



Sparks! Ignition Grants for Museums

Sample Application LG-45-14-0004-14

Carnegie Museum of Natural History

Amount awarded by IMLS: \$25,000

Attached are the following components excerpted from the original application.

- Abstract
- Narrative
- Schedule of Completion

Please note that the Sparks! Ignition Grants for Museums program no longer exists as a standalone funding opportunity. However, IMLS welcomes proposals for similar work through its National Leadership Grants for Museums / Rapid Prototyping funding level. Instructions for preparing narratives for FY2017 applications differ from those that guided the preparation of previous applications. Be sure to use the narrative instructions in the FY2017 Notice of Funding Opportunity for the grant program to which you are applying.

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Abstract

Building on previous collaborative efforts with the University of Pittsburgh's Center for Learning in Out-of-School Environments (UPCLOSE), Carnegie Museum of Natural History (CMNH) requests a grant of \$25,000 from the Institute of Museum and Library Services' Sparks! Ignition Grants for Museums program for *Seeing as a Scientist*, an innovative design-based research initiative to develop gallery interventions that measurably impact families' abilities to increase scientific observation skills. Scientific observation, or deliberate looking in order to understand visual evidence, is an essential skill for learning across scientific disciplines. This project grows out of the *21st Century Learning in Natural History Settings Conference* held at the Smithsonian Institution in February 2013, which focused on ways to build on traditional missions and strengths to transform natural history museums into vital forces for education, science, and change.

CMNH's science and education staff and researchers from UPCLOSE will engage in a series of rapid prototyping experiments involving redesigned floor experiences and objects from the collection to encourage cross-generational scientific talk and opportunities to practice scientific skills as a first step in the process of science. Participants will be parents and children aged six to ten years old. Moving beyond everyday observation, the families will be supported in making scientific observations about what the objects are (taxonomy), how they are adapted to an environment (form and function), how life forms change over time (evolution), and the importance of sharing observations with other people in the process of identifying and answering questions (process of science). The context for the project is the diorama, a ubiquitous form of exhibitry that accounts for approximately 25% of CMNH's gallery space.

In Phase 1, the project team will stage a series of quick changes and additions to dioramas and outline expected behaviors for each. Strategies will be designed to promote close looking at specific examples, as well as comparison across dioramas. In Phase 2, the four most promising interventions will be evaluated to determine which are most successful in providing the necessary support for families to establish shared focus and two-way, elaborated, scientific talk. Preference will be given to cost-effective and easily replicable interventions to increase the likelihood of their potential adoption in a wide of settings, from nature centers, zoos, and aquaria, to families' own backyards, thus benefitting a wide variety of potential users.

Information about the project, from development through post-completion, will be shared via a blog, presentations to local museum and university audiences and at national conferences, and academic publications. Within CMNH, the project will result in more effective engagement strategies that will be incorporated in CMNH's classic diorama halls and related public programs, and will guide thinking about ways the exhibits themselves might be re-constructed to enhance scientific observation and attention.

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Narrative

Driven by its mission to increase scientific and public understanding of the natural world and human culture, Carnegie Museum of Natural History (CMNH) has been collaborating with researchers from the University of Pittsburgh Center for Learning in Out-of-School Environments (UPCLOSE) since 2005 in a research and practice partnership to bring new learning-sciences findings and theories into contact with the design and deployment of natural history learning experiences. Learning researchers (housed at both the museum and university) are working with museum educators, exhibit designers, and curators to explore new ways to activate the museum's collections and scientific expertise, and to connect with diverse audiences around issues related to observing and understanding nature and changes in the natural world.

Building on several previous collaborative efforts with UPCLOSE, CMNH requests a grant of \$25,000 from the Institute of Museum and Library Services' Sparks! Ignition Grants for Museums program for *Seeing as a Scientist*, an innovative design-based research study utilizing rapid prototyping to develop effective strategies for promoting scientific observations skills in parents and children, focusing on the museum's diorama halls. Scientific observation, or deliberate looking in order to understand visual evidence, is an essential skill for learning across scientific disciplines. Moving beyond everyday looking, the family groups will be supported in making scientific observations about what the objects are (taxonomy), how they are adapted to an environment (form and function), how life forms change over time (evolution), and the importance of sharing observations with other people in the process of identifying and answering questions (process of science). The goal is to provide a set of cost-effective engagement strategies that could be easily implemented in a variety of settings.

This project grows out of the *21st Century Learning in Natural History Settings Conference* held at the Smithsonian Institution in February 2013, which focused on ways to build on traditional missions and strengths to transform natural history museums into vital forces for education, science, and change. (See <http://21centurylearningnmnh.wikispaces.com>.) Although natural history museums are sometimes characterized as irrelevant 19th-century institutions, they are, in fact, more relevant now than at any other time in our history. With our planet experiencing rapid changes in its climate, biodiversity, and ecosystems, the future depends on our ability to understand these changes and our role in adapting to or mitigating them. Natural history museum collections, which offer rich stories from Earth's history, position them to inspire people to notice, care, and act.

Conference attendees defined a national research agenda that concentrates on collective issues relating to *Audience* (diversity and experience in our settings), *Mediation* (both physical and digital platforms for engagement), *Authenticity* (the role of real objects and research in our work), and *Critical Content* (ways our resources support understanding of emerging issues that impact society such as climate change, biodiversity, and energy development).¹ *Seeing as a Scientist* furthers these efforts by developing, testing, and widely disseminating effective strategies to facilitate the learning of critical content about real objects in the museum.

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Project Justification

In 2007, CMNH opened its newly refurbished exhibit *Dinosaurs in Their Time*, which included original fossil specimens restored and remounted according to contemporary science and best practices in specimen conservation. Developed in conjunction with learning researchers at UPCLOSE, the project focused considerable attention on providing disciplinary context in the signage and, most importantly, in the display of dinosaurs within successive environmental settings. Studies found that visitors in the new hall were engaging in scientific observation, noticing features of the dinosaurs and connecting them to bigger ideas in evolution (e.g., change over time) and ecology (e.g., plant eaters depending on the flora of the time).² This outcome was encouraging; however, it depended on the mediation of a substantial technological infrastructure in the form of multi-layered multimedia kiosks, as well as the renovation of a complete exhibit hall to arrange mounts in ways that facilitated comparison.

A more recent study showed that even a simple intervention—in this case, darkening dioramas and allowing visitors to explore by flashlight—increases time spent and shared attention between parent and child and leads to higher-level conversations.³ Similarly, summative evaluation of a new collections-based exhibition, which provides opportunities for visitors to try museum-related skills such as collecting, documenting, comparing, and handling education collections, documented increases in stay times, interaction, and child-led explorations.⁴

While these interventions were successful in encouraging visitors to *slow down*, they were not designed to drive *scientific* observation per se. Learning research has demonstrated that scientific observation requires disciplinary context if young and adult learners are to be able to separate surface from salient features, gather evidence that can help answer a question, and connect specific evidence to larger concepts.⁵ Addressing that challenge, *Seeing as a Scientist* will provide approaches that drive increased engagement, conversation, and learning by prompting greater joint attention around authentic objects. Additionally, by providing disciplinary supports through mediation based in key conceptual features, these approaches will encourage the application of shared knowledge to new ideas that are observable within exhibits, but often overlooked.

Project Implementation

The project will begin August 1, 2014, and conclude on July 31, 2015.

Project Personnel and Project Management: A joint effort of CMNH and UPCLOSE, *Seeing as a Scientist* will be managed by team leaders who bring a wealth of experience to the project, as well as history of working together on efforts to improve the practice of informal science education:

- **Kevin Crowley**, PhD, is professor of learning sciences and educational policy at the University of Pittsburgh's School of Education, director of UPCLOSE, and senior scientist of the Learning Research and Development Center; his research focuses on relationships between learners, mediators, environments, and experiences.
- **Mary Ann Steiner** is a PhD candidate in learning sciences and educational policy at the

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University of Pittsburgh and has served as CMNH's curator of public engagement since 2010 and as director of learning research since 2013. Her doctoral work focuses on how scientists share knowledge with public audiences; her work at the museum connects the public on- and off-site to larger scientific and social issues, including climate change, energy development, and changing biodiversity.

- **Kaleen Tison-Povis** is a PhD candidate in learning sciences and educational policy at the University of Pittsburgh and a graduate student researcher and museum research fellow at UPCLOSE. Her work focuses on how museum visitors engage with exhibit spaces, content, and labeling, as well as with each other.

Steiner and Tison-Povis will plan and implement the overall project, ensuring coordination between museum staff and UPCLOSE contributors. Crowley will provide top-level guidance regarding project design and methodology and dissemination of results. Undergraduate research assistants from the University of Pittsburgh will assist with data collection and transcription. Although not reflected in the project budget, numerous museum staff members (supported by the museum's operating funds) will also contribute, including curators, collections managers, educators, and personnel from exhibits and visitor experiences functions.

Work Plan: The museum's science and education staff and researchers from UPCLOSE will engage in a series of rapid prototyping experiments involving redesigned floor experiences and objects from the collection that are designed to encourage cross-generational scientific talk and opportunities to practice scientific skills as a first step in the process of science.

The primary context for the research is the diorama. These elaborately recreated nature scenes, which capture specific moments in time complete with soil, plant samples, and wildlife, account for approximately 25% of CMNH's gallery space and are ubiquitous across institutions of similar type. The project will focus on a subset of the 30 dioramas in the museum's three diorama halls: *The Hall of North American Wildlife*, which features the major ecosystems of North America; *The Hall of African Wildlife*, which explores four of the African continent's major life zones—savanna, rainforest, mountain, and desert—and the unique animals that live there; and *Botany Hall*, which portrays four different biomes found in the continental United States and illustrates how varying conditions of temperature and water affect plant life.

Work will progress in two phases:

Phase 1: *Can simple retrofitted interventions scaffold scientific observation in natural history museums? Do visitors use interventions as expected? What conversations result?*

Working with CMNH curators and collections managers, the team will identify salient, observable features within the dioramas that can lead to productive scientific observations. They will then design and deploy intervention strategies that will help participants engage with four big ideas, each with specific diorama examples that are easy to observe:

- Taxonomy—finding critical features of large groups of animals and plants across dioramas

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- Form and function—identifying specific features that support life in particular environmental contexts
- Evolution—understanding variation and change in life over time
- Process of science—identifying and sharing evidence to determine which evidence is relevant to answer specific questions

With these concepts in hand, along with the notion that scientific observation requires some disciplinary support and strategies to promote joint attention to draw out the collective capacity of participants, the project team will stage a series of quick changes and additions to dioramas and outline expected behaviors for each. Strategies will be designed to promote close looking at specific examples, as well as comparison across dioramas. Interventions may include prompts, questions, and signage; tools/resources such as maps, measuring devices, magnifying glasses, and counting devices; small displays of study objects illustrating specific concepts and encouraging comparison/analysis; and environments, such as a mini-field study station that facilitates a variety of targeted behaviors. Preference will be given to interventions employing low-tech, cost-effective, readily available/replicable materials and activities to increase the likelihood of wide applicability.

Participants in Phase 1 will be recruited through elective participation by parents with children from six to ten years old who are already in the museum, and, to ensure participation by families from diverse backgrounds, by invitation to families recruited through community partner organizations such as Carnegie Library of Pittsburgh, the YMCA's Lighthouse Project, and the YWCA's Early Learners Center. (Note: to comply with Institutional Review Board Standards for Human Subject Research, the study will be limited to parents visiting with their children. Generalization of results to similar intergenerational groups may be reasonably inferred, but cannot be quantified through this investigation.) A minimum of 30-40 participants will be engaged over the course of three months.

Participants will be observed engaging with the prototypes. Researchers will look at features that support engagement and add new scaffolds to address missed opportunities. Attention will also be paid to productive behaviors that the researchers did not expect to see. Occasional mini-interviews/surveys will be conducted with the participants to further the team's understanding of participants' experiences. Each prototyping session will be followed by a team meeting to review the data collected and identify additional strategies to bring to the next session. Based on these discussions, approaches that have promise will be posted on the *Seeing as a Scientist* blog on the museum's website, with options for people to share their experiences testing similar strategies. Through this highly iterative process, the team will identify four solid engagement strategies that hold participants' attention and encourage them to talk to each other, share evidence, and connect their evidence to bigger ideas.

Phase 2: *Do the interventions from Phase 1 change family conversations and support more learning? How long did visitors stay? Did they transfer strategies to other dioramas?*

While a dozen or more engagement strategies might be designed in Phase 1, only the four most

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promising will be fully evaluated in Phase 2 to determine which are most successful in providing the necessary support for families to establish shared focus and two-way, elaborated, scientific talk. Forty parent-child pairs/groups will be recruited through the same channels as in Phase 1. Half will experience the dioramas in their current (control) condition, and the other half will experience the dioramas with the engagement strategies/prompts.

Both groups will be audio-recorded (and, potentially, videotaped) to study conversational interaction. Participants also will be asked to complete a background survey to determine what other factors (level of education, number of museum visits per year, interest and knowledge about science/diorama content/nature, etc.) might influence the effectiveness of each approach. The two conditions (controls and prompts) will be set up on alternating data collection days. Audio/video data will be transcribed and analyzed to compare how conversations developed under the various test conditions and compared to the control condition. Cross-generational learning behaviors will be analyzed with a focus on joint attention to objects in the dioramas and/or any of the supports provided in the intervention. Parent-child conversations during the exhibit experience will be coded for three main conversational occurrences: verbally noting diorama objects; jointly attending to diorama objects and intervention materials; and engaging in “high-level talk.” High-level talk analysis will identify participants’ depth of scientific-noticing, ranging from everyday observation to expert observation, with attention to shifts in specificity, connections to larger concepts, and using evidence to form arguments for an idea.⁶

Post-experience surveys and interviews focusing on the themes from the curators will provide additional data to help clarify participants’ understanding of the disciplinary concepts behind each intervention. Additionally, surveys/interviews will gauge if/how participants’ experiences with the interventions influenced their overall experience of the museum.

A final report will document the project, including formative evaluation, research findings, and discussion of the iterative process and successful strategy designs. Additional documentation will include a peer-reviewed article, presentations at professional conferences, and pilot materials to support future renovations of CMNH’s diorama halls.

Project Budget: The total project budget is \$25,000, which covers direct expenses for the researchers from the University of Pittsburgh, a modest contribution toward personnel expenses for the museum’s director of learning research, costs for prototyping materials, and transportation for participants from community partner organizations. All other personnel and related expenses required for the project will be covered by the museum’s operating funds.

Project Results

Seeing as a Scientist is intended to produce gallery interventions that measurably impact families’ abilities to develop scientific observation skills. As such, it addresses the challenge set forth in the *21st Century Learning in Natural History Settings Conference*, i.e., to build on traditional missions and strengths to transform natural history museums into vital forces for education, science, and change. Even insights from less-than-completely-successful approaches

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are likely to be highly useful to the museum and others seeking more effective ways to use their collections and other assets to help people learn about critical concepts such as ecology, evolution, climate change, extinction, and biodiversity. By focusing on cost-effective and easily replicable interventions, the strategies are designed to be applicable in a wide variety of settings, from nature centers, zoos, and aquaria, to families' own backyards, thus benefitting a wide variety of potential users.

The project team is eager to share results of their work with museum practitioners, researchers, and anyone else who might integrate those approaches found to be successful into their work. In addition to the blog and white paper developed in conjunction with the project, findings will be disseminated through a variety of avenues. Local museum and academic communities will be engaged during the prototyping phase and at the conclusion of the project. A workshop-to-practice session will be provided for local museum educators to learn the approaches and then reconvene to report back on their implementation. A research talk will also be offered at the University of Pittsburgh's School of Education Colloquium. Nationally, presentations and workshops will be proposed for inclusion in research conferences of organizations such as the America Alliance of Museums, American Zoological Association, Association of Children's Museums, Association of Science-Technology Centers, Cincinnati Museum Center's Learning through Play Conference, and Society for Research on Child Development. Efforts will be made to publish the research in academic research journals such as the *Journal of the Learning Sciences*, a practitioner journal such as *Curator*, and/or an online resource center such InformalScience.org.

Within CMNH, successful strategies will be incorporated in a variety of public programs, including summer camps, school visits, and family programming. In the galleries, the results will inform future iterations of its classic diorama halls by providing insights not only into effective engagement strategies, but also about ways the exhibits themselves might be constructed to enhance scientific observation and attention without detracting from the scientific accuracy of the specimens displayed. Additionally, the deep learning gained throughout the iterative design process will increase the capabilities of both the museum staff and the university researchers and students.

¹ B. Wilson and S.R. Werb, "One Hundred Strong: A Colloquium on Transforming Natural History Museums in the Twenty-first Century," *Curator: The Museum Journal* 2013 56(2), 255-265.

² S. Palmquist, "From dinosaurs to disciplinary thinking: Exploring the impact of children's knowledge on family learning talk in a designed learning environment" 2012, doctoral dissertation.

³ K. Tison-Povis, "Observing Together: Joint Attention and Conversations around Natural History Dioramas" 2013, unpublished manuscript.

⁴ K. Tison-Povis, "M is for Museum Evaluation" 2013, unpublished evaluation.

⁵ C.E. Eberbach and K. Crowley, "From Everyday to Scientific Observation: How Children Learn to Observe the Biologist's World," *Review of Educational Research* 2009 79(1), 39-69.

⁶ *Ibid.*, 39-69.

