topics were: extreme weather, sea level rise, the ocean-climate connection, and ocean acidification. The partners developed and tested the four visual narratives, which included digital visuals for flatscreen or spherical display platforms and accompanying scripts. The team purposely built flexibility into the visual narrative resources so educators across the US could use the products in diverse contexts and with diverse audiences. Through a robust dissemination plan, members of the leadership team trained other educators, presented at conferences across the country, and shared visual narrative toolkits online.

FrameWorks Institute conducted project research, participating in visual narrative development and testing, and advising on communications techniques throughout. New Knowledge Organization Ltd. (NewKnowledge) led a comprehensive evaluation of Visualizing Change over the three years of funding, finding that the project goals were achieved, and in many cases exceeded. The evaluation activities measured impacts on four primary audiences: partner institutions, interpreters at informal science education institutions (ISEIs), the ISEI community, and the public.

### Partner Institutions

Through the project, the four ISEI partner institutions – along with supporting teams at Buttonwood Park Zoo and the Exploratorium –

aimed to gain access to shared knowledge and resources, including the visual narratives.

In the first year of the project, NewKnowledge created an in-depth literature review to help the team understand issues that could influence the development of the visual narratives. These issues were: visitor concerns about climate change topics, public perceptions of delivery mechanisms at ISEIs, intergenerational learning, behavior change through ISEI interpretive experiences, and how visitors make meaning of these experiences in their lives. The partner institutions discussed the findings, which informed early decisions about the direction of project resources.

Over the first two years of the project, educators at the ISEI partner institutions alongside FrameWorks researchers and NewKnowledge evaluators, tested the visual narratives with visitors. In the first round of testing, we identified barriers that could impede visitor engagement, such as overly lengthy or inflexible scripts, and images that failed to illustrate the concepts. Through these tests, the visual narratives markedly improved to optimize the script and visuals to facilitate learning across broad audiences. Another benefit of this testing was that the leadership team identified the mechanisms in the design of the visual narrative tools that would promote their adoption by a range of educators and institutions. For example, they produced shortened, annotated scripts that highlighted the critical parts of the narrative, while also providing opportunities to tailor the content to specific audiences.

The partner institutions not only gained access to high quality visual narratives, they became leaders in spreading the word about these tools and training others to use them. In addition to incorporating the visual narratives into their programming schedule, partner institutions presented at sessions, roundtables, and poster sessions at 11 conferences over the course of the project. Additionally, a project leader from New England Aquarium wrote two articles about Visualizing Change for the *Informal Learning Review*. Lastly, in 2016, FrameWorks launched [www.VisChange.org](http://www.VisChange.org), an open-access website for project resources, including a Visualizing Change toolkit with adaptable scripts and contextual information, as well as background information about communication techniques. Although sufficient data were not yet

available to measure website usage, this online resource will likely have a lasting impact on the ISEI field by increasing access to a set of high quality tools.

### **Interpreters**

The project aimed to increase climate change literacy, ability to incorporate NOAA data into their interpretation, knowledge of strategies and tools for climate change education, and self-confidence in communicating about these topics.

We saw clear evidence of interpreter impacts at both partner institutions and secondary (trainee) sites. We observed that interpreters at the partner sites were highly invested in the Visualizing Change initiative, especially those who were invited to be part of the project leadership team. Their participation in developing, testing, and refining the scripts proved invaluable to creating effective visual narratives. During site visits, we observed them adapting the scripts to meet audience needs and weigh the value of different versions of the scripts and images. In the process, they became highly knowledgeable about communication techniques for climate science. Interpreters at partner sites also played a key role in dissemination efforts, leading training workshops and presenting at national conferences.

Interpreters from partner institutions led training efforts across the US to spread knowledge of the visual narratives and build the capacity of educators using them. The partners led eight trainings, which engaged 156 educators from 88 diverse organizations, including ISEIs, K-12, and higher education institutions. These numbers far exceeded project goals. Most trainings took place in-person and one was conducted online. They featured introductions to Strategic Framing communication techniques, exploration of the visual narratives and supporting materials, and work sessions for trainees to develop action plans for using the visual narratives.

Through a survey of trainees at the end of the training and a second survey several months later, we learned that educators benefitted from the Visualizing Change training. They believed the training provided critical strategies for starting the conversation with visitors, insight into visitor perspectives, and evidence-based language and scripts. They said the training helped them significantly increase their understanding of topics like ocean acidification and sea level rise. Trainees also believed they gained skills in Strategic Framing techniques and in interpreting different aspects of climate change. The delayed-post survey indicated that this level of confidence in their newfound skills was sustained.

The delayed-post survey indicated that more than half of the trainees had used at least one of the visual narratives in their work, and found them easy to implement, from both technological and educational perspectives. Although nearly all trainees had plans to train their colleagues, few had implemented these efforts in the months after their own training. Nevertheless, the training efforts appeared to help interpreters from diverse institutions understand the rationale for Visualizing Change and the resources that the project made available.

### **ISEI Community**

The project's intended outcomes for the ISEI community were to incorporate project concepts into their practice, show greater capacity to advance ocean and climate change literacy, and increase alignment of public dialogue with expert consensus.

A study of ISEI professionals at the SOS Users Network Conference found that educators use a variety of presentation platforms, including a mix of flatscreen and spherical displays to facilitate presentations and interactions with visitors. They also used these formats in different ways: about half said they played presentations on auto-run. Others said they facilitated presentations, often adapting the script to address the needs of particular audiences or contexts. These educators also expressed a strong desire for reliable visual tools about climate change. This study helped the leadership team understand the importance of producing multiple styles of Visualizing Change products that could be adapted as needed.

Members of the leadership team presented Visualizing Change content at eleven conferences from 2014 to 2016. Presentations included panel discussions, sessions, and posters. Attendees came from diverse backgrounds and institutions, including academics, museum and aquarium staff, nature center staff, and representatives from foundations and government agencies. Attendance ranged from 12 to 200 per presentation, with over 400 people exposed to the project framework and toolkit resources across all 11 presentations.

### **The Public**

The project aimed to increase climate change literacy among diverse public audiences, including youth, adults, families, teachers, and students attending programs at participating institutions.

While the visual narratives were being developed, we conducted a study of ISEI visitors across the US. Among ISEI visitors, we found that a clear majority (70.8%) were concerned about global climate change. Most were also concerned about related issues, like sea level rise and ocean acidification, though to a lesser extent. Despite their concern, visitors generally had a weak understanding of the mechanisms at work in sea level rise, extreme weather, ocean acidification, and climate change. Fortunately for climate and ocean change educators, however, 64% of ISEI visitors did not see these issues as too complicated to think about, suggesting opportunities for engaging visitors in critical conversations.

We captured initial impressions from the public during two rounds of onsite testing during summer 2014 and summer 2015. Gaining this type of insight from members of the public was invaluable to the development of the products. We found that visitors generally responded positively to the visual narratives in both rounds of testing. The testing also helped the team identify barriers, particularly in the first round of testing in summer 2014. Together, interpreters at the partner sites and NewKnowledge made recommendations based on the challenges we described and the leadership adapted the visual narratives accordingly. As a result, visitor responses became even more positive during the second round of testing in summer 2015. Many visitors reported that the connection between the images and the story helped them to better understand the science content. They also appeared to be drawn to more accessible or personally relevant images and ideas, such as increasing access to public transit.

## **In Summary**

The Visualizing Change project achieved its goals of developing four research-based and flexible visual narratives about climate change, built a strong training program as professional development for ISEI educators, and leveraged existing education and communication networks to both design and disseminate the education products. This collaborative effort created powerful learning tools for the ISEI field to educate and empower the public to work towards climate change solutions. Already, research indicates educators across disciplines and their audiences have embraced these learning products.

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# Introduction

## Background

In 2013, a consortium of informal science education institutions (ISEIs) – Aquarium of the Pacific, National Aquarium in Baltimore, New England Aquarium, and Seattle Aquarium – received a grant from the National Oceanic and Atmospheric Administration (NOAA) to support **Visualizing Change: Training and Tools to Support Informal Educators**. This project aimed to combine NOAA's comprehensive global datasets with social and cognitive research to develop visual narratives about ocean and climate change. Training in using these tools would build capacity among ISEI interpreters discussing these topics with visitors. The partners planned to disseminate the tools widely through professional networks and professional development activities. The specific project objectives were to:

1. Develop and test four visual narratives that integrate research-based strategic communication with NOAA data visualization resources;
2. Test the visual narratives in a variety of geographic regions, institution types, and on multiple technology platforms, including Science on a Sphere (SOS), Magic Planet, and flatscreen;
3. Build a professional development program for climate change interpretation with data visualization; and
4. Leverage existing networks for dissemination and peer support.

The leadership team anticipated that this project would transform ocean and climate change communication at ISEIs and impact multiple stakeholders. The team highlighted several specific outcomes for four target audiences. First, partner institutions would gain access to shared knowledge and resources, including the visual narratives. Second, the project would affect ISEI interpreters by increasing their climate change literacy, ability to incorporate NOAA data into their interpretation, knowledge of strategies and tools for climate change education, and self-confidence in communicating about these topics. Third, the ISEI community would learn to incorporate project concepts into their practice and show greater capacity to advance ocean and climate change literacy and increase alignment of public dialogue with expert consensus. Fourth, the project would increase climate

change literacy among diverse members of the public, including youth, adults, families, teachers, and students attending programs at participating institutions.

The active leadership team consisted of staff from eight institutions. Four sites (Aquarium of the Pacific, National Aquarium in Baltimore, New England Aquarium, and Seattle Aquarium) played the largest role in visual narrative development, testing, training, and project management and oversight. Staff at two additional ISEIs – the San Francisco Exploratorium and the Ocean Explorium – supported with additional testing and training efforts. At a mid-point in the project, the Ocean Explorium merged with Buttonwood Park Zoo, but this transition did not affect the project because the same staff continued their project work at the new institution. Together, these six are referred to as *primary sites* in this report.

FrameWorks Institute (FrameWorks) served as the research partners, participating in visual narrative development and testing, and advising on communications techniques. These techniques were developed originally by FrameWorks for the National Network for Ocean and Climate Change Interpretation, a project funded by the National Science Foundation. New Knowledge Organization Ltd. (NewKnowledge) served as the project evaluators. Two additional partners, NOAA's Environmental Visualization Laboratory and Pacific Marine Environmental Laboratory, provided support for development of the visual narratives.

## Evaluation & This Report

NewKnowledge conducted project evaluation to assess the impacts and outcomes of the visualization tools and techniques, with specific attention to how they supported capacity development among educators working to advance climate change literacy. Throughout the project, we collaborated with FrameWorks to ensure that both teams were apprised of the research and evaluation activities and results. We had check-in calls to coordinate site visits during the formative phases, facilitated open conversation about the focus of our observation and survey instruments (especially in light of FrameWorks' past research on climate change-related topics), and shared preliminary findings in advance of distributing them to the larger project team to facilitate



interpretation. Both NewKnowledge and FrameWorks provided the leadership team with timely information and results to help advance project goals.

NewKnowledge's evaluation was divided into three phases: front-end, formative, and summative.

- 1. Front-End Evaluation** – NewKnowledge summarized recent research related to climate research on public perception of climate change topics and ISEIs, intergenerational learning, behavior modification, and meaning-making in a Context Briefing Report, which we sent to the leadership team in advance of the first all-team meeting. Two NewKnowledge researchers attended the 2014 SOS Users Network Conference and deployed a survey to the network members to better understand current and desired uses for the Sphere at various institutions. We also deployed a national survey to explore ISEI visitor conceptions of ocean and climate change to help the project team understand misconceptions to be addressed by the visual narratives.
- 2. Formative Evaluation** – NewKnowledge conducted two rounds of site visits to the primary partner institutions to assess the effectiveness of visual narratives with visitor audiences in real-world settings and get feedback from interpreters on training and implementation. The leadership team met for a second in-person meeting, where we shared and discussed formative evaluation findings.

- 3. Summative Evaluation** – We evaluated the interpreter training sessions run by the primary partner institutions, to understand trainee experiences at the training sessions and after returning to their home institutions. We compiled and analyzed data to quantify visitor learning, interest, and engagement after viewing visual narrative presentations at trainee sites. We also assessed the broader impact of the project by tracking dissemination efforts over the course of the grant.

Each chapter of this report summarizes the activities and results for one evaluation phase. In the final discussion section, we integrate the findings to reflect on the overall impact of the project. We also provide recommendations for maximizing the distribution and continued use of the visual narratives, facilitating similar partnerships, and conducting related research.

#### *IRB Exemption*

Ethical and Independent Review Services determined that our study qualified for exemption in accordance with category 45 CFR 46.101 (b)(1): Research conducted in established or commonly accepted educational settings, involving normal educational practices. We submitted annual updates to the review board for the duration of the project.

## Front-End Evaluation

Visualizing Change aimed to equip interpreters with Strategic Framing tools and training to improve communication with the public about climate and ocean change. To inform project development, NewKnowledge reviewed the literature to provide an overview of recent studies about how the public understands climate change and strategies for increasing learning and behavior change among ISEI visitors. We also attended the 2014 Science on a Sphere Network conference and deployed a survey to the SOS network to understand how educators use spherical displays and how they might use new visual narratives. Finally, we conducted a national survey to measure the public's understanding of climate change issues and their relationships with ISEIs.

### METHODS

#### Literature Review

NewKnowledge conducted a literature review to provide project leadership with guidance on narrative tool development, including insight into how members of the public choose to engage with climate change content and potential challenges during project implementation. The Context Briefing Report summarized findings, explored different perspectives on how the public relates to climate change topics, public engagement with scientific content in ISEIs, including recent findings on intergenerational learning, theories of behavioral change, and meaning-making. We relied primarily on material published in the previous five years, but included older resources when particularly relevant.

#### Science on a Sphere: Conference and Survey

Two NewKnowledge researchers attended the 2014 SOS Network Conference in Spring 2014. The conference drew 95 people from 55 US institutions ranging from regional museums to large universities. Researchers conducted 30 informal interviews with attendees to understand how their institution uses or plans to use the Sphere. We analyzed the data using a grounded theory approach (Strauss & Corbin, 1994; Glaser & Strauss, 2009) to identify priority topics for a professional network survey.

In August 2014, we emailed a survey (Appendix A) to the 164 members of the SOS network to understand their use of data visualization tools at and their interest in using the visual

narratives. We received responses from 54 interpreters and educators from 29 institutions.

#### First All-Team Meeting

The members of the Visualizing Change leadership team met in March 2014 at the National Aquarium. Two NewKnowledge researchers attended to meet the project team, describe the evaluation activities, and observe and participate in planning discussions.

During this two-day workshop, the leadership team discussed the content of the Context Briefing Report and began to outline the visual narratives using Strategic Framing approaches to encourage solution-focused conversations around climate change impacts. The team drew on four bodies of theory to guide the development process: communication research and methodology, audience knowledge and attitudes, ocean science content, and data visualization. The workshop agenda reflected an iterative process of creation and refinement as the visual narratives were storyboarded, revised, and reimaged (Figure 1).

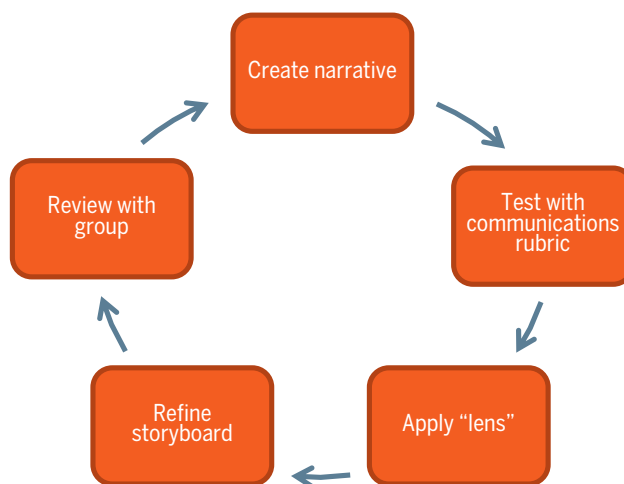


Figure 1. Diagram of the collaborative approach used to structure visual narrative development.

By the end of the meeting, the group had four testable story ideas with an accompanying script and visuals. Each institution was

responsible for the continued development, staff training, and preliminary testing of one story (Table 1) and the team established a timeline to ensure that all activities were completed in a timely manner.

Table 1. Visual narrative assignments.

Site(s)	Topic
Aquarium of the Pacific	Extreme Weather
National Aquarium	Sea Level Rise
New England Aquarium / Ocean Explorium	Primary Productivity / Ocean-Climate Connection*
Seattle Aquarium / Exploratorium	Ocean Acidification

Note. \*After an initial round of development and testing, project leadership decided to change the primary productivity topic to focus instead on the ocean's role in the climate system.

### ISEI Visitor Survey

In summer 2014, NewKnowledge designed and deployed a national survey (Appendix B) to ISEI visitors to understand their relationship with ISEIs and their emotional reaction to and understanding of climate change topics. The survey results would inform the development of the visual narratives by identifying documented gaps in knowledge or barriers to understanding. The survey included 29 close-ended questions in six modules: 1) experiences at ISEIs, 2) feelings about climate change, 3) knowledge of the four prioritized climate change topics, 4) connections with oceans, 5) perceptions of ocean issues, and 6) demographic information. NewKnowledge worked with the leadership team during survey design.

NewKnowledge deployed the survey to a panel of adults purchased through Soapbox, an online panel provider. All 1,023 respondents were required to live in the US and have visited at least one ISEI in the last year. To analyze the data, we calculated summary statistics in Excel and conducted chi-square and correlation tests in RStudio (2012).

## RESULTS

### Literature on Climate Change Communication at ISEIs

The Context Briefing Report is divided into five sections, each related to a theme affecting climate change communication at ISEIs. Each section opened with a summary of findings followed by an annotated bibliography.

Studying literature on **Visitor Concerns about Climate Change Topics**, we reviewed public perceptions related to six topics prioritized by the leadership team: 1) sea level rise, 2) glacier/sea ice change, 3) ocean acidification, 4) migration patterns and changes, 5) impact of drought/rainfall, and 6) extreme weather events. Many members of the public consider these topics to be challenging and disconnected from their personal experiences.

**Public Perception of Delivery Mechanisms at ISEIs** examined how the public views ISEIs, interpreter credibility, and the value of specific delivery mechanisms (e.g., SOS). Studies indicate that the public considers ISEI interpreters to be reliable and trustworthy and learning context plays an important role in the level and types of content knowledge visitors take away from an ISEI experience. Different settings and presentation formats likely affect learning and studying these differences will help developers to maximize learning in a specific context.

We examined literature on **Intergenerational Learning** to review current psychological and sociological research about the efficacy of different types of messaging in exhibits and programs at ISEIs. These studies demonstrate a need for ISEIs to create anchors for content that help visitors connect interpretive content to their own sense of place and relevance. Developing interpretive strategies that meet this need for different audiences shows more promise for increasing intergenerational learning than does targeting exhibit content at a specific age group or knowledge set.

Considering studies on **Behavior Change through ISEI Interpretive Experiences**, we reviewed how ISEI visits can serve as part of life-course learning, fostering discussion about expectations for visitors to take action after returning home. Taking this concept further, presentations should be used as only one step along the path to behavior change, not a change instigator in isolation.

We reviewed **Big Picture Synergy and Meaning-Making** to describe the challenges learners might face in connecting and situating their ISEI experience in their lives. This research considered how experiences and strategies might complement and reinforce other change efforts that visitors might have already encountered and recognized the importance of process and social interaction as central to achieving effective learning. Ultimately, synthesis and meaning-making should be situated within the learner's entry narrative, not compared to a national baseline.

Our findings from this literature review reinforced a Strategic Framing approach to communication. This approach combines

Careful empirical research about what people value, believe, and understand with tested communication strategies that help translate complex science in a way that allows people to examine evidence, make informed inferences, and embrace science-based solutions. This non-persuasive communication strategy (Fischhoff, 2007) prioritizes explanations of causes and consequences rather than advocating particular policies or actions and is consistent with NOAA's emphasis on helping the public to become better-informed environmental decision makers. For more details about the resources and results, please see the Context Briefing Report (NewKnowledge Publication #NOAA.52.127.01).

### ISEI Educator Needs and Interests

Interviews during the Spring 2014 SOS network meeting and our post-meeting survey provided insight into the many ways that members of the network used the SOS technology and how they might use the visual narratives produced through Visualizing Change. SOS network members represented a broad range of institutions with an equally broad range of facilities and resources. Institution types included science centers, science museums, aquariums, and planetariums, as well as universities and research institutions. Not surprisingly, most of the 54 survey respondents used SOS at their institution, but flat-screen projection systems were also common (Figure 2). Other technologies included Magic Planet, plasma screens, computer screens, iPads, and digital domes.

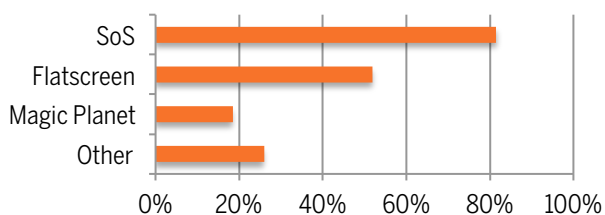


Figure 2. Percentage of survey respondents using each type of projection technology.

Institutions most commonly housed the SOS or other projection technology in a separate room or building (44%), which provided a controlled environment to interact with visitors (Figure 3). Others housed the tools in a room with many exhibits (24%) or a space with one or two exhibits nearby (13%). Many of these respondents discussed using the tools to supplement educational programs in

those spaces, but were concerned that the noise in busy environments reduced audience recruitment and engagement.

Respondents described benefits of visualization technologies, especially the ability to give visitors access to scientific data sets and content. They reported that visitors spent longer in exhibit areas featuring visualization technologies, visual representations of global data helped to present information that was *otherwise difficult to interpret*, and the *wow factor* of visualizations helped get visitors excited about topics that they may have found boring in other contexts.



Figure 3. Science on a Sphere theater at Aquarium of the Pacific.

More than half of survey respondents noted that they used the auto-run format to present their visualizations and data sets. They attributed this decision to a lack of time and resources to train interpreters to lead facilitated presentations. One drawback of the auto-run format is that it is more difficult to develop critical entry and engagement points because content is harder to customize. During facilitated presentations, some respondents reported making modifications to script content, such as relating content to exhibits at their institution or to places where audience members were from. Many felt that customization was important to engage audiences, but acknowledged that they did not always have time to make those adjustments. These respondents were interested in

visual narratives that were flexible, but did not require modification to be used effectively.

Network members expressed a strong desire to use visual narratives about climate and ocean change topics; this idea was particularly popular among respondents with a SOS display. Reactions from institutions with other projection technologies was more mixed, which may be because of past difficulties with adapting SOS visualizations to other display formats, and points to the need for the visualizations to be adaptable and diverse. For more detailed findings from the SOS interviews and survey, please see the Science on a Sphere: Conference and Survey Findings Report (NewKnowledge Publication #NOAA.52.127.02).

### ISEI Visitor Perspectives on Climate Change

Our survey of ISEI visitors indicated that many visited ISEIs regularly: more than 40% of respondents reported that they visited ISEIs a few times a year. Zoos and aquariums were the most frequently visited ISEI types (Table 2).

Table 2. Respondents who visited ISEIs in the last 12 months.

Type of ISEI	<i>n</i>	%
Zoo	604	59.0%
Aquarium	578	56.5%
National Park	552	54.0%
Science Center	504	49.2%
Nature Center	439	42.9%

Note. *N* = 1,023; Respondents could select multiple ISEIs.

### Concern about Climate Change Topics

Visitors were asked to rate their concern for ocean acidification, sea level rise, extreme weather, and global climate change. A decision was made not to ask visitors about concern for the fourth target visual narrative topic, since the phrase *ocean-climate connection* does not indicate a specific phenomenon that visitors could be expected to know. We included a question on *global climate change*, as the overarching category linking together all target visual narrative topics.

Most respondents were concerned or very concerned about climate change issues (Figure 4). Global climate change most frequently resulted in a *Very Concerned* response. While climate scientists understand the four target visual narrative topics as interrelated, one reason for the higher concern may be name

recognition of the term *climate change*. The percentage of participants that selected *Nonbeliever* (5%) was also higher for global climate change than for other three issues, possibly reflecting the politicization of the issue. In addition to the scale responses, respondents could also indicate that they did not understand the meaning of the term. About 4% of respondents indicated that they did not understand the meaning of ocean acidification, supporting our hypothesis that people are less familiar with this topic than others.

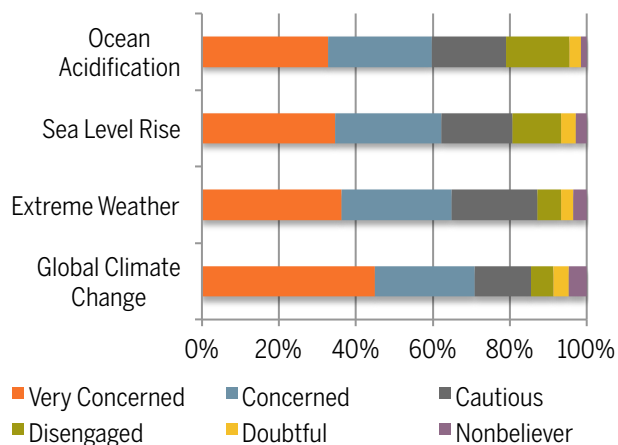


Figure 4. Percentage of respondents indicating various levels of concern about each topic.

### Content Knowledge

There was large variation in the proportion of accurate responses to the knowledge questions about the target visual narrative topics – ocean acidification, extreme weather, ocean-climate connection, and sea level rise. There was particularly large variation in the respondents' success on the ocean acidification questions, with 19-60% selecting the correct answer for each of the four questions. Respondents scored poorly on the questions about the causes and consequences of ocean acidification, exhibiting general confusion about ocean chemistry. Consistent with this confusion, more respondents selected *I don't know* for the ocean acidification content questions (21-29%) than for the other three topics, indicating relatively high unfamiliarity with the term or topic.

About one third (34%) of participants noted that they had been exposed to at least one type of educational experience (e.g., exhibit, presentation, conversation) about ocean acidification during a trip to an ISEI. Respondents who were exposed to some

ocean acidification interpretation performed significantly better on one knowledge question (rising carbon dioxide levels:  $\chi^2 = 12.01$ ,  $df = 1$ ,  $p = .005$ ,  $n = 1,022$ ; Figure 5), suggesting that they may have gained some foundational knowledge from the interpretation. However, respondents who were exposed to some interpretation performed significantly worse on another content question (ocean chemistry and temperature:  $\chi^2 = 5.90$ ,  $df = 1$ ,  $p = .015$ ,  $n = 1025$ ; Figure 5), which may have been related to question complexity. Importantly, less than 50% of respondents got either of these questions correct, emphasizing that members of the public still lack a deep understanding of the causes of ocean acidification.

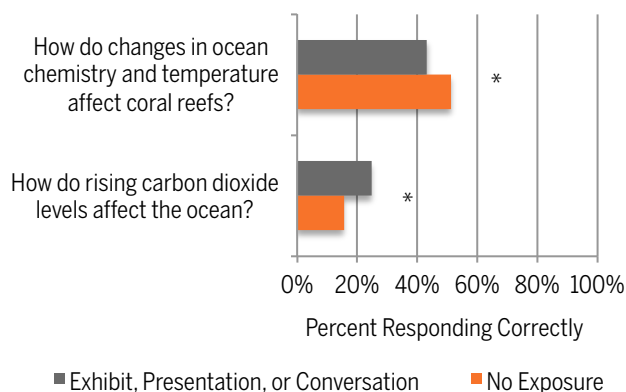


Figure 5. Relationship between previous ISEI exposure to information on ocean acidification and performance on two knowledge questions.

Note. \* indicates a significant difference at  $p < .05$ .

Respondents performed best on the extreme weather knowledge questions, with 67-75% selecting the correct answer for each of the four questions and less than 10% selecting *I don't know*. These results suggest that respondents understand the difference between weather and climate, as also documented in previous FrameWorks research (Volmert, Baran, Kendall-Taylor, et al., 2013) and as well as temperature and humidity.

Respondents were somewhat successful on the ocean-climate connection questions, with 52% responding correctly to questions about how the ocean affects climate change. This question drew on the content from FrameWorks' Climate's Heart metaphor, which focuses on how the ocean controls the circulation of heat and humidity (Volmert, 2014). Additionally, 62% responded correctly to the question about the ocean's role in the climate system.

Both questions about sea level rise focused on identifying causes; 51% correctly associated rising sea levels with rising CO<sub>2</sub> levels, but only 40% associated them with glacial coverage and thermal expansion. The relatively low proportion of correct responses for the latter question was surprising in light of the public's adherence to the Melting Ice conceptive model, in which people attribute rising sea levels to melting polar ice caps (Volmert, Baran, Kendall-Taylor, et al., 2013). The difference in correct responses to the two questions suggests that some respondents understand the determinant (rising CO<sub>2</sub>) and outcome (rising sea levels) without necessarily understanding the intermediate steps (reduced glacial coverage and thermal expansion).

We used two-tailed Pearson's correlation analyses to examine the relationships among measures of respondent behavior, attitudes, and knowledge about climate and ocean change topics. Most notably, individuals who expressed concern about climate and ocean issues tended to score better on topic-specific knowledge questions about extreme weather ( $r = -.267$ ), ocean acidification ( $r = -.290$ ), and sea level rise ( $r = -.388$ ) than those who were not as concerned. The correlation between level of concern and performance on the questions about the ocean-climate connection was much weaker ( $r = -.082$ ), though still in the predicted direction, indicating that those who were more concerned about environmental issues scored higher on the questions.

### Perspectives on Climate Change Issues and Solutions

Respondents rated their agreement with a set of statements about how they think about ocean and climate change. Fortunately for educators, most respondents did not feel like ocean issues were inaccessible (Figure 6). Additionally, most did not think that environmental problems, including changing oceans, were too depressing to talk about, which suggests that respondents were not yet overwhelmed by these topics. These findings are consistent with FrameWorks' previous finding that the public would like access to more information about climate change (Bales, 2009).



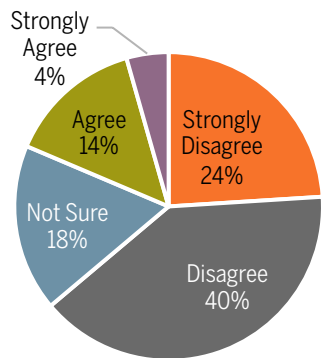


Figure 6. Responses to the statement *changes in the ocean [are] too complicated for me to think about.*

While most respondents acknowledged that their daily activities affect the ocean, 35% agreed with the statement that *the oceans are big enough to handle some change without affecting my life.* These responses indicate that not everyone viewed their relationship with the ocean as bidirectional: while these people perceived they affect the ocean, the ocean does not necessarily affect them. The latter result supports earlier research by FrameWorks that found that some US residents draw on the cultural model that the ocean is too big to be harmed (Volvmet, Baran, Kendall-Taylor, et al., 2013).

Respondents felt that the best ways to protect the ocean were individual and collective action (Figure 7). Respondents felt that government action was not an exclusive solution, with only 31% agreeing with this statement: *the only way to solve changes in the ocean is through government policy.* Rather, they believed industrial organizations must take the initiative to change their behavior before ocean and climate change issues can be ameliorated.

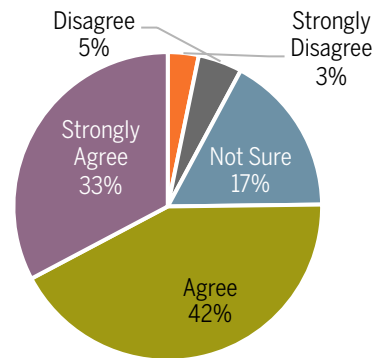


Figure 7. Responses to the statement, *if everyone acted together, we could solve the problems the ocean is facing.*

For more on the findings from the ISEI visitor survey, please see ISEI National Survey Report (NewKnowledge Publication #NOAA.52.127.04).

#### KEY TAKEAWAYS

- Findings from the literature review reinforced a Strategic Framing approach to communication, which prioritizes: (1) building on research about people's values, beliefs, and understandings of complex topics, and (2) designing and testing communication strategies that help translate science in a way that supports people as they examine evidence, make inferences, and consider science-based solutions.
- ISEI visitors did not have detailed knowledge of climate and ocean change science, and had a particularly limited understanding of ocean acidification, one of the prioritized topics for the visual narratives. Furthermore, they were confused about potential solutions and wanted concrete actions that are approachable and easy for them to adopt.
- ISEI visitors viewed climate change science as challenging, but not unapproachable or too depressing to discuss. They also viewed ISEI interpreters as trustworthy, making them critical communicators of this content.
- Interpreters wanted new and engaging ways to communicate about climate change and there is room to expand on what is currently being presented at ISEIs.
- Interpreters are focused on strategies for holding audience attention. Prioritizing the inclusion of place-based anchors and

ties that are relevant to the audience (e.g., something happening locally), especially an intergenerational audience, are helpful for increasing visitor interest and engagement.

- Staff time for training is limited, so providing strategies for making this process as efficient as possible is critical. For example, creating a single set of resources that includes options for exploring at different depths may increase the adoption and effective use of visual narratives by a range of institutions.
- The project leadership team was particularly committed to evaluation and developing a realistic timeline that allowed for collaboration and iterative design in the front-end phase.

## **RECOMMENDATIONS & RESOLUTIONS**

- The leadership team was receptive to the Context Briefing Report and paid attention to the work that had already been done to best build on it.
- The leadership team learned the importance of designing narratives and their anticipated solutions as part of visitors' behavioral change continuum, rather than an isolated action.
- The leadership team understood the need to develop communication tools that are accessible to intergenerational groups, rather than targeting only children or subsets of adults. The team designed the visual narratives and evaluation instruments to address this need.
- The leadership team understood visitors are concerned about climate change, but climate change and related topics seem distant to their experiences. As a result, they prioritized providing multiple entry points and making personal connections more tangible. A small percentage of ISEI visitors identified as non-believers of climate change. In line with the goals of the project, the leadership team did not prioritize this small minority.
- The leadership team learned about the importance of making the visual narratives flexible so that they could be customized to a particular location or audience to optimize audience engagement. They also considered the role of optional customization because ISEI educators do not always have adequate training time to make adapt narratives.

## Formative Evaluation

Following the first leadership meeting, primary partner sites continued to develop the visual narrative for their assigned topic. Each visual narrative was initially designed for the platform (i.e., SOS, Magic Planet, flatscreen) at the host institution and was later modified to ensure it could be used on all platforms. Sites collaborated closely with NOAA to identify and format visuals and datasets for each presentation (Figure 8). They worked with FrameWorks to write the scripts to accompany the visuals, ensuring that the scripts included Strategic Framing language, values, metaphors, and solutions that helped the public understand climate change and know how to address it at the community level. Sites conducted their own preliminary testing with visitors, presenting the visual narratives, collecting feedback, and using it to refine the scripts and visuals.



Figure 8. Anthropocene transportation image depicting global movement patterns used in several visual narratives.

During the formative phase, NewKnowledge conducted two rounds of onsite testing, one in summer 2014 and the other in summer 2015, to watch trained interpreters at primary partner sites present the visual narratives and gather visitor and interpreter feedback. These observations and discussions allowed us to develop recommendations to improve the interpreter training process and increase visitor engagement and learning.

By the end of the formative phase, each site had produced a set of visuals suitable for use on a SOS, Magic Planet, or flatscreen. In collaboration with FrameWorks, the teams finalized three scripts to accompany the visuals: 1) the *complete script* included visuals and notes to explain the logic behind the script, 2) the *plain script*

omitted the annotations, and 3) the *short script* abbreviated the presentation while maintaining the essential points. FrameWorks compiled background information in a *framing brief* that explained the research grounding each part of the visual narrative, including wording, sequence, and image choices and a *science summary*, which pointed interpreters to additional resources to learn more about the topic. Project leadership compiled the resources for all four visual narrative topics into the Visualizing Change toolkit for easy distribution (Figure 9).

<b>Extreme Weather</b> What's the connection between fossil fuels and more frequent and severe storms?	<b>Ocean Acidification</b> How is the chemistry of the ocean changing, and how this affect us all?
<b>Sea Level Rise</b> What is causing the level of the sea to rise? What the potential consequences – and what can we do to reduce its impact?	<b>Ocean-Climate Connection</b> How does the ocean regulate the climate, and how is a changing climate affecting it?

Figure 9. Image from the Visualizing Change toolkit that introduces the four visual narrative topics.

### METHODS

#### Onsite Pilot Testing

NewKnowledge researchers visited all six primary sites in summer 2014 and four in summer 2015 (Seattle Aquarium, Aquarium of the Pacific, New England Aquarium, and National Aquarium). During these visits, researchers observed presentations of the visual narratives, talked to interpreters to understand their experiences, and asked visitors for feedback. During our first round of site visits, visual narratives were still under development and interpreters at each site presented the visual narrative that their site was building. One year later, during our second round of visits, visual narratives had been refined. During the second round, interpreters presented as many of the four visual narratives as was possible at that time.

During observations, we recorded the visual narrative being presented, audience size, and estimated age distribution. After select presentations, we interviewed visitors to understand what they learned, points of confusion, and to determine if and to what

extent they planned to take action following the presentation. We also conducted reflection sessions with interpreters to understand their experience preparing for and delivering the visual narratives, as well as their perceptions of audience reaction and suggestions for training future interpreters.



Figure 10. Round 1 testing of a visual narrative at New England Aquarium.

We developed a qualitative coding scheme to identify emergent themes in the site visit data, including positive outcomes, areas of confusion, and barriers to engagement. With data collection occurring at different stages in the development of the visual narratives, we focused on themes that would be most useful to the project team at these points in time. Specifically, the visuals and scripts were still in development during the first round of site visits, so our analysis and recommendations focused on modifications to the visuals and script to increase visitor engagement and learning. In the second round of site visits, the visual narratives were nearing their final versions, so we focused on how to make the presentations most effective in a variety of contexts and how to best support interpreters during training.

### Second All-Team Meeting

In February 2015, in between the two rounds of site visits, the Visualizing Change leadership team met at Aquarium of the Pacific. This two-day workshop offered the team an opportunity to review research and evaluation findings with FrameWorks and NewKnowledge, discuss ongoing development of the visual

narratives, identify resources needed to accompany the narratives, discuss future testing, and develop a plan to train interpreters at other sites and disseminate the visual narratives.



Figure 11. Reviewing recommendations from FrameWorks and NewKnowledge at the second all-team meeting.

In addition to annual in-person meetings, project leadership convened monthly calls for staff at all Visualizing Change partner institutions to discuss project activities and provide updates, including evaluation results and recommendations.

## RESULTS

The two rounds of site visits offered critical insights into interpreters' experiences learning the visual narratives and audience perceptions of the images and scripts, giving researchers the opportunity to make suggestions for improvement.

The interpreter training process progressed at all institutions during and after both rounds of site visits. Interpreters were supportive of one another during the training and practice presentations, offering feedback, encouragement, and interaction as additional audience members. They also offered general support in evaluation and training practices. Interpreters reported that the training materials provided helpful context on the science and background of the narratives, and increased their confidence and buy-in as educators.

During both rounds of site visits, many interpreters felt that the scripts were too long, which made them difficult to memorize and meant that many visitors left in the middle of the talk. Interpreters were enthusiastic about the idea of developing shorter scripts to increase interpreter confidence and better retain audience attention until the critical solutions portion of the presentation.

Interpreters also expressed willingness to expand these shorter narratives by incorporating additional information or questions into the presentation when they see an opportunity to do so. They felt that this additive style was easier than reducing a long script and possibly omitting critical language. Based on this feedback, the leadership team made script modifications after the Round 2 site visits.



Figure 12. Facebook connections image used in multiple visual narratives.

Although interpreters were sometimes hesitant to adapt the scripts, they made slight, smooth adjustments to ensure that the presentations were accessible for intergenerational audiences. They incorporated questions to check for understanding and provided examples that resonated with personal experiences. During the first site visits, some children still had difficulty with certain tasks (e.g., identifying continents) and we recommended that interpreters take a moment to explain the imagery using age-appropriate language when young children are present. We observed that they did so during the second round of site visits, spending more time on images that were unfamiliar. These types of modifications may have been made in response to our recommendations, but may also indicate that the interpreters were more comfortable with the presentation content by the second round of site visits, enabling them to modify them as needed.

During the first round of site visits, visitors enjoyed the visual narratives, but reported feeling that the visuals and the script were not well synced or that the visuals were confusing or did not adequately convey the message. For example, some visitors had challenges locating themselves on the map images and we recommended that adding clear labels or interpreter guidance may provide a stronger sense of place. Visitor reactions were more positive during the second round of testing. Many visitors reported that the connection between the images and the story helped them

to better understand the science content. They were particularly interested in the images of global transportation routes and Facebook connections (Figure 12), which illustrated the web of interaction and responsibility.

During the first site visits, audiences did not always respond well to visuals regarding suggested solutions, such as using a hybrid car, which people said they could not afford. They had difficulty relating government-oriented solutions, and photos of alternative energy sources (e.g., wind turbines) that did not directly correlate to any feasible or specific action. In response, the leadership team expanded and clarified the solutions sections, incorporating actions to resonate with diverse audiences, such as additional public transportation imagery (Figure 13).



Figure 13. Slide depicting some accessible actions people can take to combat climate change.

Also during the first round of site visits, audience members reported wanting more engagement and interaction during some presentations. Messages appeared to resonate more strongly with audiences when interpreters connected the content to the local environment or community. This observation highlighted the benefits of a facilitated (versus auto-run) presentation, which would allow interpreters at any ISEI to adapt the narrative to their location. Some visual narratives already included these connections. For example, the Ocean Acidification narrative



featured a short video of solar panels being installed on the roof of the Seattle Aquarium (Figure 14).



Figure 14. Screenshot of video from Ocean Acidification visual narrative showing the solar panels being installed on the roof of the Seattle Aquarium.

For more details on the findings from the site visits, please see the Onsite Pilot Test Report (NewKnowledge Publication #NOAA.52.127.03) and the Formative Site Visits, Round 2 Report (NewKnowledge Report #NOAA.52.127.05).

## KEY TAKEAWAYS

- Site visits showed that interpreters at partner sites were being trained and becoming comfortable with the visual narratives. Even early on they showed a strong ability to make appropriate adaptations for their context to increase audience engagement and understanding, without sacrificing content goals.
- The leadership team engaged in an iterative and collaborative development process during the formative evaluation phase that included all-team discussions, modification, testing, and incorporation of recommendations. They were highly responsive to visitor feedback on the strength and appropriateness of the images. They were in frequent contact throughout the project through leadership calls and Basecamp posts, which facilitated these modifications.
- Site visits, particularly in Round 2, suggested that visual narratives were effective. Visitors gained greater understanding of the content in all narratives, as well as an appreciation for the approach combining facilitated interpretation with visual imagery and in some cases novel technology.

## RECOMMENDATIONS & RESOLUTIONS

- NewKnowledge offered detailed feedback to the leadership team in reports and debriefs about each narrative to increase visitor learning. The team incorporated the recommendations into the final versions of the narratives.
- The front-end and formative phases indicated the importance of developing multiple versions of the narrative scripts. The leadership team collaborated with FrameWorks to accomplish this work, making a shorter version of the narratives that retain the critical elements of Strategic Framing, and longer versions that can be used for advanced audiences or when more time is available.
- Again based on findings from the front-end and formative evaluation, the leadership team made all narratives available on multiple platforms so people at a range of institutions and presentation contexts with different types of technology could use them.



## Summative Evaluation

The summative phase focused on tracking the dissemination of the visual narratives through several avenues, including: training sessions to teach interpreters at other institutions how to use the toolkit, conference and workshop presentations, and efforts to make the toolkit publicly available. We aimed to measure the scale and reach of the project through the distribution and adoption of the visual narratives and toolkit resources and its overall impact, including changes in interpreter and visitor understanding of climate change topics.

### METHODS

#### Interpreter Training Sessions

In spring and summer 2016, primary partner sites conducted one or more daylong training sessions to teach colleagues from other institutions how to use the visual narratives (Appendix C). There were seven in-person trainings and one two-part online training (Table 3).

NewKnowledge developed and distributed two surveys to understand trainee experiences. The immediate post survey (Appendix D) assessed trainees' content knowledge, communication skills, comfort with the visual narrative toolkit, and training background. The content knowledge and communication

skills questions were set up in retrospective pre/post format, prompting respondents to reflect on their knowledge or skill level before and after the training. Trainers distributed the survey to trainees at the end of each session. When data were collected on paper, the trainers entered the survey data into NewKnowledge's online data collection platform for consolidation. We received responses from 137 trainees distributed across the 8 training sessions.

The trainers emailed the delayed-post survey (Appendix E) to trainees in August 2016 to gather data on how the trainees used the visual narratives after returning to their home institutions, the strengths of the narratives in adaptation, and the challenges they faced. Only trainees who attended one of the first six training sessions received the survey to ensure that they had enough time to implement the visual narratives before reflection. NewKnowledge received 32 trainee responses from five training sessions.

For both surveys, a researcher calculated summary statistics and conducted t-tests for closed-ended questions and reviewed open-ended questions for themes.

To provide additional insight into the training sessions and subsequent activities, NewKnowledge asked the trainers to share noteworthy follow-up exchanges between trainers and trainees (e.g., descriptions of how the visual narratives were being used). A

Table 4. 2016 Trainings, attendance, and institutions represented.

Trainer	Location	Date	Number of Participants	Number of Institutions
Seattle Aquarium	Seattle Aquarium, Seattle, WA	March 10	24	15
Aquarium of the Pacific	Exploratorium, San Francisco, CA	April 8	15	9
National Aquarium	National Aquarium, Baltimore, MD	April 14	29	17
Buttonwood Park Zoo	Buttonwood Park Zoo, New Bedford, MA	April 28	19	17
Aquarium of the Pacific	Aquarium of the Pacific, Long Beach, CA	May 6	16	12
New England Aquarium / Buttonwood Park Zoo	Online	Part 1: April 21 Part 2: May 12	14	8
National Aquarium	Flower Garden Banks National Marine Sanctuary Galveston, TX	August 9	20	5
Seattle Aquarium	Northwest Aquatic and Marine Educators Conference, British Columbia	August 13	19	5
<b>Total</b>			<b>156</b>	<b>88</b>

NewKnowledge researcher also interviewed Mike Foody, the CEO of Global Imagination, manufacturer of Magic Planet. Mr. Foody attended five of the in-person training sessions and offered valuable insight into the training process. The researcher audio recorded the interview with Mr. Foody and used the data to supplement the survey data.

### Visitor Survey at Trainee Sites

NewKnowledge developed a survey instrument to assess visitor reactions to the visual narratives at the trainee sites (Appendix F). The trainers asked trainees to collect surveys from a minimum of 20 visitors who viewed a visual narrative at their home institutions and enter the data online. The trainers followed up with trainees monthly to remind them to collect and submit their data.

We received responses from 138 visitors. However, they were drawn from only 5 of the 88 trainee institutions: a university environmental studies department ( $n = 77$ ), an environmental center ( $n = 24$ ), a natural history museum ( $n = 21$ ), and two zoos or aquariums ( $n = 7$ ). Nine respondents did not list the institution. A researcher calculated summary statistics for all quantitative questions and reviewed responses to open-ended questions to identify themes.

### Other Dissemination Efforts

Shorter versions of the daylong training sessions occurred through the lifespan of Visualizing Change through presentations at conferences and other events. Members of the leadership team shared resources, such as conference posters through both Dropbox and Basecamp. Project leadership kept track of dissemination efforts, and used monthly calls to discuss strategy and debrief following events.

After each dissemination event, the NewKnowledge team asked the presenter to provide information on the location, visual narrative presented, displays used, attendance, and interactions or conversations following the presentation. These data allowed us to estimate the number of people exposed to the tools and analyze the reactions received.

## RESULTS

### Interpreter Training

Training announcements were met with enthusiasm, with several of the sessions reaching capacity and turning down potential

attendees. Each training session had a unique composition of participants, including staff members from a wide range of ISEIs, as well as educators working in formal K-12 or higher education settings.

The trainings were planned and facilitated by different institutions, but the leadership team ensured the overall structure of the trainings was similar across sites. For example, each included presentations about Strategic Framing, exposure to the visual narratives, and time to discuss implementation in pairs or small groups. Training sessions did differ in several ways, including display technology used, visual narratives used (trainers used the narrative that their institution developed plus one or more others), and whether or not attendees had materials to review before the session. Some sites emphasized the theoretical framework used to develop and test the visual narratives during the training sessions, while others highlighted the practicalities of using the narratives.

Some training sessions included background information on the four visual narrative topics to help make trainees comfortable with the content before the trainers introduced the visual narratives. Most trainees stated that they were familiar with the content before the training session, but they also reported significant increases in their familiarity with all four topics after attending the training (Figure 15; ocean acidification:  $t = -4.83$ ,  $df = 222$ ,  $p < .001$ ; sea level rise:  $t = -3.72$ ,  $df = 244$ ,  $p < .001$ ; extreme weather:  $t = -4.58$ ,  $df = 255$ ,  $p < .001$ ; ocean in climate:  $t = -3.71$ ,  $df = 232$ ,  $p < .001$ ;  $n = 131-136$ , depending on the item).

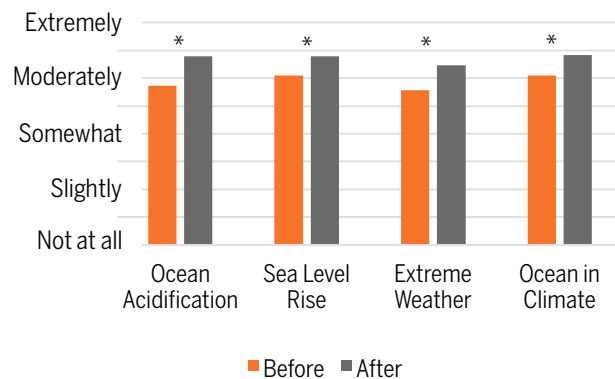


Figure 15. Self-reported familiarity with topics before and after training.

Note. \* indicates a significant difference between before and after responses at  $p < .05$ .

All visual narratives and scripts outlined the importance of the Strategic Framing approach and language specificity during the training sessions. Most respondents were unfamiliar with Strategic Framing on arrival at the training and their self-reported comfort increased dramatically as a result of participating ( $t = -13.11, df = 217, p < .001$ ). Not surprisingly, they also felt that the training helped them to improve their skills using specific Strategic Framing tools (Figure 16; values:  $t = -10.09, df = 228, p < .001$ ; explanatory chains:  $t = -10.59, df = 223, p < .001$ ; metaphors:  $t = -10.60, df = 210, p < .001$ ; solutions:  $t = -9.84, df = 224, p < .001$ ;  $n = 133-136$ , depending on the item). Responses to the delayed-post several months after training indicated that this confidence was sustained over time.

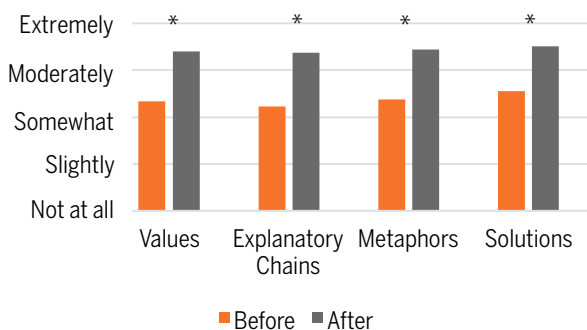


Figure 16. Self-reported confidence using Strategic Framing tools.

Note. \* indicates a significant difference between before and after responses at  $p < .05$ .

Immediately following the training in the visual narratives and Strategic Framing, trainees were offered opportunities to practice using the visual narratives in small groups. Participants reported increased confidence in communicating about different aspects of climate change (Figure 17; excess CO<sub>2</sub>:  $t = -7.00, df = 227, p < .001$ ; ocean acidification:  $t = -7.90, df = 229, p < .001$ ; climate:  $t = -6.54, df = 252, p < .001$ ;  $n = 131-136$ , depending on the item).

All trainees received a USB drive containing the toolkit resources to take home. The toolkit resources changed slightly over the training sessions as the leadership team made final updates. Limited time meant that the trainers did not go through the toolkit resources in depth. Trainees reported that they were excited to *dive in deeper* and appreciated having the electronic version of the toolkit so they could do so on their own schedule.

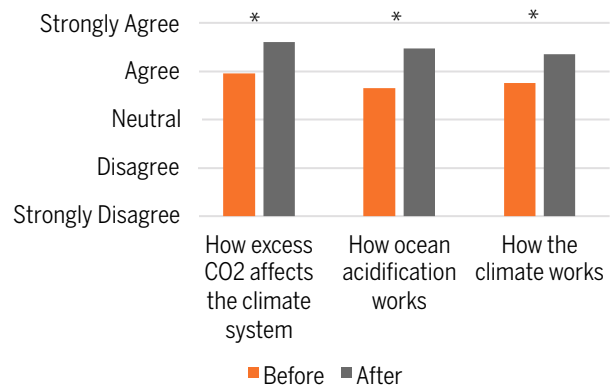


Figure 17. Self-reported confidence explaining various aspects of climate change to the public.

Note. \* indicates a significant difference between before and after responses at  $p < .05$ .

At the end of training sessions, trainers led exercises to help trainees envision how to use the narratives at their home institutions. These activities ranged from sharing a hope with the group to filling out an *Action Plan* worksheet with prompts like, *Are there stakeholders who can help you implement Visualizing Change narratives at your institution?* and *Identify one outcome you hope to achieve by using Visualizing Change narratives*. This planning helped jumpstart the process of identifying opportunities and barriers to using the visual narratives. Eighty-six percent of trainees planned to use the toolkit at their home institutions. About 23% indicated that they would need more support to understand how to use the toolkit, which suggests that follow-up may be a useful opportunity for all participants.

Both trainer reports and survey results indicated that attendees felt that the training sessions were informative and useful. Trainees believed the training provided critical strategies for starting the conversation with visitors, insight into visitor perspectives, and evidence-based language and scripts. Trainee responses to the delayed-post survey indicated high confidence in their abilities to communicate about climate change topics with the public in the months following the training. Several of the respondents offered specific illustrations about how that the training session increased their comfort with communicating about the topics. Almost all (97%) of attendees agreed that the training sessions were effective at teaching them how to use the visual narratives.

There was little negative feedback about the training sessions. Nearly all training sessions were limited to one day to ensure that the time commitment did not prohibit interpreters from attending. Although limited by the short time frame, trainees thought the sessions were well-planned. Almost all trainees agreed that there was enough time for presentations (97%) and discussion with colleagues (94%). Several trainees felt it would have been helpful to have more practice with the visual narratives and wanted to receive more feedback. Despite that challenge, most attendees were eager to put the new material into practice when they returned home.

Reflecting on their aspirations for their new skills, trainees aimed to *create a population that sees themselves as agents of change*. Some described specific ideas for how they would use the toolkit at their home institutions. Ideas ranged in specificity, with some considering the ease of implementation, gaining institutional buy-in required to successfully leverage the visual narratives, and plans for timelines that would work for individual and institutional constraints, showing that trainees were thinking broadly about opportunities to use the tools. Specific ideas included:

#### *Programming*

- *Integrate the narrative into our dive show and aquarium field trips;*
- *Incorporate climate change education into all of our public programs;*
- *Create [a] hands-on activity for a traveling exhibit; and*
- *Take the narrative framework and use it to...revisit our existing programs.*

#### *Technology*

- *Effectively use our spherical displays;*
- *[Use the] presentation on a static display;*
- *Move Science on a Sphere up the priority list; and*
- *Use our Magic Planet for more than a wow factor.*

#### *Interpreter Training*

- *Empower and strengthen staff and volunteers so we all feel comfortable and confident sharing such important and critical information;*
- *[Increase] student involvement in communicating climate science to the public;*

- *Allow more staff to have experience and tools to use the Science on a Sphere;*
- *Offer informal educator trainings that focus around a hopeful, solution-oriented conversation;*
- *Improve communication with leadership so they...are supportive of these trainings; and*
- *Understand the challenges informal educators face.*  
*Outreach*
- *Talk to family members about climate change;*
- *Use this framing for general communication (e.g., press releases, social media posts);*
- *Share this information on the <http://www.oacurriculumcollection.org/> website;*
- *Inspire teachers to work with their students to create local solutions within their communities and families;*
- *Collaborate with other institutions; and*
- *Include in presentations to partner local governments and community organizations.*

#### **Trainee Actions**

All training institutions followed up with the trainees after the sessions, reminding them about the resources and support available. Many trainees took the opportunity to thank the trainers for the session and commented on the usefulness of the toolkit. In some cases, trainees asked questions or shared ideas, or provided details on how they were working to accomplish their action plan goals. For example, some institutions had detailed plans for staff training sessions, incorporating the visuals into current programs, developing new exhibits on narrative topics, and making adaptations to tailor the narratives to specific audiences.

Some trainees responded to a delayed-post survey distributed three to five months after the training sessions and described their actions since the training. Of the 32 respondents, 21 (65%) indicated that they used at least one of the visual narratives at their home institution (Table 4), with several using more than one ( $M=1.57$ ,  $SD=1.12$ ,  $Max.=4$ ). This percentage may overestimate the true rate of uptake, since trainees may have been more likely to respond to the survey if they have taken some action since the training.

Of the 21 institutions responding to the survey, three had tried all four visual narratives at their institutions. For those who were more

selective, the Ocean-Climate Connection visual narrative was used most frequently and Sea Level Rise the least (Table 4). Users said that they prioritized the relevance of the topic to existing exhibition or program content and ease of learning for staff when making their selections.

Table 4. Number of respondents who have used the visual narratives at their institutions.

Visual Narrative	<i>n</i>
Ocean-Climate Connection	10
Ocean Acidification	9
Extreme Weather	8
Sea Level Rise	6

Notes. *N* = 21 respondents who used the visual narratives. Respondents could select multiple visual narratives.

Users were most likely to present using a SOS (*n* = 6) or flatscreen TV (*n* = 6). None of the respondents listed use of a Magic Planet. Responses indicated that those who did not use the standard platforms incorporated the material into an activity, printed out the maps, or used alternative tactile materials (e.g., CO<sub>2</sub> tank) to illustrate visual narrative concepts. Although many of the survey respondents stated that they were using the visual narratives, most also stated that they had plans to increase their use in the future. We surmise that this response indicated a growing comfort with the tools and techniques in the months following the training.

Eleven respondents (34%) had not used any of the visual narratives when they took the delayed-post survey. Several provided reasons, including: 1) technical problems with projection platforms, 2) a decision to apply the toolkit information to other presentations or platforms rather than using the visual narratives in their original form, 3) continued preparation for presenting the visual narratives, and 4) a lack of sufficient knowledge. Those who cited a lack of knowledge requested *content training in addition to the script review training* and *links to online webinar so more staff could be trained for use*.

Regarding staff training, on the immediate post survey, 95% of trainees planned to share the toolkit with colleagues. On the delayed-post survey, 15 out of 19 users reported that they had actually shared the visual narrative toolkit with colleagues, a drop from what they anticipated immediately after the training. Those who did share felt that their colleagues were able to use the resources effectively although they did not attend a training session. That result suggests that making the toolkit available

online may be an effective way to disseminate the content for adoption at other institutions.

Experiences using the narratives were positive. Most users confirmed that the scripts were easy to learn and the visualizations worked well on their platforms. Short scripts and science summaries were the most popular resources (Table 5).

Table 5. Number of respondents indicating toolkit resources used.

Resource	<i>n</i>
Short Scripts	8
Science Summaries	8
Complete Scripts	6
Plain Scripts	3

Notes. *N* = 21 respondents who used the visual narratives. Respondents could select multiple resources.

Visual narratives worked better in some contexts than others. Although the scripts were shortened over the course of the project, timing varied according to interpreter and setting, and some respondents still found them too long: *the [Ocean-Climate Connection] script is too long for our visitors here. Most visitors leave after 10 minutes and a good portion only stay for 5 minutes*. Others modified the visual narratives to make them more appealing for their specific audiences, such as adding hands-on activities or demonstrations. Others plan to make some modifications in the future, such as translating the narratives into another language, adding questions for the audience, and prioritizing some content. Several users indicated that they would like to modify the visual narratives to suit a younger audience. One wrote, *the narrative and group brainstorm [during the training session] was super helpful to gear what you provided us to a younger age range*.

Teachers who attended the training sessions expressed interest in turning the visual narratives into a classroom presentation, using them as part of an online course, or as a professional development tool. Given the number of formal educators encountering the visual narratives through workshops and conferences, Buttonwood Park Zoo spearheaded the development of resources for classroom-based teachers. After a quality retention review by FrameWorks for consistency with the Strategic Framing approach and careful consideration by the leadership team, these resources were adapted for inclusion in the toolkit and offered on the website.

Most of the respondents who used the visual narratives indicated that they plan to continue using them. Some suggested that having access to presentations that are backed by social science research was appealing. Others highlighted the benefits of standardizing the content delivered, one writing, *it will give continuity to our messaging to have all staff using these narratives instead of making their own individual climate change programs.*

### Visitor Survey at Trainee Sites

Interpreters at trainee sites surveyed 138 visitors who viewed a visual narrative presentation. More than one quarter of respondents were frequent visitors to ISEIs, visiting science museums, nature centers, zoos, or aquariums three or more times per year; a minority visited less than once per year (Figure 18).

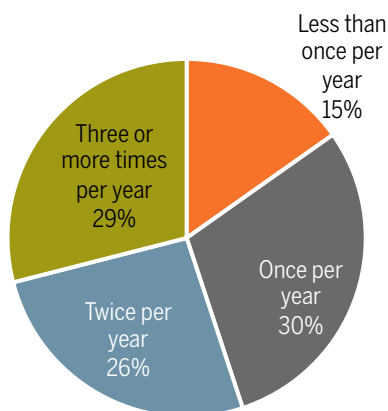


Figure 18. ISEI visitation by respondents to the visitor survey.

Almost two-thirds (65%) of the respondents viewed the Ocean Acidification visual narrative and about one quarter viewed the Ocean-Climate Connection narrative before responding to the survey. Sea Level Rise and Extreme Weather were less common, with only 5% and 2% of respondents viewing each, respectively. Most respondents said they viewed the visual narrative on a flatscreen, although one institution submitting data had a SOS. One institution that used a flatscreen mentioned that it was an iPad and another mentioned using an iPhone. Others did not use projections during presentations.

Audience members were typically able to name or summarize the topic of the visual narrative they watched (Table 6). For example, almost all respondents named or described ocean acidification

after watching the presentation and most of the remaining respondents described a related concept, such as *renewable energy* or *climate change*. The Ocean-Climate Connection presentation was slightly more difficult for audience members to characterize, though most respondents were partially correct, listing responses like, *fossil fuels, how we can protect the ocean, or alternative energy sources.*

Table 6. Visitor characterizations of the visual narrative topic.

	Correct <i>n</i>	Partially Correct <i>n</i>	Incorrect <i>n</i>	Total <i>n</i>
Ocean Acidification	67	11	1	79
Ocean-Climate Connection	11	18	5	34
Sea Level Rise	6	0	0	6
Extreme Weather	1	2	0	3

Visitors responded positively to the presentations, with the majority indicating that they thought the presentation was interesting and wanted to learn more (Figure 19). Slightly fewer, though still the vast majority, indicated that they planned to take action based on what they learned (Figure 19), though we do not know what specific actions they plan to take. About one quarter ( $n = 34$ , 28%) of presentations included tactile artifacts like blocks or a CO<sub>2</sub> tank, but the use of tactile objects was not a significant predictor of visitor responses. This lack of a relationship may reflect the fact that respondents were adults; tactile objects may be more important when interacting with children.



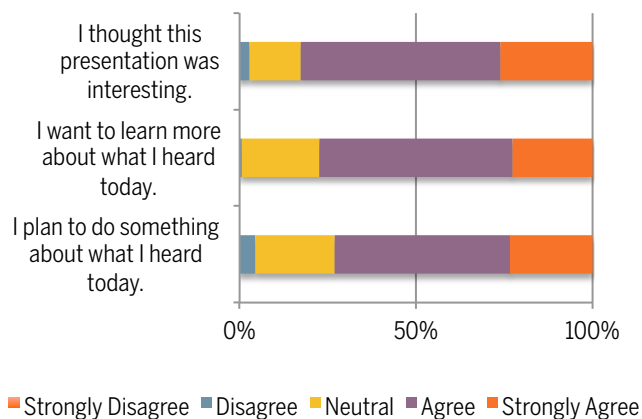


Figure 19. Visitor reactions to the visual narratives.

Interpreters described anecdotes that gave them insight into positive gains in their audiences' understanding of climate change science and grasp of solutions. Interpreters reported that audiences – including children – were drawn to metaphors like *Heat Trapping Blanket* and sticky language like *rampant CO<sub>2</sub> and natural CO<sub>2</sub>*. Paired t-tests indicated that visitors' self-reported understanding and ability to communicate about climate change issues increased after viewing the presentations (Figure 20; I understand science ideas:  $t = -7.43$ ,  $df = 130$ ,  $p < .001$ ; explain science ideas:  $t = -9.79$ ,  $df = 128$ ,  $p < .001$ ; know how to address climate change:  $t = -7.27$ ,  $df = 127$ ,  $p < .001$ ;  $n = 133-135$ , depending on the item).

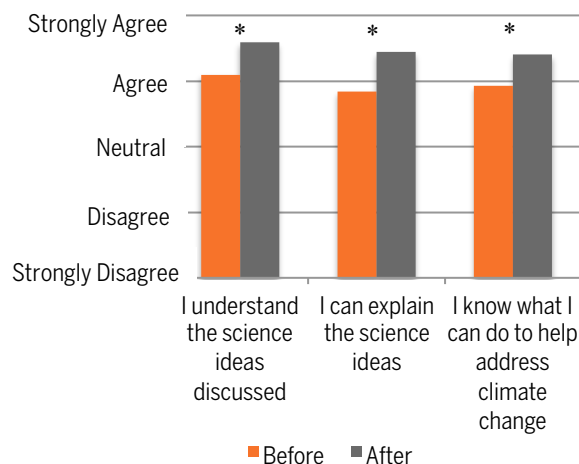


Figure 20. Self-reported knowledge and skills before and after the presentation.

Note. \* indicates significant difference between before and after responses at  $p < .05$ .

About half of the respondents provided additional feedback describing their impressions of the presentations. Many of the comments provided general, positive comments, indicating that they thought the presentation was *insightful, interesting, well-done, reliable* and *engaging*. One respondent wrote that the narratives were effective at *breaking down the concepts* and another wrote that the *visuals were helpful in explaining ideas*. Most of the negative comments related to difficulty hearing, sometimes resulting from technical difficulties with audio equipment. Some respondents requested additional information on the *transformation of CO<sub>2</sub> into carbonic acid*, the relationship between *fossil fuels and climate change*, the relationship between *rising ocean temperatures and rising sea levels*, and additional examples and solutions. Two respondents who watched the Ocean Acidification visual narrative praised the building block example. A few respondents thought the narrative was not good for kids, while a similar number thought it was good for kids or *family-friendly*.

## Dissemination Efforts

### Publications

The Visualizing Change project produced two peer-review journal papers to date, which are also related to the efforts of the National Science Foundation-funded National Network for Ocean and Climate Change Interpretation.

Goldstein, E., Hamilton, P., & Anderson, J. (2015). Addressing Global Climate Change in Museums. *Informal Learning Review*, 130: 3-8.

Anderson, J. (2016). Angling Towards Solutions in Climate Change Education. *Informal Learning Review*, 136: 3-8.

**Presentations**

Members of the leadership team presented Visualizing Change content at eleven conferences from 2014 to 2016 (Table 7). Presentations included panel discussions, sessions, and posters. Attendees came from diverse backgrounds and institutions, including academics, museum and aquarium staff, nature center staff, and representatives from foundations and government agencies. Attendance ranged from 12 to 200 per presentation, with over 400 people exposed to the project framework and toolkit resources across all presentations.

Members of the leadership team presented Visualizing Change materials at additional events. For example, in December 2015, staff from the Buttonwood Park Zoo presented the Ocean Acidification visual narrative to 335 middle school students attending a climate change resiliency summit and again as part of a family event at the Whaling Museum in New Bedford, MA.

The Visualizing Change project often stood out among other presentations at these conferences as an exemplary of a multi-institutional collaboration. Presenters described how even brief introductions to the project were enough to inspire conversations about using Visualizing Change resources and the Strategic Framing approach. Presenters at the 2016 SOS Network conference described the *tremendous interest in the narrative template as a tool to craft new presentations*. Many attendees expressed interest in an auto-run narrative to use at their ISEIs on NOAA kiosks or SOS. During later conferences, attendees, especially those with a SOS, were interested in hearing about the research and evaluation to consider how the visual narratives may be optimized at their institutions.

Table 7. Conference presentations by the leadership team.

Date	Partner Presenting	Conference	Format	Title
Oct 2014	New England Aquarium	Association of Science-Technology Centers	Panel	<i>Innovative Trends in Communicating Climate Science</i>
May 2015	Seattle Aquarium	National Marine Sanctuary Educator’s Conference	Session	<i>Visualizing Change as Applied NNOCCI Pedagogy</i>
Oct 2015	New England Aquarium	Association of Science-Technology Centers	Panel	<i>Climate Change: Six Ways to Solutions</i>
Nov 2015	National Aquarium	National Association of Interpretation	Session	<i>Evolving Practice: Using Global Visualization to Engage Audiences</i>
Dec 2015	Seattle Aquarium	SOS Users Network Conference	Session	<i>Telling a Story with Your Sphere</i>
Dec 2015	Aquarium of the Pacific, Seattle Aquarium, Exploratorium	SOS Users Network Conference	Session	<i>Visualizing Change</i>
Mar 2016	New England Aquarium, Buttonwood Park Zoo	MA Environmental Education Society	Session	<i>Visualizing Change</i>
June 2016	Aquarium of the Pacific	National Marine Educators Association	Session	<i>Visualizing Change</i>
July 2016	NewKnowledge	Visitor Studies Conference	Poster	<i>Visualizing Change: Evaluating Training and Tools to Support Informal Educators</i>
Sept 2016	Seattle Aquarium & National Aquarium	Association of Zoos and Aquariums	Poster and Round Table	<i>Poster: A Roadmap to Visualizing Change</i>
Nov 2016	Seattle Aquarium	National Association for Interpretation	Poster Presentation	<i>Visualizing Change: Telling the Story of Climate and Ocean Change Through Visual Narratives</i>

### *Increasing Access to Resources*

FrameWorks developed a public website at [www.vischange.org](http://www.vischange.org) that launched on October 11, 2016. The site offers open access to a suite of Visualizing Change resources, including the four visual narratives and their supplementary materials, such as scripts annotated with contextual information, shortened scripts, and classroom activities. The website also provides videos of educators from four sites performing the four scripts, as well as in-depth resources on climate sciences and training materials for Strategic Framing techniques. While sufficient data about website use are not yet available, we anticipate that this new resource will expand the project's impacts for several years as educators across the US have open access to Visualizing Change tools.

### **KEY TAKEAWAYS**

- The leadership team distributed resources and trained interpreters during seven in-person and one online training sessions. The sessions provided trainees with opportunities to view and practice the visual narratives and discuss strategies for implementing them at their institutions.
- The training sessions were well-received. Trainees were highly engaged, felt like the sessions helped them to become more comfortable with climate change content and communication skills, and left the sessions motivated to use the visual narratives at home.
- When we followed-up with trainees three to five months after the training sessions, some had begun to share the toolkit with their colleagues and use the visual narratives at their institutions. Experiences were positive, with most trainees feeling that the visual narratives were easy to implement and modify for their specific audiences.
- As we found during the onsite testing at the primary partner sites, visitors at the trainee sites understood the main message of the visual narratives, were interested and engaged during the presentations, and had gains in their self-reported understanding of climate change science. These positive outcomes provide strong support for the efficacy of the toolkit resources coupled with the training session.
- The leadership team has made ample progress disseminating the project resources through presentations at conferences, special events, and publications. Currently, these dissemination efforts have exceeded original objectives outlined in the grant

proposal, resulting in broader project reach and potential institutional adoption of the Visualizing Change tools.

### **RECOMMENDATIONS & RESOLUTIONS**

- The toolkit is available online for download by interpreters and members of the public, which will increase project reach.
- The leadership team is discussing how to provide follow-up coaching and support to trainees to troubleshoot and understand how the visual narratives are working at secondary sites.
- The leadership team is considering running additional online trainings to reach staff at institutions not located near the primary partner sites. Testing the visual narratives with ISEI visitors from inland communities will provide insight into the broad applicability of this approach to climate change messaging.
- Many institutions in the SOS network rely on auto-run presentations and the leadership team might consider seeking additional funding to create auto-run versions of the visual narratives building on FrameWorks' short scripts. Development should be coupled with additional research to understand how long visitors will watch auto-run presentations and what they take away from them.
- The leadership team should continue to seek additional partners to participate in training and dissemination, and ensure that the visual narratives stay up to date. The SOS network or NOAA's National Marine Sanctuaries may be two such partners, as members' expertise and regular meetings will help to ensure that the materials are updated as necessary.

## Discussion & Conclusion

Considering the outcomes of the Visualizing Change initiative, we reflect on the experiences of and impacts for each main audience: partner institutions, interpreters at other institutions, the ISEI community, and the public. From the outset of the initiative, the project team prioritized these four audiences as products were developed and disseminated.

### Partner Institutions

The project team initially hoped the partner institutions – Aquarium of the Pacific, Seattle Aquarium, National Aquarium, and New England Aquarium, along with the supporting teams at Buttonwood Park Zoo and the Exploratorium – would gain access to shared knowledge and resources, including the visual narratives.

The three-year evaluation showed that all partners were highly dedicated to the project. Each institution expressed their commitment through regular attendance in monthly calls, staff efforts between group meetings and calls, and testing and refining the narratives with their visitors. As a result, outcomes for partner institutions exceeded original objectives. Partner institutions gained skills and experience beyond mere access to shared knowledge and resources. They successfully engaged in a high level of inter-institutional collaboration, which brought them into close team-working situations with peer organizations, as well as other types of partners like social science researchers and data visualization scientists.

Our observations of team process and the high quality of the visual narratives indicated that the collaborative project team structure was effective. Moreover, staff and their supervisors at these partner institutions fully comprehended the project goals, were able to balance project goals with institutional goals, and openly shared resources and information with each other, which contributed to positive partnership outcomes.

The partners represented geographic locations on both coasts of the US and offered the opportunity to test the visual narratives in different institutional settings with different visitor types. The project may have been strengthened further by including institutions in landlocked states in the leadership team, possibly expanding the institutional perspectives involved in developing the visual narratives. Nevertheless, the visual narratives appeared to

be valuable to a wide variety of institutions – including those in landlocked states – as was demonstrated by the study of secondary sites that participated in trainings.

### Interpreters

The intended outcome for interpreters was to increase their climate change literacy, ability to incorporate NOAA data into their interpretation, knowledge of strategies and tools for climate change education, and self-confidence in communicating about these topics.

The inclusion of interpreters on the project leadership team improved the tools' usability because project leads had direct experience presenting the visual narratives. We observed interpreters at primary partner sites adapting the visual narratives as they delivered programs for their audiences. These interpreters highlighted the importance of the visual narratives' flexibility, prioritizing scripts that could be adapted to audiences' interests and needs. Both the interpreters and researchers on the project leadership team worked together to modify the visual narratives based on these personal experiences.

We had limited insight into how the tools were used at secondary sites (those with interpreters who had participated in a Visualizing Change training). But interpreters at these institutions occasionally described how they adapted the materials to work in different contexts. In some cases, these interpreters applied what they learned in the training to other communication efforts, not using technology-based tools at all.

As a result of the training and involvement in the project, interpreters said they were more confident when discussing climate change with the public. Interpreters at the partner institutions had been regularly implementing the tools with their audiences over a longer period of time. Some interpreters who attended the trainings had also begun using them at their home institutions. Both groups reported that they could effectively use the Visualizing Change tools without additional training. During the trainings, educators developed action plans for implementing programming using the visual narratives at their institutions.

The follow-up study indicated that about 65% of interpreters at secondary sites had used the tools or their knowledge with visitors several months after the training. This percentage may overestimate use if sites that had not used the visual narratives were less likely to respond to the survey.

We speculate that this low adoption rate may be due to a variety of reasons. First, the training required no follow-up exercise or practice using the visual narratives. Some institutions may have had internal barriers, such as technology issues or lack of active institutional support. Finally, implementation may have proven more challenging than interpreters anticipated, despite receiving support from partner institutions after training. Perhaps these individuals needed more than a single training to become familiar and comfortable with both Strategic Framing and the Visualizing Change tools. We note a lesson learned in the NNOCCI project: even after extensive training in Strategic Framing, some educators were unable to leverage these skills at their home institutions. It is possible that ongoing support from the Visualizing Change and NNOCCI communities, in the form of conference outreach, networking, and access to the new website may improve interpreters' likelihood to implement the tools with their audiences.

### **ISEI Community**

The project's intended outcomes for the ISEI community were to incorporate project concepts into their practice, show greater capacity to advance ocean and climate change literacy, and increase alignment of public dialogue with expert consensus.

Trainings have offered capacity-building opportunities to a wide range of ISEIs. Individuals and organizations not traditionally considered part of the ISEI community also showed strong interest in Visualizing Change trainings and resources. The participation of Indigenous tribe representatives, schoolteachers and administrators, as well as those who work in environmental policy suggests that ISEIs might have been too narrowly defined at the outset of the project. Educators and activists from different sectors could be another primary audience for the trainings or partnerships with traditional ISEIs on climate change communication.

The leadership team's highly active dissemination at ISEI professional conferences, including the SOS Users Network Conferences, has exceeded original targets. As a result of these and other efforts, educators and leadership at institutions across the US began to show interest in and support for this method of aligning data visualizations and research with public dialogue.

Visualizing Change's association with the NNOCCI project – which also had a growing reputation in the ISEI community – might have been an advantage as well. The Science on a Sphere network served as natural vector for generating interest in and promoting the adoption of the visual narratives. Presentations about Visualizing Change at Science on a Sphere conferences have been popular.

Overall, dissemination to the ISEI community was a clear strength of the Visualizing Change initiative. The dissemination efforts at conferences exceeded original plans for spreading the word about these tools. This level of effort was a testament to the leadership team's belief in the effectiveness of the learning products. Additionally, the [vischange.org](http://vischange.org) website created by FrameWorks also surpassed original dissemination plans.

### **The Public**

The project's intended outcome for the public was to increase climate change literacy among diverse audiences, including youth, adults, families, teachers, and students attending programs at participating institutions.

We cannot comment on the possibility of large-scale shifts in climate change literacy for the public. It is unlikely that there have been measurable changes in knowledge of climate processes and solutions for the US public as a direct result of this three-year project. Nevertheless, the evaluation demonstrated visitors reported learning about climate change science and solutions from the visual narratives. They also reported high engagement and interest, suggesting that these tools were both appealing and conceptually accessible to diverse audiences. Based on the national survey data, the public believes that climate change is an important issue to understand and people like them can contribute to solutions.

The early success of the Visualizing Change products, combined with the public's inclination to learn more about climate change suggests impact is likely to grow in the future as diverse ISEIs become more likely to use these products. Support for these tools among ISEI leadership and interest from different sectors will also likely expand impact. There is also the possibility of several barriers among institutions that cannot facilitate educators' training in Strategic Framing and do not have technology for displaying the visual narratives.

## **CONCLUSION**

The evaluation of the Visualizing Change initiative, funded in part through NOAA grant #NA13SEC0080010; CFDA No. 11.008, demonstrated the project produced four effective visual narratives with NOAA data visualizations and communications research to interpret climate change. Based on extensive testing at sites across the US, the project team created visual narratives and educator tools with the flexibility to be used in a variety of settings with several technology platforms for diverse audiences. Through rigorous training and dissemination efforts –including a permanent website at [www.vischange.org](http://www.vischange.org) – the project team exceeded its goals for broad sharing of the project’s legacy products. Initial testing showed that visual narratives increased the capacity of educators and their institutions to facilitate learning among the public. Over time, the project’s impacts will likely grow as more ISEIs and educators adopt these tools.



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# Visualizing Change: Summative Report Appendix

**Project:** Visualizing Change

NOAA-#NA-13-SEC-0080010

December 19, 2016

**For:** William S. Spitzer, PhD (PI)  
New England Aquarium

**By:** Su-Jen Roberts

**NewKnowledge Publication** #NOA.052.127.06-A

- Overview**
- Appendix A. SOS Network Survey Instrument
  - Appendix B. ISEI Visitor Survey Instrument
  - Appendix C. Training Recruitment Advertisement
  - Appendix D. Trainee Immediate Post Survey Instrument
  - Appendix E. Trainee Institution Visitor Survey Instrument
  - Appendix F. Trainee Delayed-Post Survey Instrument

## Appendix A. SOS Network Survey Instrument

1. What is the name of the institution where you work?
2. What type of institution is it?
3. In which state is your institution located?
4. Please describe your visitor population.
5. What data visualization tools are currently used at your institution? (Select all that apply.)
  - Flatscreen projection
  - Large Science on a Sphere (diameter is 6 or more feet)
  - Small Science on a Sphere (diameter is less than 6 feet)
  - Magic Planet
  - Other data visualization tool (Please specify.)
6. Where is your data visualization tool located?
  - In a separate, designated room or building (Please explain.)
  - With one or two other exhibits close by (Please explain.)
  - In one large room with many other exhibits (Please explain.)
  - Other (Please explain.)
7. Do you currently experience challenges using your visualization tool effectively? If so, please describe.
8. What benefits do you experience from using your visualization tool? Please describe.
9. Are any of the visualization tools at your institution set to auto-run (without an interpreter)?
  - Yes (Which tools?)
  - No
  - I don't know
10. What is the role of your interpreters in using the visualization tools? Please identify the tool and the interpreter's role.

The Visualizing Change project is creating four data visualization products designed for SOS Network members to use at their own institutions. The project team is currently assessing whether narratives about the following topics would be useful for SOS Network members: Extreme Weather, Ocean Acidification, Sea Level Rise, and Primary Productivity. These visualization tools will be designed for use on SOS, flat screen projectors, and smaller spherical projection screens. To design the most useful product for all SOS Network members, we'd like to ask you a few questions about your potential interest in these visualization products.

**11.** Do you have an SOS platform?

- Yes
- No
- I don't know

**12.** How likely are you to use a data visualization product for the SOS platform?

- Very likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Very unlikely

**13.** Do you use another platform for data visualizations?

- Yes
- No
- I don't know

**14.** How likely are you to use a data visualization product for another platform?

- Very likely (Please specify which platform.)
- Somewhat likely (Please specify which platform.)
- Neither likely nor unlikely
- Somewhat unlikely
- Very unlikely

**15.** Would you prefer to have a visualization product that you can customize for your education facility and/or your particular region of the country?

- Yes, I'd like a product that can be fully manipulated to suit the needs of my visitor population.
- Yes, but I'd like the product to require very little manipulation before I can use it in my institution.
- No, I'd like a product that requires no manipulation by staff at my institution.

**16.** Please explain your response above.

**17.** Are you planning to acquire any other data visualization tools in the next two years?

- Yes (Please specify which tools.)
- No
- I don't know



18. If NOAA provided a visual narrative about *Extreme Weather*, how likely are you to use it with the projection system at your institution?

- Very likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Very unlikely
- I'm not sure

19. Please explain your response above.

20. How are you currently covering topics related to *Extreme Weather*?

21. If NOAA provided a visual narrative about *Ocean Acidification*, how likely are you to use it with the projection system at your institution?

- Very likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Very unlikely
- I'm not sure

22. Please explain your response above.

23. How are you currently covering topics related to *Ocean Acidification*?

24. If NOAA provided a visual narrative about *Sea Level Rise*, how likely are you to use it with the projection system at your institution?

- Very likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Very unlikely
- I'm not sure

25. Please explain your response above.

26. How are you currently covering topics related to *Sea Level Rise*?

27. If NOAA provided a visual narrative about *Primary Productivity*, how likely are you to use it with the projection system at your institution?

- Very likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Very unlikely
- I'm not sure

28. Please explain your response above.

29. How are you currently covering topics related to *Primary Productivity*?

30. Please provide any other suggestions or comments that you have for the *Visualizing Change* project team.

## B. ISEI Visitor Survey

1. Over the last 12 months, have you attended:

- A zoo (e.g., Busch Gardens in Florida or Brookfield Zoo near Chicago)
- An aquarium (e.g., SeaWorld in San Diego or New England Aquarium in Boston)
- A national park, sanctuary, or reserve (e.g., Yellowstone or Key Biscayne In Florida)
- A nature center (e.g., an Audubon center or a narrated nature walk)
- A science center (e.g. National Museum of Natural History in Washington DC or the Exploratorium in San Francisco, CA)
- I have not visited any zoos, aquariums, national parks, nature centers, or science museums in the last 12 months.

2. On your visit to one or more of these centers did you encounter any of the following?

- An exhibit providing information about climate change
- An exhibit providing information about ocean acidification
- A presentation by an employee that included information about climate change
- A presentation by an employee that included information about ocean acidification
- A conversation with an employee that included information about climate change
- A conversation with an employee that included information about ocean acidification

*[If any options were selected, proceed to Q3, which will list the selected encounter type(s). If none are selected, skip to Q4.]*

3. What did you learn from that exhibit / presentation / conversation?

4. How often do you typically go to Zoos, Aquariums, National Parks, Nature Centers, or Science Museums?

- Never, I have never been to any of these.
- Rarely, once every few years.
- About once a year.
- A few times a year.
- A regular visitor, at least three times a year.

5. Please select the response (from very concerned to nonbeliever) that best represents what you think and feel about each of the topics.

	Very Concerned	Concerned	Cautious	Disengaged	Doubtful	Nonbeliever	I do not know what this topic means.
More Extreme Weather	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Air Pollution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global Climate Change	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sea Level Rise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ocean Acidification	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### *Sea Level Rise Knowledge Questions*

6. Which is the best explanation for changing sea levels?
- Global temperatures and the cycles of the moon.
  - The ocean's association with storm frequency and tidal variations.
  - Glacier coverage and thermal expansion. (correct)
  - Sea level change is a natural occurrence.
  - I don't know.
7. What is the driving force behind sea level rise?
- Increased carbon dioxide levels in the atmosphere. (correct)
  - Plastics, medical waste, and sewage being dumped in the ocean.
  - Sea level rise is a natural occurrence.
  - I don't know.
8. How do rising carbon dioxide levels affect the ocean?
- Create holes in the ozone, letting in more sunlight and warming the ocean.
  - More carbon dioxide dissolves in the ocean, changing its chemistry. (correct)
  - Rising carbon dioxide levels block sunlight and make the ocean colder.
  - Carbon dioxide does not affect ocean.
  - I don't know.

### *Extreme Weather Knowledge Questions*

9. Which best describes the effect of the ocean on the weather?
- Energy exchanged between the ocean and atmosphere affects both humidity and temperature. (correct)
  - Wind drives ocean circulation.
  - Oceans do not affect weather.
  - I don't know.
10. Which statement is correct?
- Cyclones and hurricanes gain energy from warmer ocean surface temperatures. (correct)
  - Cyclones and hurricanes gain energy from the heat of the world's deserts.
  - Cyclones and hurricanes gain energy from tropical rainforests.
  - None of the above.
  - I don't know.

11. How are weather patterns expected to change in the future?

- More extreme weather events will occur around the globe. (correct)
- We cannot predict how weather patterns will change.
- There will be no changes in weather patterns.
- Weather patterns will become more predictable.
- I don't know.

12. The clothing you might choose to wear tomorrow is based on:

- Climate
- Weather (correct)
- I don't know.

*Ocean's Role in Climate System Knowledge Questions*

13. The ocean . . .

- Absorbs heat from the sun.
- Loses heat through evaporation.
- Supplies almost all rain.
- All of the above. (correct)
- None of the above.
- I don't know.

14. The ocean has had and will continue to have a significant influence on climate change by:

- Absorbing, storing, and moving heat
- Absorbing, storing, and moving carbon
- Absorbing, storing, and moving water
- All of the above. (correct)
- I don't know.

15. How do changes in ocean chemistry and temperature affect coral reefs?

- Higher temperatures allow corals to thrive, increasing ocean biodiversity.
- Coral reefs change little despite wide variation in ocean chemistry and temperature.
- Algae living in corals die, causing mass coral bleaching. (correct)
- I don't know.

### *Ocean Acidification Knowledge Questions*

16. What is a main consequence of ocean acidification?
- It can damage marine mammal lungs.
  - It will eventually make the ocean unsafe for swimming.
  - It decreases the ability of marine organisms to build shells. (correct)
  - None of the above.
  - I don't know.
17. What causes ocean acidification?
- Acid rain falling into the ocean.
  - Sewage runoff being dumped into the ocean.
  - Ocean absorbs excess carbon dioxide in the atmosphere. (correct)
  - None of the above.
  - I don't know.
18. Which is the best way of addressing ocean acidification?
- Design energy systems that produce less carbon dioxide. (correct)
  - Put chemicals into the ocean to neutralize its acidity.
  - Breed shellfish that are not affected by ocean acidification.
  - No prevention is needed because the ocean is very big and will overcome any changes.
  - I don't know.

### **Perceived Connection with Oceans**

19. How much do you trust informal science education institutions about information on the ocean?
- Not at all
  - A little
  - Somewhat
  - Mostly
  - Entirely
20. How close do you live to the ocean?
- Less than one mile
  - Between one and five miles from the ocean
  - Between five and 10 miles from the ocean
  - Between 10 and 50 miles from the ocean
  - Between 50 to 100 miles from the ocean
  - Over a hundred miles from the ocean



21. How much does the ocean impact your life?

- Not at all
- Slightly
- Somewhat
- Moderately
- All the time, every day

22. Please rate your agreement with the following statements.	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
The oceans are big enough to handle some change without affecting my life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I'm not concerned about my seafood choices.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My daily activities have no affect on the oceans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't understand much about the ocean.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thinking about changes in the ocean is too complicated for me to think about.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If everyone acted together we could solve the problems the ocean is facing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23. Please rate your agreement with the following statements.	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
The only way to solve changes in the ocean is through government policy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Individual action is the best way to protect our oceans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It doesn't matter what individuals do if industries do not change their behavior.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I'm just fed up about listening to the depressing story about our changing oceans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I'm already doing everything I can to protect the environment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't like to talk to other people about environmental problem because it's depressing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other people aren't as worried as I am about ocean issues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

24. Are you?

- Male
- Female
- Prefer not to answer

25. On political matters, do you generally consider yourself to be:

- Very liberal
- Liberal
- Neither liberal nor conservative
- Conservative
- Very conservative


**26.** Do you consider yourself a member of any political party?

- Republican
- Democratic
- Tea Party
- Libertarian
- Green Party
- Other (Please specify.)
- I consider myself to be independent of all political parties.

**27.** Please select your highest level of education.

- Less than high school
- High school degree
- Some college
- Associates degree (2 years)
- College graduate (4 years)
- Some post graduate study
- Post-graduate/Professional Degree (e.g., MA, PhD, JD, MD, MBA)

## Appendix C. Training Recruitment Advertisement



# VISUALIZING CHANGE

Is your institution looking for ways to use display screens more effectively with visitors? Are you interested in building more capacity to use data visualizations among education staff? Are you eager to translate the science of climate change more frequently and more effectively? Visualizing Change may be able to support your efforts.

### VISUALIZING CHANGE OFFERS TOOLS AND TRAINING FOR INFORMAL SCIENCE EDUCATORS

Visualizing Change is a partnership of informal science educators, data scientists, and social scientists. Our goal is to design and share effective data visualizations about climate change and its impact on our ocean and coasts. Building on recent climate communication research and climate interpretation initiatives in zoos and aquariums nationwide, the project has developed and tested four Visual Narratives that can be used on a flat screen, handheld tablet, or a spherical screen (such as Science on a Sphere®, Magic Planet®, or HyperGlobe®). These narratives have been field-tested with interpreters and visitors, and are highly effective in building public understanding of key climate topics:

<p><b>Extreme Weather</b></p> <p>What's the connection between fossil fuels and more frequent and severe storms?</p>	<p><b>Ocean Acidification</b></p> <p>How is the chemistry of the ocean changing, and how does this affect us all?</p>	<p><b>Sea Level Rise</b></p> <p>What is causing the level of the sea to rise? What are the potential consequences - and what can we do to reduce its impact?</p>	<p><b>The Ocean-Climate Connection</b></p> <p>How does the ocean regulate the climate, and how is a changing climate affecting it?</p>
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### WOULD YOU LIKE TO ENHANCE YOUR INTERPRETATION OF THESE TOPICS? HERE'S HOW TO LEARN MORE.

Visualizing Change is offering several one-day workshops around the country to equip informal science educators to use these narratives. Participants will come away with a more thorough grounding in climate communication in general, and plenty of tools to support interpreters in using these four narratives in particular. The training and tools are FREE. In return, we ask that all participants commit to assisting with our evaluation of this project. Participants are responsible for their own travel and parking costs, but we'll give you lunch! To register or for additional information, please email the contact person at your preferred location/date.

- April 8 - Exploratorium, San Francisco, CA - Mary Miller [mmiller@exploratorium.edu](mailto:mmiller@exploratorium.edu)
- April 14 - National Aquarium, Baltimore, MD - Megan Anderson [manderson@aqua.org](mailto:manderson@aqua.org)
- April 28 - Buttonwood Park Zoo, New Bedford, MA - Annette Brickley [abrickley.edu@gmail.com](mailto:abrickley.edu@gmail.com)
- May 6 - Aquarium of the Pacific, Long Beach, CA - Dave Bader [dbader@lbaop.org](mailto:dbader@lbaop.org)



Visualizing Change is supported by a grant from the National Oceanic and Atmospheric Administration's Office of Education.

## Appendix D. Trainee Immediate Post Survey Instrument

1. Please rate your familiarity with the following topics before and after participating in the training session.

	Before Training					After Training				
	Not at all familiar	Slightly familiar	Somewhat familiar	Moderately familiar	Extremely familiar	Not at all familiar	Slightly familiar	Somewhat familiar	Moderately familiar	Extremely familiar
Ocean Acidification	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sea Level Rise	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Extreme Weather	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Role of the Ocean in Climate	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Strategic Framing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

2. Please rate your agreement with the following statements before and after participating in the training session.

	Before Training					After Training				
	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I can explain the basic science about how excess CO <sub>2</sub> affects the climate system to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can explain the basic science about ocean acidification to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can explain the basic science about how the climate works to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can use values when explaining climate change science to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can use explanatory chains when explaining climate change science to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can use metaphors when explaining climate change science to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can use solutions when explaining climate change science to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Please rate your agreement with the following statements.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I plan to use the toolkit at my institution.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I plan to share the toolkit with my colleagues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I need more support to help me understand how to use the toolkit.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Do you have additional feedback about the toolkit?

5. Please rate how you feel about this training session.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
The training session was effective at teaching me to use the visual narratives.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There was enough time for presentations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There was enough time for discussion among colleagues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, I am satisfied with this training session.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. Do you have additional feedback about the training session?

## Appendix E. Trainee Delayed-Post Survey Instrument

1. Which institution facilitated the training session you attended during the spring/summer of 2016?
  - Aquarium of the Pacific
  - Buttonwood Park Zoo (in person)
  - Buttonwood Park Zoo/ New England Aquarium (online)
  - Exploratorium
  - National Aquarium
  - Seattle Aquarium
  
2. Which visual narrative(s) have you used at your institution? (Select all that apply)
  - Ocean Acidification
  - Extreme Weather
  - The Ocean-Climate Connection
  - Sea Level Rise
  - None *[If selected: Why have you not used any visual narratives? Is there anything we can do to support you in using them in the future? Use skip logic to proceed to Q9.]*
  
3. Did you share the toolkit with colleagues at your institution?
  - Yes
  - No *[if selected, use skip logic to proceed to Q5.]*
  
4. Please rate your agreement with the following statement: My colleagues who did not attend the training session are able to use the toolkit effectively.
  - Strongly Disagree
  - Disagree
  - Neither Agree nor Disagree
  - Agree
  - Strongly Agree
  - I don't know
  
5. Approximately how many times did you or others at your institution deliver each narrative? *[Will use piped text to include only those narratives selected in Q2. If selected one narrative, proceed to Q6. If selected multiple narratives, proceed to Q7.]*

	5 or fewer	6 to 20	More than 20
Ocean Acidification			
Extreme Weather			
The Ocean-Climate Connection			
Sea Level Rise			



6. Please tell us about your experience. Why did you select that narrative? Was it easy to learn? How did your audience react? *[Skip to Q8]*

7. Please tell us about your experiences. Were some narratives easier to learn than others? Were some better for certain audiences?

8. Do you plan to continue using the narratives? Please explain.

9. Which platforms have you used at your institution? (Select all that apply)

- Science on a Sphere
- Magic Planet
- Flatscreen TV
- Tablet
- Other (please specify)

10. Which toolkit resources have you used? (Select all that apply.)

- Complete scripts
- Plain scripts
- Short scripts
- Science summaries
- Other (please specify)

11. Do you feel that you understand the narrative topic(s) better than you did before the training? Please explain.

12. Please rate your agreement with the following statements.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
I can explain the basic science about how excess CO <sub>2</sub> affects the climate system to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can explain the basic science about ocean acidification to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can explain the basic science about how the climate works to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can use values when explaining climate change science to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can use explanatory chains when explaining climate change science to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can use metaphors when explaining climate change science to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can use solutions when explaining climate change science to the public.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I need more support or additional training to help me use the toolkit more effectively.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please explain your responses to the questions above.

**13.** Do you have additional feedback about the toolkit and visual narratives?

## Appendix F. Trainee Institution Visitor Survey Instrument

1. In your opinion, what was the science topic covered in today's presentation?

2. Please think about your knowledge before you saw the presentation and now and rate your agreement with the following statements.

	Before Presentation					Now				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I understand the science ideas discussed in the presentation.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can explain the science ideas in the presentation to another person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know what I can do to help address climate change.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3. Please rate your agreement with the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I found this presentation interesting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I want to learn more about what I heard today.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I plan to do something about what I heard today.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This presentation relates to other exhibits around me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The technology used was helpful for learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Do you have any other feedback about this presentation?

5. Finally, how often do you visit zoos, aquariums, science museums, or nature centers?

- Less than once per year
- About once per year
- One to two times per year
- Three or more times per year

### For Institutional Use Only

*[filled out by the staff member distributing the survey]*

Institution Name: \_\_\_\_\_

Visitor responded as:

- An individual
- A group

Narrative:

- Ocean-Climate Connection
- Ocean Acidification
- Sea Level Rise
- Extreme Weather

Were tactile objects (e.g., biofacts) used?

- Yes
- No

Technology used (select all that apply):

- SOS
- Magic Planet
- iPad
- Flat Screen Monitor
- Other 2D (please specify)
- Other 3D (please specify)
- None

Concepts articulated clearly (select all that apply):

- Value
- Metaphor
- Solution



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*Facing Society's Grand Challenges Head On*

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