Create.Connect

SUMMATIVE EVALUATION REPORT

Alice Anderson[•], Marjorie Bequette[•], Allison Cosbey[°],
Gretchen Haupt[•], Catherine Hughes[°]
2016

[•] Science Museum of Minnesota
[°] Conner Prairie Interactive History Park

Acknowledgements

The authors would like to thank our fellow evaluators who contributed to the Create.Connect project: Ameido Amevor, Al and Betty Kobilic, Al Onkka, Gayra Ostgaard Eliou, Molly Phipps, Maija Sedzielarz and Amanda Svantesson DeGidio. Our advisor to the evaluation, Jessica Luke, provided a tremendous amount of helpful support and guidance in all phases of the project. The Create.Connect exhibition was made possible by the generous grant support of the National Science Foundation, the Duke Energy Foundation, and the Institute of Museum and Library Services.

This report was based on work supported by the National Science Foundation under Grant No. 1223770. Any opinions, findings, and conclusions or recommendations expressed in this report are those of the author(s) and do not necessarily reflect the views of the Foundation.

Suggested Citation: Anderson, A., Bequette, M., Cosbey, A., Haupt, G. & Hughes, C. (2016) *Create.Connect Summative Evaluation Report*. St. Paul, MN: Science Museum of Minnesota.

Table of Contents

Executive Summary

In 2012, the Conner Prairie Interactive History Park began work on the National Science Foundation-funded *Prairie Science* project. Its goal: to produce a framework for integrating informal science experiences into exhibitions, interpretation, and programs at historic sites and museums. From the outset, the core project team acknowledged that the task of integrating STEM (Science, Technology, Engineering, and Math) and History learning would challenge the norms of both disciplines and institutions. Conner Prairie is a history museum in Fishers, Indiana, with a long tradition of exploring novel exhibition and interpretation strategies to engage visitors with history. In this project, Conner Prairie collaborated with the Science Museum of Minnesota to find ways of integrating STEM learning into existing offerings at history institutions, to create experiences that are meaningful to audiences, culturally respectful of their subjects, historically authentic, and scientifically accurate.

The project, which became known as Create.Connect, resulted in three major products:

- the *Create.Connect* exhibition at Conner Prairie,
- four smaller exhibitions at partner institutions,
- and a framework for sharing the process of creating experiences at history institutions that blend STEM and history learning for families.

In this report we describe the impact of the project on the two main audiences: family visitors to *Create.Connect* and the professionals at four partner history institutions. The report was collaboratively written by evaluators at the Science Museum of Minnesota and Conner Prairie.

A family watches a news program from the 1950s.

The *Create.Connect* Exhibition and Installations at Partner Institution

First, the core project team (comprised of Conner Prairie and Science Museum of Minnesota staff) developed *Create.Connect*: a 2,500 square foot exhibition focusing on historical stories of innovation in Indiana integrated with STEM interactive activities. The exhibition is organized into four nodes, each with a strong and clear narrative, activity table, experiment bench, and historical objects and setting pieces.

In addition, four partner institutions installed exhibit components adapted from *Create.Connect* with the guidance and support of the core project team. At Mystic Seaport and the California State Railroad Museum, these exhibit pieces were integrated into larger exhibitions with other STEM interactives. The additional planning and funding of these exhibitions was inspired by the sites' participation in *Create.Connect*.

- **California State Railroad Museum**, in Sacramento, California, has integrated electrical-circuit activities from *Create.Connect* into a new exhibition about the 1950s transition from steam to diesel/electric-powered railroads.
- **Wabash County Historical Museum**, in Wabash, Indiana, has highlighted a moment in history —the lighting of Wabash in 1880—to engage audiences in a circuit-building activity and story elements from *Create.Connect*.
- **Mystic Seaport**, in Mystic, Connecticut, has integrated a wind-speed activity and various story components from *Create.Connect* into a larger exhibition called *The Search for Speed*.
- **Oliver H. Kelley Farm**, in Elk River, Minnesota, will be installing historical settings and a wind-energy activity from *Create.Connect* in its new visitor center opening in late 2016. Until then, the exhibit interactives are available to visitors in a temporary facility.

The process of creating this framework for integrating STEM activity pieces with history institutions' other exhibits has been refined and documented over the course of the project. The project web site, **www.createconnect.org**, captures the stories of how each partner site adapted pieces of *Create.Connect* to its own institution and offers guidance for other institutions on approaches to programs, facilitation, STEM activities, and History interactives.

Summary of Evaluation Findings

This evaluation examines both the experience of visitors to the *Create.Connect* exhibition (and, to a lesser extent, visitors to partner institution exhibitions) and the experience of the professionals working together to develop and adapt the exhibition. The evaluation questions focus on four broad dimensions of this project:

1. Visitors' behaviors in the exhibition,
2. Visitors' attitudes towards the exhibition,
3. Visitors' conversations in the exhibition, and
4. Partner institution's experiences with and perspectives on the exhibition.

Overall, we found that the work accomplished is of high quality and has had significant impact on both staff at partner institutions and visitors to the exhibitions. Major findings include:

Impact on Visitors to *Create.Connect*

According to several measures, visitors engaged with and enjoyed the *Create.Connect* exhibition at Conner Prairie.

Visitor Experience

- All respondents said they are likely to return to *Create.Connect* on their next visit to Conner Prairie.
- Almost all visitors reported thinking that *Create.Connect* fits in at Conner Prairie because the exhibition is historical. Some mentioned that it was different from the rest of Conner Prairie, and they liked the variety.
- Visitors most frequently mentioned a hands-on STEM activity table as what they enjoyed about their time in *Create.Connect*. These activity tables were also the most frequently visited components.
- Children typically persisted with the STEM activities and used different problem-solving approaches, but the presence of adults increased stay times, instances of iterative behavior, and reaching an endpoint. This effect was observed regardless of whether the adult was a Conner Prairie facilitator or an adult in the child's group.
- Among other changes to the exhibition, adding historical settings that offered a more immersive environment with interactive historical objects seemed to help visitors slow down and spend more time in the exhibition.

Gender Equity

- In *Create.Connect*, boys and girls not only explored in similar ways, but they explored the exhibition for similar amounts of time. In fact, girls' median stay time in the exhibition was slightly longer than boys'.
- Boys and girls also engaged in similar types of conversation with their families and facilitators. Girls, though, received more emotional support from adults and more often participated in connection-making. Girls also participated in more conversations that contained evidence of Historical Thinking Strategies.

Interdisciplinary Dialogue

- Visitors have on-topic conversations during almost their entire visit in *Create.Connect*.
- Different activites prompt different kinds of conversations. For example, the Wind Turbine Bench is frequently the site of modeling conversation, while conversations at the Plane Activity Table more commonly focus on Cause and Effect.
- History Exploration conversations happened more frequently among older children than younger children, while STEM exploration happened with the same (very high) frequency across all age groups.
- Roughly half of visitor groups verbally explored STEM and History ideas within the same conversation. This talk is indicative of the type of interdisciplinary learning that the Create.Connect project was designed to promote.
- Instances of higher-level STEM thinking were distributed evenly throughout the four areas, but the Electricity area was the location for 59% of higher-level historical thinking conversations.

Impact on History Institutions and Staff

The professionals involved in Create.Connect seem to have a high level enthusiasm for approach. Staff from partner institutions shared the evolution of their thinking over the course of the project, which provided insights into how challenges encountered during the project informed the developing framework and how they envision this model might work in additional settings. A few highlights of their reflections are as follows:

Collaborative Approach

To guide their collaboration, the core project team called upon a shared commitment to find places at which STEM and History complement one another in meaningful ways. This clear focus helped frame decision points and establish the framework for finding local historical narratives that complimented STEM activities.

Supporting Partners

- Each of the four *Create.Connect*-inspired exhibitions built by history institutions was well-received by its staff and visitors.
- Partner institutions reported on the successful integration of the physical exhibition into their space.
- Partner institutions reported that their participation in the project has resulted in or supported additional initiatives aimed at bringing STEM learning into history institutions.
- As they tackled the challenges associated with building their own exhibits, staff at partner institutions valued seeing the *Create.Connect* exhibition multiple times in person, and to see how it was changed because of evaluation feedback.
- The collaboration among the four partner institutions revealed that future work in this area will likely be supported through professional networks with guidance from Conner Prairie and the Science Museum of Minnesota, using the STEM/History integration framework developed out of this project.

Continuing to Develop the STEM/History Framework: Emergent Theories

The *Create.Connect* exhibition and interpretation strategies were developed out of discussions about how to develop experiences that integrated STEM and history learning. These conversations were informed by both formal and informal educational research literature from both disciplines, as well as prior experience. But these resources often felt unsatisfying for the interdisciplinary goal of the project: "sustained, creative activity where visitors engage in creative approaches to solving problems incorporating STEM and historical thinking." As the project team began to develop the exhibition and put their assumptions, beliefs, and ideas into action, a few "emergent theories" developed. The working theories listed below are a combination of those that were incorporated into the *Create.Connect* exhibition and suggestions for further areas for exploration—both for exhibition development and informal education research:

1. Historical empathy is an important skill. In *Create.Connect*, one way to build that empathy is to have visitors explore STEM challenges people faced in the past.
2. Understanding historically based, real world applications of science can motivate children to explore STEM concepts, and experimenting with STEM concepts can motivate children to explore real world application of science, both present and past.
3. Visitors are willing to be multi-disciplinary learners who make connections and explore different topics while incorporating their own relevant experience and perspectives.
4. Multiple entry points, open-ended exploration, and narrative storytelling at each of the exhibit nodes are key for engaging families and providing access to all learners.
5. Extended stay times allow visitors to explore STEM processes and historical thinking more deeply; adult-child interactions (with both staff and family members) help support longer stay times.

Throughout the evaluation report, we revisit (a) how these theories are reflected in the evaluation data and (b) where these ideas are ripe for further exploration.

A Conner Prairie facilitator (blue shirt) works with visitors at the windmill activity table.

Introduction

The Create.Connect Exhibition at Conner Prairie: A Framework for Approaching STEM and History Integration

A description of the Create.Connect exhibition, the process of its development, and how it relates to other experiences at Conner Prairie.

By Catherine Hughes°, Allison Cosbey°, and Brian Mancuso°

Project Goals

Starting in 2007, Conner Prairie began highlighting the role of the sciences in its programming. This came about in response to the national crisis in STEM education, expressed in reports from National Science Board and other agencies.[1] With a mission to inspire curiosity and foster learning, Conner Prairie sought to diminish the disciplinary boundaries and explore the intersections of science and history. Across the outdoor grounds, interpreters highlighted historical activities that demonstrated scientific concepts (like churning butter) or emphasized math (as in a recipe or making change in Whittaker's Store). A Science Lab of activities was built inside Connor Prairie's Welcome Center. Eventually, these projects coalesced into something called the Prairie Science Initiative. Expanding upon these ideas in 2010, Conner Prairie leadership sought to create a separate exhibition that could feature not just isolated demonstrations or the history of science, but also highlight the active processes of the scientific method embedded in historic stories. The new push was an effort to truly integrate history with science, rather than embedding science activities into a history museum.

Conner Prairie partnered with the Science Museum of Minnesota and secured a grant from the National Science Foundation to develop the *Create.Connect* exhibition. In addition, Conner Prairie wanted to enable and encourage other historic sites to integrate science by disseminating, as a model, the *Create.Connect* concept and the process of its creation. Conner Prairie leadership saw it as an opportunity to affect change in the many historical museums and societies scattered throughout the country (often in areas without a science museum), to bring attention to the important role of science, engineering, and technology in shaping the past, and to create fun, hands-on ways for visitors, particularly families and children, to learn about scientific processes and principles related to historical topics.

[1] See National Science Board. A National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System, NSB-07-114; http://www.nsf.gov/ nsb/edu_com/draft_stem_report.pdf (accessed March 2016); Business-Higher Education Forum, A Commitment to America's Future: Responding to the Crisis in Mathematics and Science Education, (Washington, DC: Business-Higher Education Forum, January 2005). http://www.bhef.com/solutions/MathEduPamphlet_press.pdf (accessed March 2016).

°Conner Prairie Interactive History Park staff

Create.Connect Exhibition Design

Throughout the project, evaluation and research played an important role in informing the development and revision of the *Create.Connect* exhibition. The version of *Create.Connect* visitors experience today (2016) is vastly different from the first version, installed in early 2013. The first exhibition was very traditional, in the sense that proximity between exhibit components was the only method of supporting and guiding connections between STEM activities and historical materials. It was comprised of three nodes of different historic moments in Indiana's history that were linked with a scientific focus; each had a large kiosk covered with historical photos, label copy, and objects (cased for small objects or behind a barrier for larger ones), and was paired with both a large, wooden work table for make-and-test activities and an activity bench (included to provide activities that required less active facilitation). The exhibition team consciously chose three historical moments of invention or innovation within the last 100 years of Indiana history, moving through time and space, to break from the perception that Conner Prairie addresses only 19th century history. Each node had almost identical elements with no historic finishes or large graphics. In our observations of visitor behavior, visitors appeared to be the most engaged with the hands-on STEM activities and the make-and-test tables, while the historical materials were largely unexplored. The iterative nature of the project enabled us to find a better balance between science and history by establishing place-making elements, strengthening the historic narratives, and increasing access to historical objects.

To pilot the next version of the *Create.Connect* concept, the exhibition team chose the Electricity node, paired with a story of the effect of the Rural Electrification Act (REA) in 1936. Out went the monoliths and long label copy. In went interactive objects and an immersive environment resembling a 1936 farm kitchen in rural Indiana that had just received electricity.

Installed in the modular wall system are two windows, complete with curtains. In one window, a video screen shows historical and modern images of rural Indiana. The walls are painted white and green and decorated with a chair rail. In one corner, a calendar shows the date in 1936. Visitors can open this calendar to reveal more information about the Rural Electrification Administration (REA), the New Deal program that brought electricity to Indiana farms for the first time.

Conner Prairie

Figuring out the contraptions at the Ball run experiment bench.

To prompt connections and comparisons between now and then, large historic pieces were added, such as an actual 1930s-era stove that invites hands-on exploration with its many doors and compartments. Opening these, visitors find coal and replica food, as well as short-form labels describing the importance of coal stoves like this one. These short-form labels include inquiry-based questions, in keeping with Conner Prairie's Opening Doors[2] ethos of instigating conversations through open-ended questions. Near the stove, a single, bare Edison-style bulb hangs from the ceiling, and a heavy pre-electric iron serves to demonstrate how difficult this simple chore was before electricity. In the center of the room an actual radio from this era was placed, re-engineered to play digital content such as music or a radio program—a Conner Prairie creation about rural electrification. The node also features an authentic Hoosier cabinet and a refrigerator which, like the stove, are filled with authentic and replica items and food from the historical period, as well as short labels that share more about farm life after the advent of electricity. All of these additions in the REA node were geared toward fostering intergenerational conversations within social groups like prompting visitors to talk about the historical objects in relation to their own personal histories. ("My grandmother had this stove!")

The STEM activity, a make-and-test activity table, received only slight modifications. At the activity table, visitors are presented with an array of electrical elements, a variety of switches, clip-on wires, and battery packs. Using these, visitors try to make working circuits that can power an element like a light. The wooden blocks that hold the electrical elements were printed to look like household appliances—for example, a red LED represents an iron. Once the visitor has created a working circuit, they can place that appliance in a floor plan of a house, just as families in rural Indiana in the 1930s did to plan their own household wiring. The team also added another activity- an experiment bench- in this phase of modifications. The experiment bench presents a variety of electrical components that snap together with magnets. Here visitors experiment with AC and DC power. By following instructions on a computer screen, they can complete a variety of experiments that demonstrate the properties of alternating current (AC) and direct current (DC). An oscilloscope, an electronic test instrument, makes the electrical flow "visible" and is an introduction into this real-world STEM tool.

After these changes were made to the Electricity node, a timing-and-tracking study showed an increase in visitors' stay time in that area. Encouraged that the installation of immersive and historic elements described above appeared to be strengthening the historic narrative and having a positive impact on visitor engagement, the team then began to fully develop the other exhibit nodes. The STEM activities were—as much as possible—historically themed, and utilized graphics, materials, and images in order to support the context. Historical content was embedded inside setting pieces, such as a label discovered by opening a door of the coal stove, and on historical (or reproduction) objects to encourage exploration and engagement.

[2] Opening Doors began as a research study; the outcome was an approach to interpretation that provides new ways to engage Conner Prairie guests and deliver the kinds of hands-on, interactive experiences that open a dialogue and start a larger discussion about history and the world around us. http://www.connerprairie.org/About-Conner-Prairie/Driven-by-Our-Mission/Our-Mission-at-Work (accessed March 2016).

***Create.Connect* exhibit elements:**

- Physical setting (wall set, paint, furniture) to emphasize time period
- An activity table for making and testing something (e.g. a circuit, a windmill)
- Other interactives that demonstrate STEM concepts (experimentation benches)
- Historical objects (authentic or reproduction), as accessible as possible
- Introductory label copy to orient visitors to the setting
- "Snoops": hands-on, explorable exhibit elements or objects (e.g., patent copies in drawers or historical tools hidden in cabinet)
- Period-appropriate audiovisual media that interprets the historical narratives being told (e.g., the Early Aviation node features a silent movie)
- Loose materials, reproductions of primary sources, books, or magazines to invite in-depth exploration and to enhance the setting
- Integrated labels hidden within explorable objects like a coal stove or in hands-on flipbooks to invite exploration of the historical story
- A mix of objects, labels, and activities that target different styles of learners

Conner Prairie

A Conner Prairie facilitator demonstrates how the rubber bands make the paper airplanes fly at the Airplane activity table.

Conner Prairie

Watching the ball roll at the Ball run experiment bench.

Conner Prairie

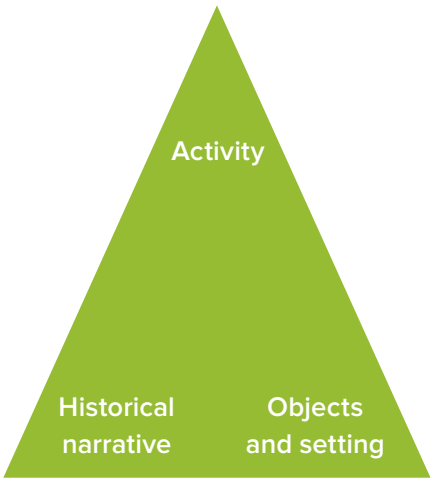
Selecting a program on the 1950s era TV.

Anchoring Ideas for Each Node

As evaluators began the remedial evaluation, we began to formalize how we could anchor each node and build four cohesive settings. In the end, we realized there were various successful routes by which to merge science and history goals into the exhibition while avoiding the need for extensive explanation to visitors.

First was the STEM-based activity (bench and make-and-test activities). Since the integration of STEM and history was under investigation, partners from the Science Museum of Minnesota suggested the use of several successful and proven activities from their exhibits rather than creating new ones. For example, the Chain Reaction Activity, where visitors can assemble materials to build and test a chain reaction machine, originally referenced a Rube Goldberg engineering competition at Purdue as its historic basis. The remedial evaluation found the Purdue story caused confusion, but the activity was a successful anchor around which to build a new and better narrative about inventions in an Indianapolis Patent Office during the space race of the 1950s.

In the Electricity node, narrative—always central to these Indiana history-based experiences—became the key aspect. As historical research progressed into the Rural Electrification Act (REA), it became apparent that the story was a perfect fit for *Create.Connect*. This moment in Indiana's history, when power came to rural farms, serves as a perfect stage to explore STEM/History intersections. The other elements developed from there.



Three-dimensional objects and their ability to stimulate senses and transport visitors into the past became the third anchoring idea. Conner Prairie had in its collection a full-size and functional historic windmill. Its majestic presence provided the central interpretive tool in the Wind Power node, establishing time, place, and narrative. These three elements—activity, narrative and setting—came to be considered our exhibition design framework for integrating science at a history museum (see Hughes, Mancuso & Cosbey, 2015). The objects and Snoops support the visitor in making connections among the narrative, the activity, and themselves. Setting gives the activity a reason to exist. Narrative brings the history into the activity and shows the STEM in the objects that comprise the setting. The activity offers a hands-on STEM experience and plays a part in driving the narrative.

Each of the four nodes contains similar types of interactives:

- The Rural Electrification Act (1936) includes two electricity interactives to explore an electric circuit and AC versus DC power.
- Flight in Indiana (1910) includes three interactives that explore flight, lift, and wind.
- The Patent Office (1957) tells stories of innovation and invention in Indiana and has two interactives that explore simple machines.
- The Windmill node (1900) shares the story of wind power and energy transfer and has two interactives that allow visitors to create windmills and measure their energy output.

Staff Facilitation in *Create.Connect*

At a living history site like Conner Prairie, conversation is a core programmatic element. During their visit, guests meet and converse with staff in uniform or in historic costume. These interactions serve as a platform for learning about history or science at Conner Prairie. In *Create.Connect*, there are both uniformed third-person interpreters and costumed first-person interpreters who facilitate visitor engagement through conversation.

As the exhibition prototype neared completion, the final anchoring tool to emerge was historical character. While Indiana had many roles in the early days of aviation, these stories are often overshadowed by the Wright brothers. By creating a young composite aviatrix character, who is a fan of the various Indiana aviation pioneers, multiple stories could be bundled together and serve as the basis for experimenting with air flow, design, and lift. In this node, her story was built into a cabinet that holds her scrapbook, sketches, newspaper clippings, goggles, and other historically-reproduced items. When an interpreter is playing this aviatrix, she can invite guests to explore her cabinet and workshop, and reference her personal experience with the objects and ideas of early aviation. When this character is not present, a uniformed interpreter can share her story in third-person while inviting guests to experiment with air flow and lift. In this way, interpreters are able to move from one node to the next whether they are in costume or not.

The current study of *Create.Connect* and of conversations that occur in this exhibition harkens back to an earlier study called "Opening Doors" conducted at Conner Prairie (Rosenthal and Blankman-Hetrick, 2002), which also considered visitors' conversation as a way to understand learning. Growing out of other research that suggested that learning happens when visitors talk about what they have seen, remembered, and explored (Leinhardt and Crowley, 1998; Schauble, Leinhardt, & Martin, 1998), this study used transcripts of family group conversations as a unit of analysis. The pedagogic aspect of conversation is in the give and take of dialogue, with questions and answers, comments and reflections. Such reflexive and reciprocal qualities are necessary for learning to result (Burbules and Bruce, 2001).

At the time of the Opening Doors study, the interpreter's role was determined to be a conversation catalyst and support for parents to engage their children. Rosenthal and Blankman-Hetrick (2002) found that a "learning conversation was more apt to happen between parents and children if an interpreter had stimulated it" (p. 325). This study led to interpretive changes at Conner Prairie, which continue to serve as the foundation for all conversational interactions with visitors, as well as impact interpretive text and labels.

***Create.Connect* facilitation elements:**

- Opening Doors interpretation is about engaging visitors in conversations rather than presenting information in a monologue.
- It is visitor-centered, rather than driven by set interpretive or educational goals.
- The objective is to find out what the visitor might find relevant or significant and move into conversation from there.
- Conversational goals include trying to provoke visitors' interest in an activity or subject, and endowing the visitor with knowledge and experience that enables entrée into a discussion.

Ultimately, while these ideas served as primary drivers for the four nodes, we, the interpretation and design staff, realized each node required all four ideas to truly integrate history and science. We were gratified to see that evaluation showed the combination of objects, story, interpretation, and STEM activity had a favorable impact on the experience.

A costumed Conner Prairie interpreter watches as a visitor tries out the 1930s stove.

A costumed interpreter talks with visitors in the windmill area.

Visitor try out different blades on the windmill mechanism with a Conner Prairie facilitator.

Summative Evaluation: Design and Methods

The goals of this Summative Evaluation were to determine if *Create.Connect* was appealing and engaging for visitors to Conner Prairie, how visitors explored STEM and History ideas during their visit, and to reveal lessons learned from the partner institutions about *Create.Connect* exhibit components at other history institutions. Guiding the evaluation were project-wide questions about how the two disciplines could be integrated in an informal setting and whether visitors would feel that the exhibition fit in a history institution. Specifically, the Summative Evaluation was designed to speak to four broad dimensions of this project:

1. Visitors' behaviors in the exhibition,
2. Visitors' attitudes towards the exhibition,
3. Visitors' conversations in the exhibition, and
4. Partner institution's experiences with and perspectives on the exhibition.

Evaluators at the Science Museum of Minnesota led the evaluation, with significant collaboration and input from evaluation staff at Conner Prairie. Jessica Luke, Director of the University of Washington's Museology program, was the external evaluation advisor. She gave feedback and guidance on instrument development, data analysis, and report writing.

Evaluation History

Evaluation played an important role in both developing *Create.Connect* and in supporting partners to develop their own exhibits over the course of the three-year project. The *Create.Connect* exhibition was built through an iterative development process guided by three phases of evaluation. In each phase we gathered data from visitors through multiple methods (surveys, interviews, and timing and tracking), which allowed for analysis of the visitor experience through both their behavior and attitudes.

The initial formative phase began with the first prototype exhibit. We used observation and timing and tracking protocols to measure where visitors stopped, whether there was sustained engagement with the activities as measured by stay times, and whether visitors exhibited the kinds of behaviors indicative of scientific experimentation and engineering design (such as building, testing, making modifications, and creating successful designs). We also interviewed adult visitors and their families to capture their reactions to *Create.Connect* and if they thought the exhibition fit in at Conner Prairie. After the initial round of exhibit development and First Formative Evaluation, changes were made to the exhibition, and a Second Formative Evaluation was conducted. The Summative Evaluation took place after the final version of the exhibition had been open to the public for three months. This report primarily refers to data collected during the Summative Evaluation, unless otherwise noted.

Table 1. Timing and Methods of Evaluations

First Formative Evaluation Summer 2013	**Second Formative Evaluation** October 2013	**Summative Evaluation** Summer 2014
Timing and Tracking (n=67) Focused Observation of Activities (n=100) Family Exit Interview (n=93)	Timing and Tracking (n=91) Family Exit Interview (n=66)	Timing and Tracking (n=157) Exit Surveys (n=101) Lobby Survey (n=100) Recorded Family Conversations (n=35)

Summative Evaluation Methods

1. *Create.Connect* Timing and Tracking

A timing and tracking study documented visitors' behavior in the *Create.Connect* exhibition. Timing and tracking data were collected every day of the week (except Monday, when Conner Prairie is closed). Data collection took place over 25 days between June 21, 2014, and August 12, 2014. A sign was posted at the entrance to the exhibition notifying visitors that they might be observed. Data collectors used continuous random sampling to select a family (defined as a multi-generational group whose members were visiting Conner Prairie together) with at least one child who appeared to be age four or older. Data collectors then purposely selected an individual from the family to track, with the goal of obtaining a sample with a balanced number of girls and boys (i.e., females and males under age 18) and sufficient numbers of adults for analysis. Data collectors noted the estimated age and perceived gender of the individual being tracked, where the individual stopped, how long they stayed at each element, and whether observed instances of pre-defined target behaviors were present. These observable behaviors, like trying more than one approach to solve a problem, are associated with successful interactions with STEM activities, and are explained in more depth later in the report (page 22). A total of 157 timing and tracking cases were collected; 69 were adults and 88 were children. The 88 child cases included 44 boys and 44 girls. See appendix 1 for the Tracking and Timing protocol and map of the Create.Connect exhibition.

2. *Create.Connect* Exit Surveys (Page 32)

In order to determine visitor attitudes about the final *Create.Connect* exhibition, we conducted a survey with a sample of visitors as they exited *Create.Connect*. Exit surveys were conducted every day of the week except Mondays (when Conner Prairie is closed). Surveys were collected across 24 days between July 24, 2014, and September 1, 2014. Data collectors used continuous random sampling in a designated spot outside of the *Create.Connect* exhibition. They approached visitors who appeared to be age 18 or older who were visiting with at least one child who appeared to be age four or older. Data collectors only approached groups who spent five minutes or more in the exhibition. The survey instrument combined a written protocol with verbal follow-up questions and focused on visitors' attitudes about the *Create.Connect* experience: whether it was interesting and enjoyable for them and their children, specific things they learned or enjoyed, their interest levels in history and science, and their opinions about the thematic focus of *Create.Connect* and how well the experience fit with the rest of Conner Prairie. The survey took about eight minutes to complete, and visitors received a coupon for a free ice cream at Conner Prairie's café as a thank-you for their participation. A total of 101 exit surveys were collected; 41 visitors declined to participate. See appendix 2 for the Exit Survey and Interview protocol.

Data collectors also collected surveys in the entrance lobby of Conner Prairie from visitors who had just checked in at the ticket desk and were on their way into the exhibitions. The purpose of this survey was to generate a description of general Conner Prairie visitors with regard to their interest in STEM and History. Lobby surveys were collected on six weekdays between July 24, 2014, and August 12, 2014. The sampling protocol was the same as the exit survey, and the survey instrument repeated many questions from the exit survey except for those focused on *Create.Connect*. A total of 100 lobby surveys were collected; 89 visitors declined to participate.[3] See appendix 2 for Lobby Survey and Interview protocol.

3. *Create.Connect* Recorded Family Conversations (Page 45)

To better understand family interactions in *Create.Connect*, data collectors audio recorded the visits of adult-child dyads. This data was collected across four days in April 2014 and two days in August 2014. Family groups who had at least one child who appeared to be age four or older were approached as they entered *Create.Connect* and asked if they would help evaluators learn about the exhibition by wearing microphones during their visit. The sample of groups was evenly distributed in terms of age (in three groups: 6-years-old and younger, 7 to 9-years-old and 10 to 13-years-old) and gender.

Families who gave consent to participate chose two individuals—one adult and one child—to wear small lavaliere (clip-on) microphones, and they were told to use the exhibit as they normally would. Data collectors then observed the families as they explored *Create.Connect*, listening in on their conversations and taking note of interactions that seemed to indicate STEM or History exploration. When the family indicated that they were ready to leave *Create.Connect*, a data collector conducted a reflective interview with the adult, mentioning significant moments they had observed and asking the adult to reflect and elaborate on their experiences in the space. Immediately after each case, the data collector wrote a detailed case memo summarizing the family's visit and the information shared in the reflective interview. Families received two coupons for free ice cream in Conner Prairie's café as a thank-you for participating. A total of 36 family conversation cases were recorded, and 35 were viable for analysis (one family spoke Spanish during their time in *Create.Connect*). See Appendix 3 for Family Conversations Recruitment and Interview protocol.

4. Partner Institution Study (Page 72)

Information about the experience of working on *Create.Connect* was gathered from staff at all six participating sites during the active phase of the project. The group included the core project team Conner Prairie and Science Museum of Minnesota, as well as four partner sites: California State Railroad Museum, Mystic Seaport, Oliver H. Kelley Farm, and Wabash County Historical Museum. The core team commenced collaboration when the grant began in September 2012, but the partners (selected by the core team to represent the diversity of institutions in the History field) were officially introduced to the project in January of 2013.

Data from partner staff (mostly qualitative) were collected via surveys, interviews, and observations, and were analyzed for emergent themes that would (a) answer the project's evaluation questions and (b) provide take-away lessons about what led to the success of *Create.Connect*—both at Conner Prairie and the four partner sites. See Appendix 4 for a list of staff participating in workshops and interviews.

[3] Data was not collected on the demographics of visitors who declined to participate.

Visitors working hard at the Invention activity table.

Results and Discussion

1) Visitor Behavior in *Create.Connect*

As described in the previous section, a timing and tracking study was implemented to determine where visitors were spending their time, in what ways they were interacting with the exhibit elements, and if there were changes in dwell time and other measures of engagement compared to previous formative evaluations in the exhibition. As is standard in studies of timing and tracking, a visitor was counted as "stopping" at an exhibit element if they had their feet planted facing the element for at least three seconds (Serrell, 1998). See Appendix 1 for floor plan and exhibit elements.

Dwell Time

The overall time a person spends exploring an exhibition, which we will refer to here as "dwell time," is a standard measure of engagement in museum settings. Longer dwell times can suggest that visitors find the elements in the exhibition interesting and enjoyable, and longer dwell times also offer more opportunities for learning to occur (Serrell, 1998). The median dwell time for all visitors in *Create.Connect* was 13 minutes, 31 seconds. Children who were tracked and timed had a slightly higher median dwell time than adults.

Table 2: Median Dwell Times: Summative

	Median dwell time	Median number of stops	Median dwell times per stop	*n*
All	0:13:31	3	0:03:27	157
Children	0:14:48	3	0:03:40	88
Adults	0:12:06	4	0:03:25	69

Children's dwell times in the Summative Evaluation were higher than those recorded in the two previous iterations of the exhibition, with the summative dwell time being nearly three minutes longer than the dwell time recorded during the Second Formative Evaluation, and almost 10 minutes longer than in the First Formative Evaluation; both previous evaluations were conducted with earlier iterations of the exhibition (Figure 2). This suggests that the changes in the exhibition made following the First Formative Evaluation resulted in families spending significantly ($p<0.001$) more time in the exhibition[5]

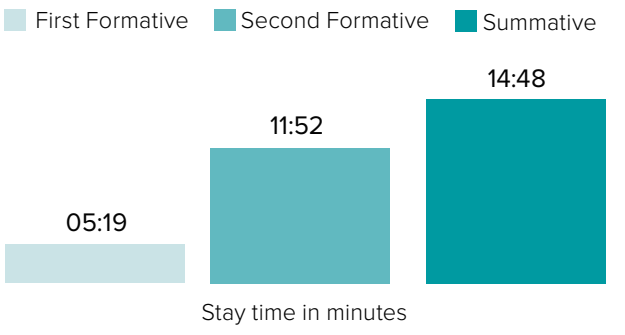


Figure 2: Children's Median Dwell Time during Each Phase of Evaluation

It is important to note that although there were more exhibit elements installed during the Summative Evaluation than during previous iterations, visitors' median number of stops stayed the same (three stops). Visitors did not seem to be stopping at more elements, but rather they seemed to be slowing down and spending more time when they stopped. Though dwell times among all children increased following changes made after the Second Formative Evaluation, the differences were not statistically significant.[6]

[5] Changes made between the First Formative Evaluation and the Summative Evaluation include the introduction of more immersive historical environments, the addition of hands-on historical objects, the creation of a fourth exhibit area, and additional activities.
[6] Dwell time data was skewed by a handful of exceptionally long cases. We accounted for this during data analysis, but it did not impact significance. Please refer to tables 24 and 25 in Appendix 1 for mean and medians, along with p values.

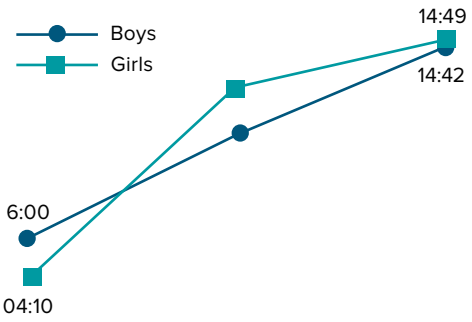


Figure 3: Boys' & Girls' Median Dwell Times in minutes during Evaluation Phases

While the median dwell times of girls (females under age 18) were slightly higher than boys' (males under age 18) after the introduction of a more immersive historical setting in the Electricity area, the differences are not statistically significant, which strongly supports the assertion that *Create.Connect* is successfully employing best practices to engage visitors of both genders. Girls also tended to make more stops while exploring the exhibition, with a median of 4 stops compared to boys' 3. Both of these findings are encouraging, as the exhibition team was concerned about girls' engagement in the space after the First Formative Evaluation found boys' median dwell time in *Create.Connect* and at activity tables was slightly higher than girls (Figure 3).

Sweep Rate Index

The sweep rate index (SRI) of an exhibition is a measurement that can be used to compare dwell times to those of other exhibitions of the same type by dividing the square footage by the exhibition's median dwell time (Serrell, 1998). The summative SRI for *Create.Connect* (a 2,330 square foot exhibition) was 175 feet per minute. This is lower than the benchmark SRI listed in Serrell's timing and tracking database (300 feet per minute) which shows that guests experience *Create.Connect* at a slower pace than is typical for museum exhibitions of this size (Serrell, 2009).

Frequency of Dwell Times and Number of Stops

The majority of case groups (54%) spent less than 15 minutes in *Create.Connect*, though there were fewer short visits when compared to the Second Formative Evaluation (71% of case groups spent less than 15 minutes in the Second Formative Evaluation—see Figure 4). Also, the summative data showed an increase in longer *Create.Connect* visits, with 5% of case groups spending more than 50 minutes in the exhibition. The highest recorded dwell time was 67 minutes. This increase in the number of longer *Create.Connect* visits is an indicator of increased engagement in this final version of the exhibition. The data set represents a skewed distribution, with more visits on the shorter end of the scale; skewed distributions are typical for exhibition dwell time data (Serrell, 1998).

Attraction Power of Exhibit Elements

Activity Tables and Experiment Benches

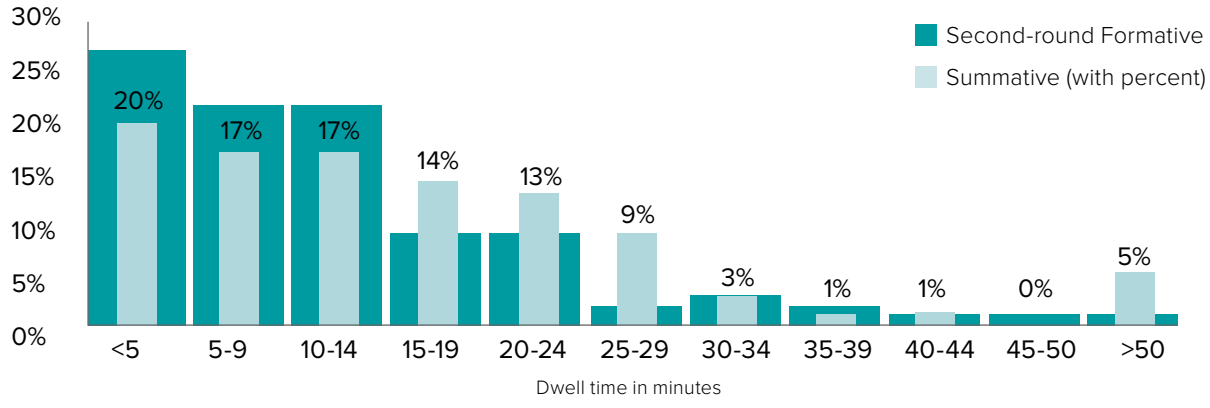


Figure 4: Frequency of Dwell Times for Children

Timing and tracking can assess the attraction power of individual exhibit elements. Table 3 shows what percentage of visitors stopped at the exhibit components in *Create.Connect*.

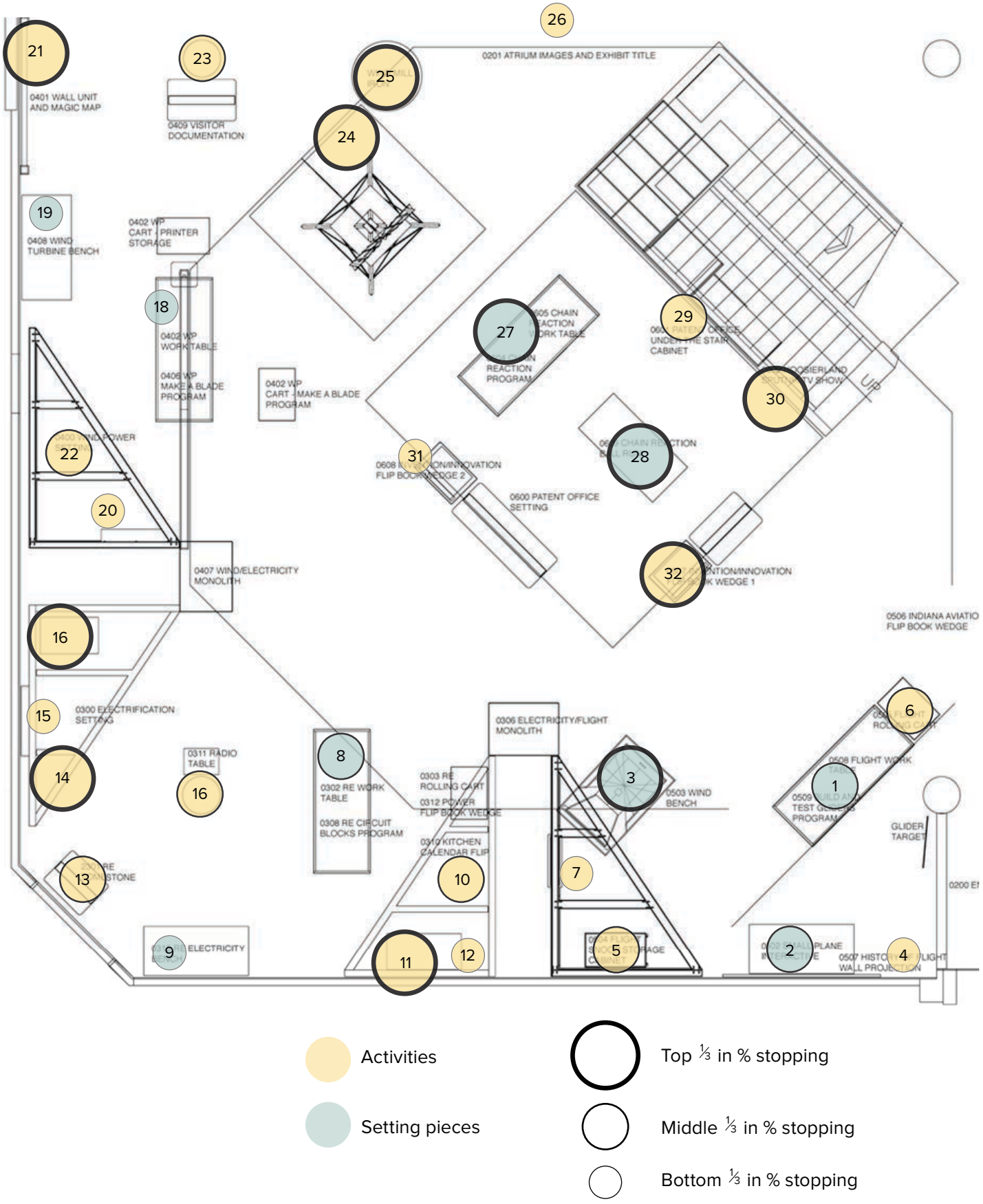
The hands-on activities were by far the most frequently visited exhibit elements in *Create.Connect.* Nearly all visitors stopped at them; only two (one adult and one child) of the 157 tracked visitors did not visit an activity table. Activities farthest from the exhibition entrances tended to be visited less frequently than those in the front of the exhibition (see heat map, Figure 5). Also, activities that could be accessed from multiple sides were more frequently visited than activities located along the walls.

Table 3: Stopping at Activity Tables

	Exhibit Component	Percent of Visitors who stopped	
3	Flight/Wind Experiment Bench	50%	Top ⅓ of activities in attraction
28	Ball Run Experiment Bench	49%	
27	Invention Activity Table	44%	
8	Circuit Blocks Table	31%	Middle ⅓ of activities in attraction
1	Airplane Activity Table	30%	
92	Mini-Plane Experiment Bench	24%	Bottom ⅓ of activities in attraction
18	Windmill Activity Table	24%	
9	Electricity Experiment Bench	24%	
19	Wind Turbine Experiment Bench	24%	

The heat map on the next page, Figure 5, illustrates the rates of attraction of the activities and setting elements in *Create.Connect*. As noted above, attraction varies significantly between activities and setting pieces. The heat map compares activities to other activities (blue circles) and setting pieces to other setting pieces (yellow circles).

Figure 5: Heat Map



Full list of exhibit elements can be found in Appendix 1.

Table 4: Stay Times at Activity Tables

	Exhibit Component	Median Stay Times in Minutes	
1	Airplane Activity Table	0:06:12	Top ⅓ of elements in stay time
27	Invention Activity Table	0:05:48	
8	Circuit Blocks Activity Table	0:03:37	
28	Ball Run Experiment Bench	0:02:05	Middle ⅓ of elements in stay time
9	Electricity Experiment Bench	0:02:01	
19	Wind Turbine Experiment Bench	0:01:45	
18	Windmill Activity Table	0:01:38	Bottom ⅓ of elements in stay time
3	Flight/Wind Experiment Bench	0:01:32	
2	Mini-Plane Experiment Bench	0:01:17	

Table 5: Stopping at Historical Setting Pieces

	Exhibit Component	% Stopped	
17	Radio (n=66) [7]	15%	Top ⅓ of elements in attraction
16	Fridge	13%	
25	Windmill Mechanism	11%	
30	TV	11%	
11	Stove	10%	
14	Hoosier Cabinet	10%	
21	Wind Map	8%	
32	Inventor Flipbook 2	8%	
24	Windmill	8%	
5	Aviator's Cabinet	6%	Middle ⅓ of elements in attraction
13	Electricity Flipbook	6%	
22	Windmill Flip Labels	6%	
6	Flight Flipbook	5%	
29	Patent Cabinet	4%	
10	Calendar Flip Label	3%	
23	Windmill Designer Photos	3%	
31	Inventor Flipbook 1	3%	
7	Flight Flips Labels	2%	Bottom ⅓ of elements in attraction
15	Magic Window	2%	
20	Machine Shelf	2%	
4	Flight Video	1%	
12	Ironing Board	1%	
26	Gobo Lights	1%	

While all the activity tables were very frequently visited, they differed from each other in median stay times and frequency of observed target behaviors (see pg. 28). The activities that showed the longest median stay times were also among the most frequently visited activities. However, the Flight/Wind Bench in the flight area was the most frequently visited activity but had a median stay time of just one minute, 32 seconds. Interactions with the Wind Bench often appeared to be more focused on open-ended exploration and play as opposed to construction or problem solving, which could contribute to the lower stay time. It is also located near the entrance/exit of the exhibition so visitors might approach it first or stay there before leaving.

Setting Pieces

Table 5 shows the percentage of visitors who stopped at the exhibit elements that are part of the historical setting.

As a whole, these exhibit elements were visited less frequently than the activity tables or experimentation benches. Roughly half (52%) of tracked visitors stopped at one or more setting pieces in *Create.Connect* (62% of adults and 43% of children).

The most frequently visited setting pieces were those that allowed for hands-on exploration and discovery: the radio, fridge, stove, and Hoosier cabinet in the Electricity area, the interactive wind map in the Wind Power area, and the television and one of the flipbook-style labels in the Invention section.

[7] The radio was removed from the exhibition for repairs during part of the data collection period. It was present in the exhibition for 66 of the 157 cases. 60 of these cases were children.

Table 6: Visitor Behaviors at Hands-on Historical Objects

	Hands-on historical objects	Percent of those who stopped that engaged hands-on	Percent of those who stopped that interacted with a facilitator	Percent of those who stopped that engaged in multi-generational collaboration
11	Stove	94%	0%	75%
25	Windmill Mechanism	88%	24%	71%
17	Radio	80%	30%	81%
16	Fridge	77%	14%	86%
14	Hoosier Cabinet	69%	19%	60%
5	Aviator's Cabinet	33%	11%	44%
29	Patent Cabinet	17%	17%	33%

The items in the table above (Table 6) are all historical setting elements that were placed in the exhibition to encourage visitors to explore the historical narratives in a more hands-on way. Typically, the hands-on objects are being used as intended: visitors open doors or move parts of the object when they stop to view it, though they use some objects less frequently than others. Visitors' stops at the hands-on objects in the above table were only occasionally accompanied by a Conner Prairie facilitator. However, multi-generational collaboration, where adults and children in the same visitor group explored the objects together, occurred more frequently than exploring a historical object independently.

Conner Prairie

Young visitors build their paper airplanes at the Airplane activity table.

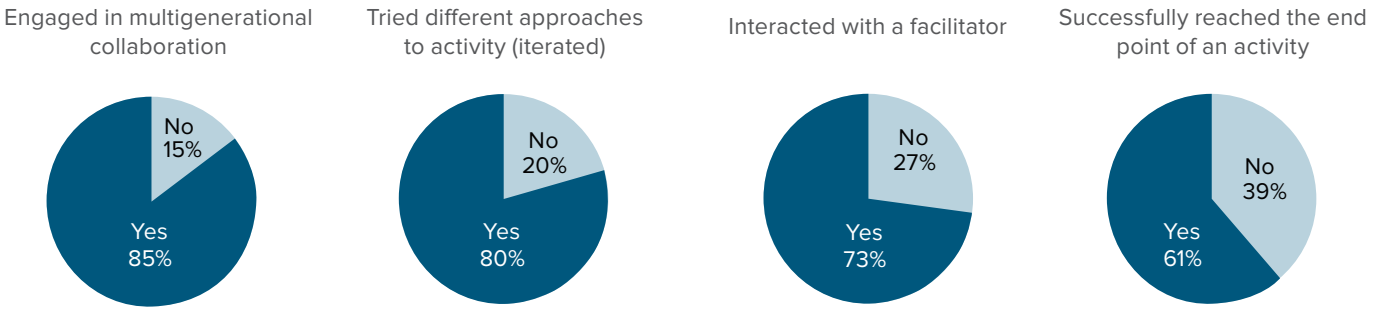
Target Behaviors Across All Cases

A visit to *Create.Connect* was intended to foster particular behaviors that are associated with the scientific or design process, such as trying multiple approaches to solve a problem (iterating) or successfully solving the design challenge by reaching the end-point of the activity (Beaumont, 2010a; Beaumont, 2010b; Cardella et al., 2013; Dierking & Falk, 1994; NRC, 2013). During the visitor's time at exhibit elements, data collectors noted instances of these behaviors, including:

- **Working with the items:** The visitor interacts with the activity or element in a hands-on way. At activities, this interaction should resemble building or making.
- **Iterating:** The visitor tries more than one approach to reach the activity end point successfully or starts a second project that incorporates more complexity. (This behavior could only occur at activities. Successfully reaching the end point of an activity: The visitor finishes a hands-on activity with a successful result (e.g., a working circuit, a windmill that can turn on its own). (This behavior could only occur at activities.)
- **Interacting with a facilitator:** The visitor has a verbal interaction with one of the Conner Prairie staff members working in the exhibition.
- **Engaging in multigenerational collaboration:** The tracked individual works together with someone of another generation in their group (e.g., an adult works with a child in her group). Both individuals do not have to engage in hands-on exploration for it to be "collaboration."

Figure 6 shows the number of children[8] who exhibited target behaviors at least once. The majority of children visiting *Create.Connect* received some kind of adult support, either by collaborating with an adult in their group or by interacting with a facilitator. Adult support can lead to more successful experiences in informal learning environments (Crowley et al., 2001; Crowley & Galco, 2001). In this study, adult support appeared to lead to longer stay times at activities (see Figure 7 on page 29). The high percentage of children observed using different approaches to solving problems at activities indicates that children were not typically leaving the activities if they did not immediately succeed, and that the activities were not so linear as to discourage varied approaches to solving the problem.

Figure 6: Percent of Child Cases Showing Instances of Target Behaviors



[8] We observed a great difference in the frequency of adults and children engaging in target behaviors. Children were more likely to engage in a hands-on way with the items, while adults frequently would observe and interact with the child but not with the items in the activity.

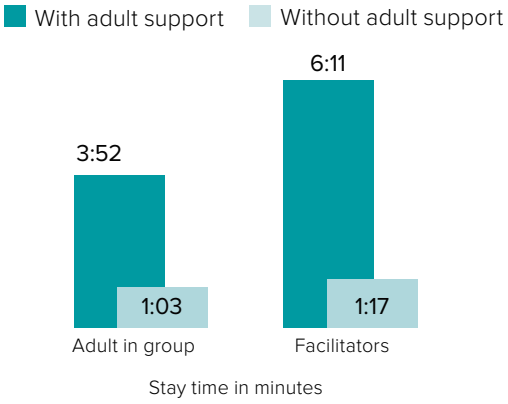


Figure 7: Children's Median Stay Times at Activity Stops in Minutes

Impact of Adult Collaboration and Staff Facilitation on Children's Stay Times

Figure 7 shows the median stay times at activity stops for children with adult support and without adult support. Each time a child stopped at an activity, data collectors noted whether the child interacted with a facilitator or an adult who was part of their family or visit group. If we examine the stay times of those activity stops, comparing those when the child interacted with an adult in their group or a facilitator and those when they did not, we see a trend toward longer stay times when some kind of adult interaction occurred.

Figure 7 shows the median stay time of all the stops made at activity tables and benches by children.[9] We know from recorded family conversations in the exhibition that adults often encouraged children to persist at activities or try them a different way (see page 67). Just as longer stay times offered more opportunities for learning to occur, adult participation seemed to support children's STEM exploration of activities by encouraging persistence, making connections between the activity and the child's life, or providing STEM information and context for what the child is doing.

Furthermore, Figures 8 and 9 show the percentage of children with and without adult support who successfully reached the end point across all activity stops (Figure 8) and who iterated across all activity stops (Figure 9). These data suggest that where adult interaction was present, children had higher rates of both behaviors––reaching the end point of the activity and iterating.

This effect is almost the same for interactions with facilitators and those with other adults (such as parents and grandparents), evidence that an exhibit built to encourage adults to collaborate with their children through experiences and objects can lead to longer and more successful interactions at activities, even in institutions without facilitation.

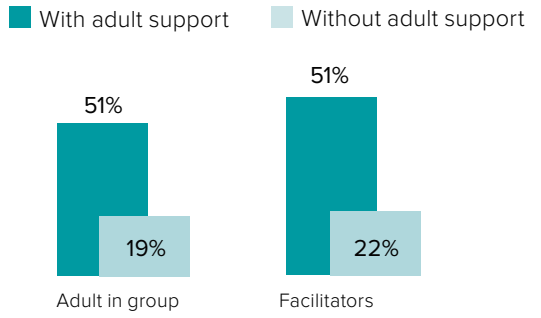


Figure 8: Percent of Children Who Successfully Reached End Point at Activity Stops

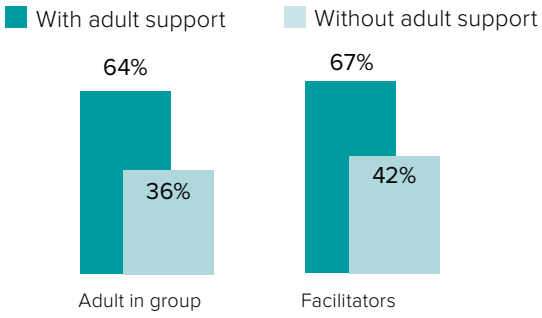


Figure 9: Percent of Children Iterating at Activity Stops

[9] These figures are calculated by looking at all stops children made at all activities. All samples are n>50 in these charts.

Summary

As additional historical elements and setting were added to the experience over the course of the *Create. Connect* project, the time visitors spent in the exhibition steadily increased. In the Summative Evaluation, dwell times were as much as four minutes higher than those recorded in the Second Formative Evaluation. Though additional elements and activities were added, visitors' number of stops did not increase; rather, they seemed to be slowing down and spending more time when they did stop. Also, when compared to a field-wide benchmark measure, visitors' time spent in the exhibition was above average. Girls and boys spent about the same amount of time exploring the exhibition, indicating that the exhibition is appealing and inviting to both genders.

Visitors stopped most frequently at the hands-on STEM activity tables, and this is also where they spent the bulk of their time. Visitors did not stop as frequently at the elements associated with the historical narratives (objects, labels, and media pieces). The most frequently visited elements related to the historical narrative were those that allowed for hands-on exploration. These elements were added to the exhibition after the First Formative Evaluation in an attempt to make the history as interactive and attractive as the hands-on activities. It seems these hands-on historical objects have not fully met the goals of exhibit developers; while they were the most frequently visited historical elements and did encourage hands-on interaction, the STEM activities continued to be the elements with the most attraction and holding power by a rather large margin.

Observation of family behaviors showed that visitors frequently displayed behaviors indicative of engagement with the scientific or design process, such as trying different approaches to solving a problem. The presence of an adult at the STEM activities seemed to lead to longer stay times for children, as well as to more frequent instances of behaviors associated with successful STEM engagement. We saw this effect whether the adult present was a Conner Prairie staff facilitator or an adult in the child's group, such as a parent or grandparent.

We have observed in both timing and tracking and family-conversation data that the *Create.Connect* visit was principally child-driven; adults encouraged children to decide for themselves where they would go in the exhibition and how long they would spend there. Though many children did approach the historical objects on their own, they were more typically attracted to the hands-on activities, where they quickly saw the opportunities for pretend play. Children typically jumped from activity to activity until the adult in their group decided it was time to move on from *Create.Connect*, often with a few historical objects stops on the way.

In analyzing these data, it is also important to consider what the visitor contributes, cognitively and behaviorally, to engagement with the STEM and History ideas presented in the exhibition. The STEM learning goals of the exhibition tend more toward process-focused goals than content-focused ones; children work through a process of trial and error, employ multiple approaches, and work toward stated goals to create something that works, which often leads to a very basic understanding of related STEM concepts, like circuitry or aerodynamics. It is clear from simply viewing the exhibition as a whole that history is present and the areas of the exhibition are evocative of the past, but truly understanding the intended history concepts requires that a visitor reads labels or interacts with a media piece or a Conner Prairie facilitator. These behaviors are generally not as immediately attractive to children as the opportunity for play. Sometimes this difference is a matter of a child's cognitive development: Many of the children who visit Conner Prairie and *Create.Connect* are not yet able to read, and thus would not typically be attracted to more traditional text-based labels. One respondent mentioned this in an interview, saying

> *"To get the history, you have to read or interact with a character. Two of my kids can't read, so this [activity] area is usually less crowded and does not require interacting. The format [of the activity] is ideal for learning on their own."*

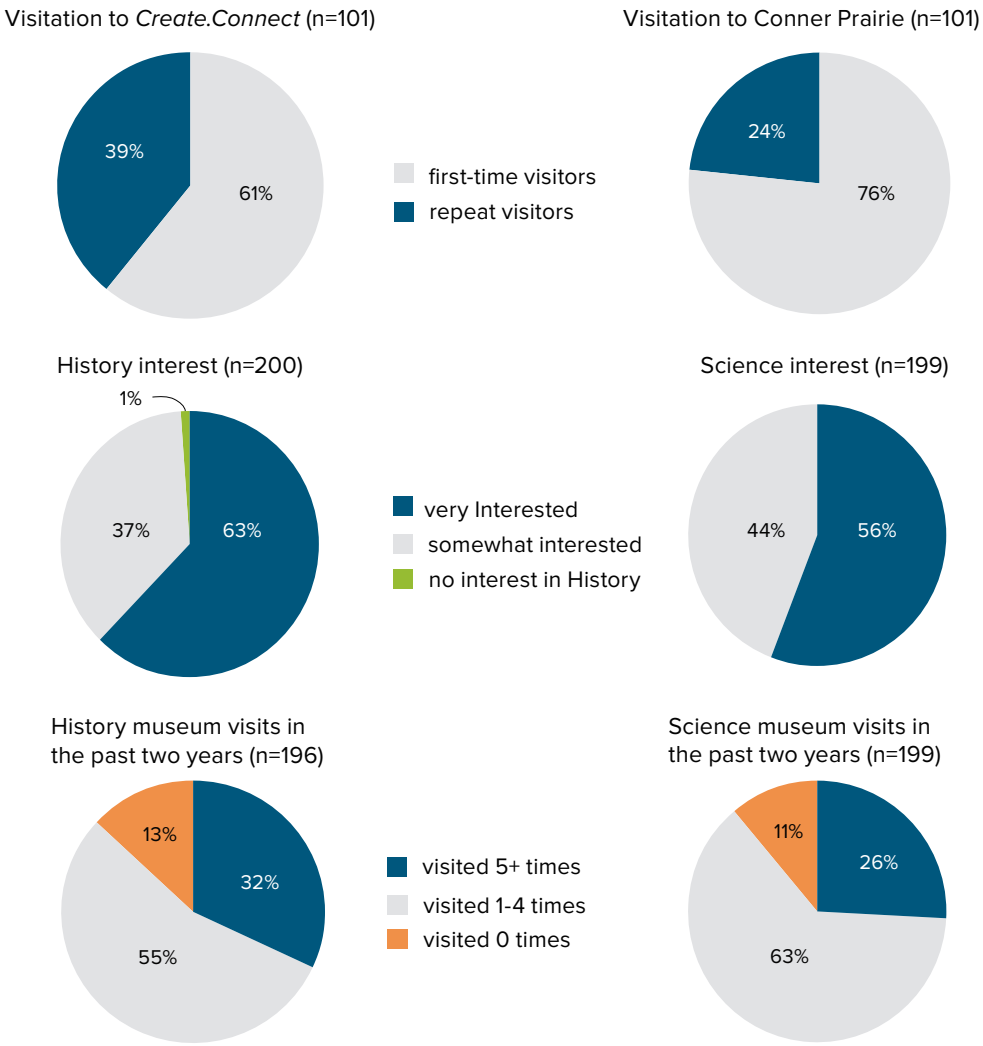
While it is also true that parents can read aloud or paraphrase labels for their children, if the children do not choose to visit the object or label on their own, the family is probably less likely to attend to it due to the child-driven nature of most families' visits.

2) Visitor Attitudes about *Create.Connect*

Visitor perspectives on the *Create.Connect* exhibition itself, its relationship to the rest of Conner Prairie, and their own priorities for visiting all provide insight into visitor engagement with the exhibition as described in the section above. These perspectives also speak to overall acceptance of the exhibition's integration of disciplines.

Two surveys were conducted at Conner Prairie with the intention of comparing two samples of Conner Prairie visitors: those just entering Conner Prairie to begin their visit (i.e., visitors who may or may not have visited *Create.Connect*) and those exiting *Create.Connect* (i.e., visitors who did spend time in the exhibition on the day of collection). The same questions were asked of each group of visitors with regard to their agenda for visiting Conner Prairie, their interest in science and history, and how often they had visited Conner Prairie and *Create.Connect*. Visitors to *Create.Connect* were also asked about their experience in the exhibition, how they felt the exhibition fit in Conner Prairie, and what they thought their family learned from the experience. Initially, we had speculated that the subset of Conner Prairie visitors who spent time in *Create.Connect* might differ from the overall visitor sample in their responses to these questions, but we found no statistically significant difference on interest in science, interest in history, visitation to science museums, or visitation to history museums between the two samples. The following section combines the data from both survey groups (n=201) to best describe the typical Conner Prairie visitor.

Table 7: Survey Respondent Profile
(See Appendix for full data.)



Visitors who were observed during the timing and tracking study did not participate in the exit survey of family groups leaving *Create.Connect*. However, looking at these two pieces of the Summative Evaluation together offers insight into how the behaviors observed through timing and tracking relates to the ways in which families given the exit survey talked about what they had learned and enjoyed.

Interest in Science and History

One approach to understanding whether visitors would find *Create.Connect* appealing was to better understand their interest in the two disciplines that the exhibition draws from: Science and History. In the exit and lobby surveys, visitors were asked to rate their interest in Science and their interest in History on a scale from 1-10, where 1=no interest and 10=extreme interest. Visitors reported a slightly higher level of interest in History, but the distribution of responses by each discipline was similar overall. The average interest rating for history was 7.92, and the average rating for science was 7.64.

To understand their museum-visiting behavior and whether they had a preference for one discipline over the other, visitors were also asked to report how many times in the past two years they had visited other museums (or places like museums) where they learned about science or history. Visitation to science and history institutions was also similar: the median number to science museums was 2, and the median number of visits to other history institutions was 2.5.

Table 8: Relative interest in History and Science (n=199)

	Percentage of sample
Interest in history is higher	37%
Interest in science is higher	31%
Interested in both equally	34%

Additional analyses helped evaluators better understand visitors' relative interest in each discipline: we subtracted their score for Science from History. For example, someone who rated their History interest at 7 and their Science interest at 5 would show a difference of 2. Likewise, a Science interest of 7 and History interest of 5 shows a difference of -2. Differences that are negative indicate participants who gave higher Science scores than History scores; presumably, they are more interested in Science. Positive differences indicate participants who are more interested in History than Science. A difference of zero indicates they are interested in Science and History equally. As seen in Table 8, this analysis shows a roughly even distribution across the three categories.

Motivations for Visiting Conner Prairie

The final question asked of both groups was why they wanted to come to Conner Prairie on the day of collection and what they valued about a trip to Conner Prairie. These questions were asked early in the interview portion of the survey to assess what visitors expected during their visit and then to compare with the feedback from visitors to Create. Connect about their experience in the exhibition. For this open-ended question, visitors gave a wide variety of responses that fell into a number of categories; some visitors gave more than one response. Comments were coded into thematic categories (see Figure 10). Almost all responses mentioned something about learning or education.[10]

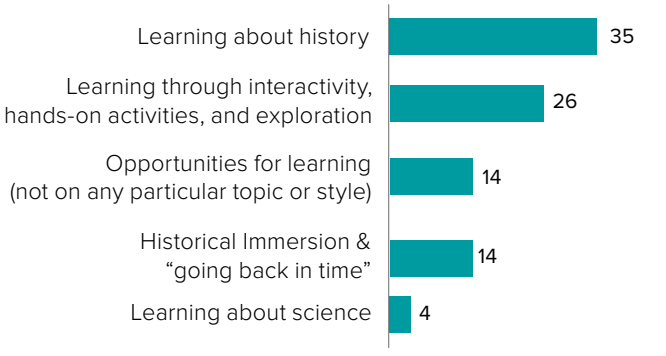


Figure 10: What Do You Value about visiting Conner Prairie? (n=129)

[10] The responses reported here represent those that mentioned something about education and learning. Other responses were about practical considerations. See Appendix 2 for full codes.

The responses to these two surveys indicate that there were no major differences between visitors to Conner Prairie who had and had not visited Create.Connect. That is, we did not find evidence to suggest that a certain visitor type (e.g., a visitor who was more interested in science, first time visitor) was more likely to visit Create.Connect. We also learned that visitors primarily thought of Conner Prairie as a place to learn, especially through interactive methods, such as hands-on activities or historical immersion. Visitors were also open to learning about multiple disciplines, as evidenced by the only slight difference in interest in History and in Science.

Visitor Reflections on Create.Connect

Visitors who had spent time in *Create.Connect* also responded to a number of close-ended survey items about their enjoyment of the exhibition, what they learned, whether they felt it fit within their overall Conner Prairie experience, and whether they would return to the exhibition in the future. These questions were on the minds of the project team members from the early planning stages of the project. Since Conner Prairie's exhibitions, programs, and interpretation are primarily history-focused, there was a question as to whether visitors would feel that an exhibition with STEM activities would seem out of place. Evaluators also asked visitors to elaborate on their answers through a number of open-ended questions after they completed their survey.

Visitor Interest in and Enjoyment of *Create.Connect*

Respondents to the exit survey were asked to rate the *Create.Connect* experience in terms of interest and enjoyment, both for themselves and for the children who accompanied them. As the figures below show, visitors overwhelmingly found the exhibition to be interesting or very interesting and enjoyable for both themselves and their children.

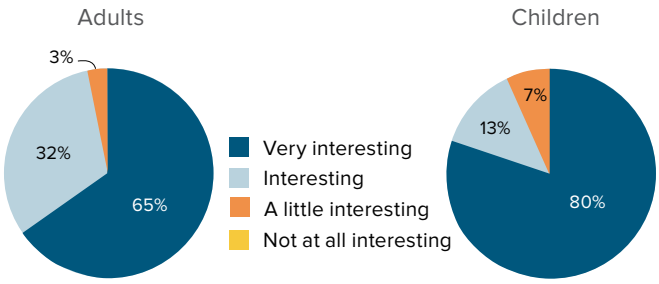


Figure 11: How Interesting was *Create.Connect?* n=101

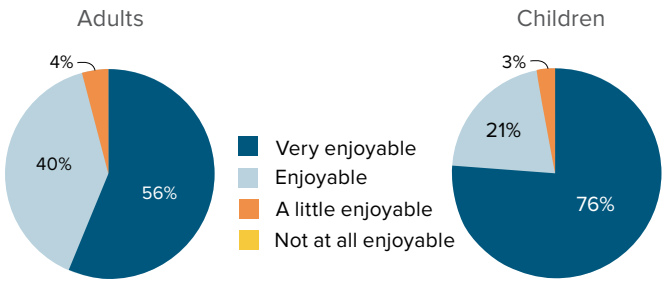


Figure 12: How Enjoyable was Create.Connect? n=101

Specific Aspects of the *Create.Connect* Exhibition

As part of the subsequent interview, data collectors asked visitors what they particularly enjoyed about *Create.Connect*. Most of these responses mentioned a particular hands-on activity (or more than one) that the family had enjoyed. Most respondents gave more than one response.

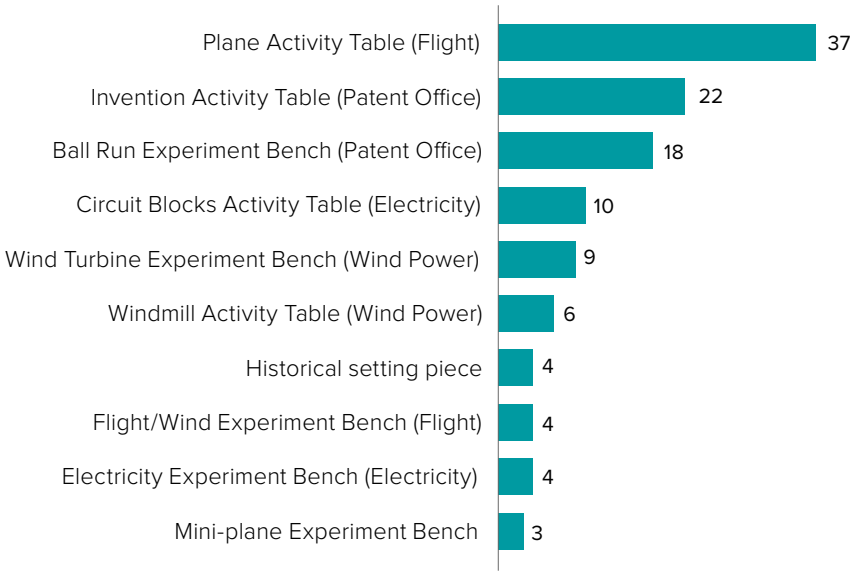


Figure 14: What Did Your Family Enjoy in *Create.Connect*? Specific activities mentioned (n=101)

The Plane Activity Table was by far the activity most frequently mentioned as something the families enjoyed. Some respondents mentioned that it was good for young children or families with children of varying ages. Both activities in the Patent Office (the Invention Activity Table and Ball Run) were frequently mentioned as well. These popular Patent Office activities were also among the most frequently visited activities in *Create.Connect*. (See previous section for timing and tracking data.) However, while the Plane Activity Table was the most frequently enjoyed activity, it was not among the most frequently visited ––it attracted 30% of individuals during the timing and tracking study. In other words, visitors who worked at the Plane Activity Table enjoyed it very much, but not all visitors spent time there.

Every activity table in *Create.Connect* was mentioned in response to the question about what families most enjoyed. Four respondents mentioned that their families particularly enjoyed a piece of the historical setting, such as the stove or television. Some respondents mentioned other topics in addition to or instead of particular exhibit elements when asked what they enjoyed, such as

- The friendly and supportive staff working in Create.Connect
- The hands-on nature of the activities
- Seeing their children solve problems or work together.

Visitor Perception of Fit with Conner Prairie

Overwhelmingly, visitors felt that *Create.Connect* completely (62%) or mostly (37%) fit in at Conner Prairie.[11] Only one visitor felt the experience mostly did not fit in. (This visitor negatively viewed the difference between the historical periods interpreted indoors and those in the outdoor areas.) When interviewers asked respondents to explain their answers, respondents gave a variety of responses that were grouped into categories. The frequency of response categories is outlined in the graph below. (See Figure 16 for code definitions and more visitor quotes.)

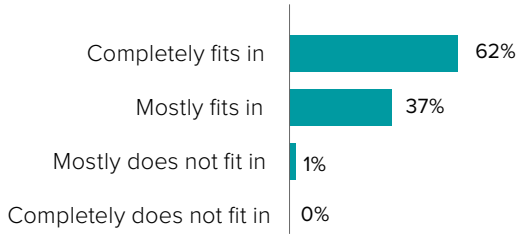


Figure 15: Does *Create.Connect* Fit in at Conner Prairie? (n=68)

[11] This question was only asked of visitors who had previously visited the rest of Conner Prairie, either on a prior visit or before seeing *Create.Connect*.

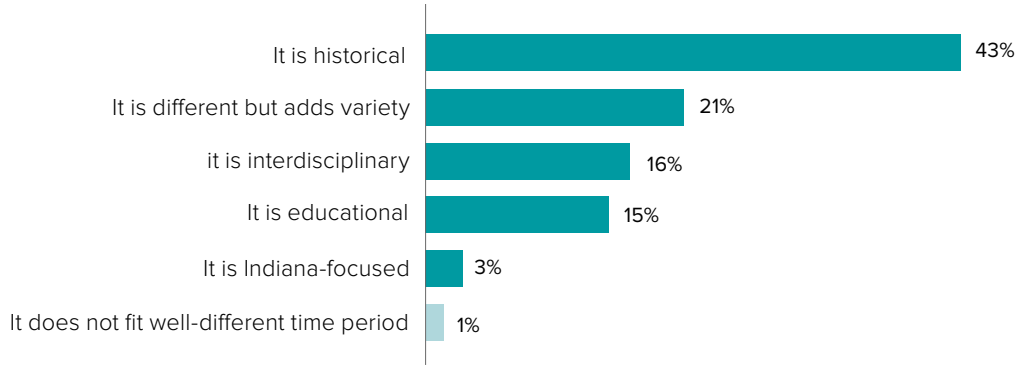


Figure 16: What about *Create.Connect* Makes it Seem Like it Fits/Doesn't Fit? (n=66)

The largest category of responses (43%) referenced only the historical aspects of *Create.Connect* as a reason why the exhibition fits in at Conner Prairie. Respondents saw both Conner Prairie and *Create.Connect* as places where one can learn about the past. Sixty-eight percent of visitor responses to this question touched on the historical narratives or setting in *Create.Connect* in some way, but may fall into another response category (such as "*Create.Connect* is interdisciplinary").

Beyond that response, visitors acknowledged that there were differences between *Create.Connect* and Connor Prairie, but in positive ways: that it added variety to their experience and that it was interdisciplinary. As one respondent said, "I think it's different from everything that's outside, but I think it's a nice addition, especially for homeschoolers; they're not just coming here and learning history, they're learning science as well." Some responses in this category noted that *Create.Connect* deals with different, more recent historical periods than the outdoor areas, but felt that this was an appropriate choice. One respondent explained:

> *...as the years progress it is harder and harder to tie children back 200 years, and so this is a really good maybe mid-step, for lack of a better term, where they can still see historic inventions but it may not be so drastic that they just can't even relate to it at all.*

A few respondents noted that Conner Prairie has recently been expanding its offerings beyond 19th century Indiana history, and *Create.Connec*t fits with this new direction.[12] One visitor explained, "*I used to think of Conner Prairie as just the 1836 village, but you have the 1863 now, you have the Lenape Indian village. So to me Conner Prairie isn't just about the Conner Home anymore; it's expanding.*" However, this same visitor recognized that Conner Prairie had skillfully integrated the experience into their existing offerings, saying, "*If this was an aerospace room only, I think it wouldn't work.*"

Most of the respondents who indicated that *Create.Connect* mostly fit were focused on the difference in time period, noting that the rest of the park deals with 19th century Indiana history while the stories in *Create.Connect* all take place in the 20th century. With the exception of one respondent who felt *Create.Connect* mostly did not fit, everyone who noted the different historical period described that difference in positive or neutral terms and still felt the experience fit with what Conner Prairie offers. In fact, some respondents felt the choice to interpret more modern history made it easier for them to make connections between the topics presented with their children.

[12] In recent years Conner Prairie has created new programs and exhibits that have a history-and-STEM focus, such as the Curiosity Fair, Passport to Hi Tech, STEM camps, Festival of Machines, the Balloon Exhibit, Nature Walk and Discovery Station.

Visitor Descriptions of Learning in *Create.Connect*

In exit interviews with adults leaving *Create.Connect*, evaluators asked, "What is something you feel you or your family learned while in *Create.Connect*?" Responses to this question were coded into categories (one response could be coded into multiple categories), and the number of responses by category is illustrated in the graph below (Figure 17).

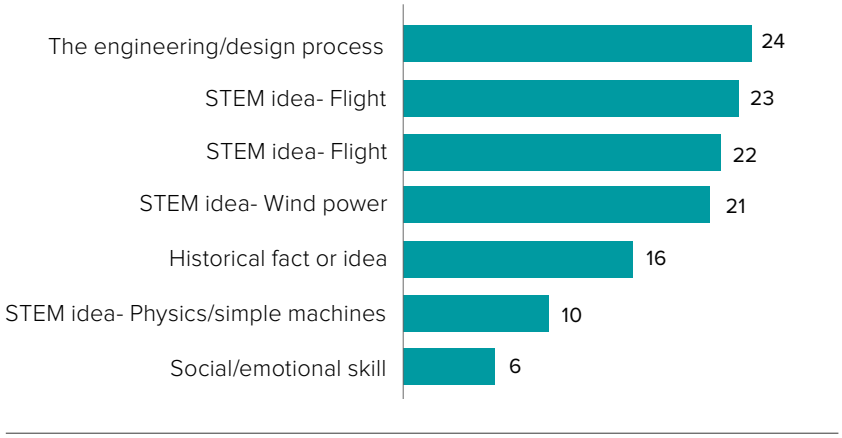


Figure 17: What Did You or Your Family Learn? (n=100)

Visitors most frequently mentioned learning something related to the engineering design process (the cycle of testing and adjustment that is often required to produce something that works). Though respondents did not actually use the terms "*engineering or design process,*" we assigned responses to this code if they referenced a cycle of testing and adjustment, solving a problem with a goal in mind, or simply the process of figuring out how to build something that works. As one respondent described, "*I think [we learned] lots of problem solving and sequencing, and how to figure out what's going wrong and what's not and how to fix that problem.*" This topic was mentioned frequently in connection with the activities in the Patent Office, but it came up in reference to other activities as well. Each of the broad STEM ideas presented in *Create.Connect*—flight, electric circuits, wind power, and simple physics—were mentioned. Simple physics ideas, like gravity or simple machines, were mentioned less often than the others, though; this may be due to visitors more frequently associating the Patent Office activities with learning about the engineering or design process.

Several respondents mentioned learning something about history in *Create.Connect* as well. Some historical topics mentioned include Morse code, Indiana inventors, windmill technology, or an appreciation for how people lived in the early days of electricity. Some visitors made a connection between the historical topic and the STEM content or activities. One respondent mentioned:

> *[The staff person] talked a little bit about the space race, and brought in Sputnik which the children were familiar with 'cause I've talked about that, but it's good to remind them of that. How—I don't think they got that far into it, but as far as how the competing nations really helped advance technology through the space race. Even using simple devices and machines and competing against each other can help you create, you know, accelerate creativity, and make new things.*

Some responses visitors gave fell within the domain of social-emotional skills, such as taking turns, developing confidence, or teamwork. Visitors felt the activities offered opportunities to learn how to overcome failure or to collaborate with other children on a project. During their exit survey interview, one adult and child pair had the following exchange:

> **Adult:** *It was nice that it was like teamwork.*
> **Child:** *Definitely.*
> **Adult to child:** *Because you were working with another guy that you didn't even know. And it worked.*
> **Child:** *Made new friends.*

In addition to learning, some respondents mentioned an increased interest in a topic presented in *Create. Connect*. As one child mentioned, "*I learned about circuits, and I wasn't really into it before. . . I wasn't into it and now I'm kind of into it.*" This was possible for adults as well. As one visitor mentioned,

> *From a senior-citizen viewpoint, I learned a lot. I love to learn. It inspired me to want to go to a larger museum to learn about science technology. It inspired even a senior citizen to want to learn. We've always been interested in history, but kind of rekindled in me the interest in science.*

Some mentioned that they had or were planning to do similar activities at home because of their children's burgeoning interest. A visitor mentioned, "*Last time we were here, my daughter spent a lot of time with the circuits, and learned a lot about that to the point that we had to experiment at home with it.*"

Conner Prairie

Visitors connecting wires to create electric currents at the Circuit block activity table.

Figure 18: What is Create.Connect About?
Number of responses by response category (n=101)

Visitor Perceptions of Create.Connect Theme and Focus

To better understand visitor perceptions of the thematic focus of *Create.Connect*, we asked exit interview respondents, "*If you had to describe this exhibit to a friend, what would you tell them it is about?*" We grouped responses based on the topic or theme they mentioned; responses focused on STEM topics, history, the engagement style in *Create.Connect*, or some combination of these categories. We defined engagement style to be the way the visitor described interacting with the exhibits (e.g., hands-on, interactive, active learning). The largest category of responses (more than double any other category) was those that mentioned a STEM thematic focus together with an engagement style. These responses mentioned either a broad category of STEM (like "engineering" or "science") or a specific STEM topic present in *Create.Connect* (such as "electricity"). Responses that mentioned an engagement style typically focused on the hands-on nature of the activities, the emphasis on experimentation or discovery, and the fact that children can figure things out on their own. As one respondent described in a comment that combined discussions of STEM and engagement style, "*It's about introducing science to kids in a way that is with manipulatives. It's not just words, but principles. It gives that first 'A-ha!' moment.*" Fifteen percent of responses combined all three categories–STEM, history and learning style–when describing *Create.Connect.*

Looking only at responses to this question, it seems that STEM was more frequently top-of-mind when visitors considered the focus of *Create.Connect*. This makes sense considering that the majority of visitors' time was spent exploring the hands-on activities, which are more strongly STEM focused. However, looking closely at responses to the question "*Why do you feel Create.Connect fits in at Conner Prairie?*" reveals at times more complex and nuanced conceptualizations of the interactions between STEM and history in the experience. It is here that we begin to see the integration of history and STEM expressed in visitors' own words.

Some respondents specifically mentioned how they felt *Create.Connect* "tied" or "wove" together history and STEM. "Technology" and people's changing relationship with it through time came up in these comments as well. As one adult and child pair explained:

> **Adult:** [Create.Connect focuses on] the beginning of flight, and how electricity works and how things worked back then. It's a different and interactive way to demonstrate to the kids how life was back then, and how technology makes a difference.
> **Child:** [Create.Connect focuses on] how to work things and how things have changed from back then to now.
> **Adult:** We don't have windmills in our backyard to generate electricity anymore.

Several respondents mentioned how their children have only experienced our current technologically saturated era, and that it's important to understand how our modern technology came about through the ingenuity of people in the past.

> *Generally, I think anything that connects, and says this stuff now, which is high tech, is still related to things that happened one, two, and three hundred years ago, and we can tell that to kids—especially in homeschooling families, since we're taking care of all of this—but when they can see and go, "you mean this technology has been around that long?", it gives a way to show that in a very tangible way. So I definitely think it matters. 'Cause I think kids can get the mistaken assumption that in the past there was no such thing as technology. Which is wrong, or we wouldn't have what we have today.*

Other respondents offered their explanations of how history and STEM intersect and how both are relevant to life today. The experience prompted some to reflect on the presence of science in our world in the past and present. As one described, "*I mean, Conner Prairie initially I would say was mostly about history, but when you look at the blacksmith shop, and the science of blacksmithing, and tying in the history of simple machines and the whole educational aspect of it, it fits in perfectly.*" Another said, "*There is science in farming, using the wind. . . but all of it. Science is part of life. That shows in [Create.Connect] and all of this is also good when talking to kids later about it. 'Do you remember when you did this? Remember how that worked?'*" Others specifically mentioned how learning about STEM in the past is relevant to learning STEM today.

For instance, one said, "*[Create.Connect] focuses on a certain era, and helps understand things that are still being understood today. And it all seems to go together.*" Some respondents noted that the choice to interpret history of the 20th century allowed them to make connections more easily with their children than they could in older historical areas, as technologies like household electricity and airplanes were familiar to their children. As a respondent explained,

> *They can relate more to how this [modern technology] was created into their life. Where did electricity come from? How did that airplane stay in the air? At this age, these children today, it's always been that way. Someone had to create it. That's the learning part of it.*

In the interview we also asked visitors if they felt the exhibition seemed "science-y" or not. Nearly all (97%) of survey respondents felt *Create.Connect* was "very" or "somewhat science-y." Among the 3% who said it was only "a little science-y," some respondents indicated that they felt this was a positive attribute of the experience. One respondent mentioned, "*The science part was the good part, but it wasn't in your face. It didn't feel like 'Now you're going to learn about a principle called aerodynamics.'*"

When asked what made it feel "science-y," most respondents repeated or expanded upon the learning they described when asked what their family learned in *Create.Connect*. All the STEM content areas present in *Create.Connect*—flight, wind power, electrical circuits, and simple physics—were mentioned with about the same frequency. Many respondents also mentioned that their families learned a bit about the engineering or design process by testing and adjusting their creations, and a few mentioned other broad science process skills like stating hypotheses or observing the results of an experiment. Interestingly, seven respondents to this question actually mentioned some aspect of the historical narratives or setting when asked what their family had done that was science-related. For example, one visitor said, "*I learned just at that big windmill about how it was so popular because it had a brake, so when it got real windy it didn't tear the machinery up.*" These comments suggest that visitors perceive the STEM and history integration in *Create.Connect*.

Visitor Interest in Returning to Create.Connect

Another indicator of a positive visitor experience is a desire to return and experience an exhibition again. All 101 respondents indicated that they would "definitely" or "probably" visit *Create.Connect* again if they came to Conner Prairie in the future. When asked why they would want to experience *Create.Connect* again, respondents gave several different types of responses, which were coded into thematic categories (see Figure 20). Some responses could be coded into multiple categories.

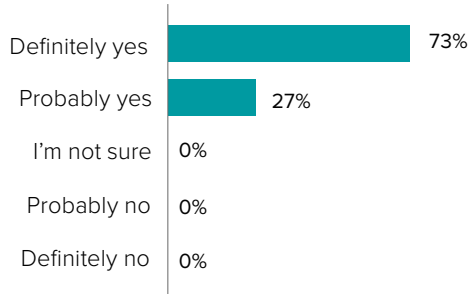


Figure 19: Would You Like to Visit *Create.Connect* Again? (n=101)

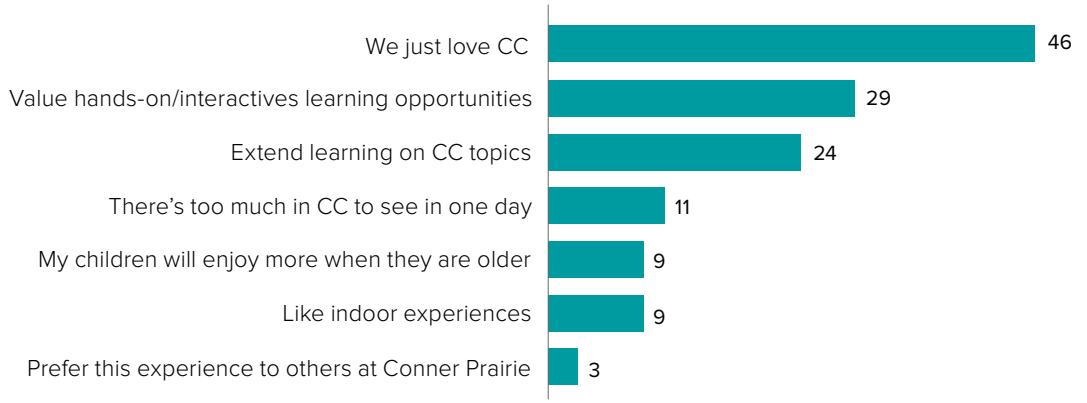


Figure 20: Why Would You Want to Visit Create.Connect Again? (n=100)

Nearly half of the respondents said they would return to *Create.Connect* simply because their children love it. As one parent said, "*I can't get my kids to leave. I mean, that says enough right there, that it holds their attention. They absolutely love it.*" Some mentioned that their children specifically ask to come to *Create.Connect*. Many respondents also said that they value the kinds of interactive and hands-on learning experiences that are available in *Create.Connect* and think they are particularly effective for their children. There was a feeling among several respondents that subsequent visits would allow their children to build on or extend their learning on the topics presented in *Create.Connect*. One respondent explained:

> *I think repetition is really important, and I think deeper learning takes more than one visit . . .And I would come back again, maybe even to bring other children as well, but I think next time she's here she'll do it a little better, a little deeper, a little more learning will happen because she won't be at that first step where they just explore the material, kind of play.*

Experience of Repeat Visitors in *Create.Connect*

Five repeat visitors[13] agreed to give their perspective on the value of repeated visits to *Create.Connect*. These visitors come to *Create.Connect* with their family regularly, sometimes as often as twice a month. When asked what they particularly enjoyed about the *Create.Connect* experience, they mentioned the open-ended, "*unlimited*" nature of the activities and that the activities did not require computers or screens. One visitor also brought up the history tie as something they valued about the *Create.Connect* experience. Of these visitors, three indicated that they had repeated activities like the ones in the exhibition at home. As one visitor explained, "*I had to pull my kids away from the exhibit by suggesting we could make a ball run at home.*" These visitors described how they had made windmills with construction paper and marble runs similar to the ones in *Create.Connect*. One respondent indicated that she was a public school teacher and had done similar activities in a formal education setting as well as at home. One respondent mentioned that they had sought out history documentaries to watch together.

[13] The survey was distributed to 15 visitors who had previously been identified by evaluation or exhibition staff as guests who visit *Create.Connect* frequently.

All five survey respondents had previously noticed their children making connections between what they saw or did in *Create.Connect*. Their children made comparisons between life in the past and life today as well as personal connections with the past. One respondent mentioned how she and her son had talked about refrigeration in the past in the context of his great-grandmother's kitchen. Connections were also made between the *Create.Connect* experience and what the child was learning in school. Respondents described the value of these conceptual connections in different ways, but always in a positive light. One said that connections are "*priceless. Everything is connected. We don't study separate subjects. We just learn and follow wherever the explorations go.*" Another mentioned that making these kinds of connections encouraged her son to really think in a way iPads and computers cannot. One respondent stressed the importance of repetition saying, "*I think repeated experiences are priceless for learning, so having the exhibit up for a long time is key.*"

Some respondents mentioned that the *Create.Connect* experience gave them new ideas for exploring STEM or history with their families. Some recounted the activities they had done at home. One mentioned that they had gotten books about electricity and another mentioned reading about historical achievements in science. When describing new ways of looking at history, one respondent said their family was "*taking one aspect of modern life like electricity and exploring the inventions and the ways they have changed, and been changed by, society.*"

Conner Prairie

A costumed Conner Prairie interpreter shows off the provisions in a 1930s era electric fridge.

Summary

Overall, visitors found *Create.Connect* to be enjoyable and interesting, both for themselves and for their children. They also indicated that they would like to return to experience it again for a variety of reasons. When asked which specific parts of the exhibition they enjoyed, visitors mentioned all nine hands-on activities as well as some elements of the historical setting. When reflecting on what they had learned or experienced in *Create.Connect*, visitors mentioned both history and science (but with different frequency), and they felt that it allowed for hands-on learning opportunities that were particularly effective for children and families.

The question of if visitors thought *Create.Connect* as about science, history, or a combination of both is a complex one that can be explored by looking at the data in different ways. Though about one-third of respondents mentioned historical topics specifically when asked "What is *Create.Connect* about?", when asked why they felt *Create.Connect* fit, history-focused topics and comments were much more prevalent. In fact, many responses to this question show how visitors conceptualized the connections between history and science in *Create.Connect*.

There are many possible explanations for why visitors more frequently mentioned STEM when considering the big idea or theme of *Create.Connect*. As mentioned earlier, the bulk of a visitor's time in *Create.Connect* was spent around the hands-on activities, which have more of a STEM focus. When asked, "What is this exhibition about?", a respondent typically reflected on the things he or she had seen or done, or observed his or her family members do. Since the adult visitor's time was often spent observing children engaging with activities, and the activities strongly support STEM concepts and allow children to practice the engineering or design process, it stands to reason that the largest category of responses would be those that mentioned STEM topics like engineering and the hands-on, participatory engagement style of the experience.

Also, though the exhibition does not have a stated "big idea," one could in fact consider the unifying concept shared by each of the four *Create.Connect* nodes as being primarily focused on innovation in STEM fields. Each of the historical narratives takes place in a different time and concerns a different topic, but underlying each of these narratives is a story of innovation or technological change. While each of the stories takes place in Indiana's past, the initial litmus test of whether or not a historical story was appropriate for inclusion in *Create.Connect* was if it concerned science or technology, not a particular era or event in history. The STEM focus of the experience is also what sets *Create.Connect* apart from other Conner Prairie experiences. For some, it may be a forgone conclusion that *Create.Connect*, an exhibition at a history institution, is historical, and that what makes it different is the opportunity to engage with STEM ideas and activities. It is also significant that the question about why the exhibition fits into the context of Connor Prairie was asked later in the survey than the question about the main idea. By the time they answered this question, visitors had slightly more time to reflect on the experience and employ the abstract thinking strategies that would allow them to make conceptual connections between history and STEM ideas.

One notable and related finding is that the number of respondents who mentioned history—68%—increased from an earlier formative evaluation of the prototype exhibit (*Create.Connect* First Formative Evaluation Report, unpublished), when only 55% of respondents mentioned history when asked if the exhibition fit at Conner Prairie. This suggests that changes made after that First Formative Evaluation succeeded in making the history more apparent in the space.

3) Visitor Conversation and Evidence of Learning

Conversation with adults can support children's exploration and persistence, as well as expand their knowledge of activities and artifacts (Borun et al, 1998; Crismond, 2001; Gutwill & Allen, 2010; Schauble et al, 2002; Tenebaum et al, 2010). The *Create.Connect* exhibition was designed to prompt conversation through the exploration of intriguing historical artifacts, hands-on activities, and interactions with interpreters. While there is a long tradition of studying visitor conversation in museums, there was no precedent for the type of exhibition: one in which we anticipated hearing visitors explore both STEM and history ideas within their visit. How and to what extent would visitors draw from conversational and thinking strategies unique to each discipline? If so, how would this emerge and be supported? Above all, we were curious to understand what STEM and history learning look like when brought together in a museum exhibition.

Our approach to designing this piece of the Summative Evaluation drew from other frameworks for examining visitor conversation that show evidence of learning, as well as STEM and history disciplinary thinking strategies. We conducted three rounds of coding that allowed us to draw increasingly more detailed conclusions about the qualities of conversation and how they aligned with the exhibition and interpretation goals. In this section, we first describe our approach to coding and the development of our coding scheme. Then we report on the quantity of different conversational strategies to describe common conversational patterns. Next, we examine instances where STEM exploration and history exploration co-exist in a single conversation. Finally, we explore the relationships between codes, such as where in the exhibition codes were more frequently applied, when in the conversation they appeared, and who in the group initiated the exchange.

Data Collection[14] and Case Descriptions[15]

Thirty-five qualifying adult-child pairs (one case was excluded because the family spoke in Spanish during their time in the exhibition) were recorded as they explored the *Create.Connect* exhibition. Stay time ranged from 10 minutes and 28 seconds to 2 hours and 6 minutes, with a median time of 34 minutes and 30 seconds. Once conversations had been recorded, the audio files were transcribed and imported into the Dedoose qualitative coding software.

Table 9: Target Child Profile

Age Range	Number of Cases	%
6 and under	11	31%
7 to 9	13	37%
10 to 13	11	31%

Gender	Number of Cases	%
Female	20	57%
Male	15	43%

[14] See page 20 for details on data collection methods.
[15] See Appendix for more detail on group configuration.

Coding Process

Coding was completed by three individuals on the evaluation team using the Dedoose qualitative coding software. Codes in Dedoose are applied to selected portions of the transcript, referred to as an excerpt. Excerpts vary in size, may overlap, and may receive more than one code. The unit of analysis that bounds an excerpt can be consistent – as in the case of the 1-Minute excerpts applied in the first round of coding – or variable to accommodate the differing length of conversations and exchanges in subsequent coding.

Inter-rater Reliability

Inter-rater reliability was established by employing Dedoose's built-in testing function. Each of the three evaluators was the primary coder for one test case. The testing mode presented each excerpt from one evaluator's test case to the two other evaluators, masking the original codes. For each test, Dedoose reported the percentage of agreement between the three evaluators by code. Codes with agreement levels below 80% were reviewed to identify the basis of the inconsistencies. The purpose of the testing function was to both identify aspects of code definitions that needed to be further refined and to bring all coders into alignment regarding their understanding of the coding scheme. Discrepancies or confusion were discussed until the parameters had been clarified and/or the definitions were refined. As codes were developed collaboratively, there were relatively few instances of disagreement.

Developing the Coding Scheme: Extant Literature on Family Conversations in Museums and Disciplinary Thinking

Prior to data collection, the evaluation team conducted an extensive literature review of family learning in museums, paying special attention to features of science and history exhibits that influence the qualities of conversation. We were guided by prior research on family conversations in museums (Beaumont, 2010a; Borun, et al., 1998; Gutwill & Allen, 2010; Leinhardt, Crowley & Knutson, 2002; Leinhardt & Knutson, 2004), facilitation strategies for deepening learning (Crowley & Callanan, 1998; Rosenthal & Blankman-Hetrick, 2002), and frameworks for historical thinking skills (Alexander, 2010; NCSS, 2010; Gosselin, 2011; NRC, 2013) and science process skills (Ash, 2003; Seixas & Morton, 2013; NRC, 2009; Padilla, 1990). We also relied on the descriptions of what the exhibition developers and interpretation staff had articulated as goals for the visitor experience in *Create.Connect*.

Relevant, STEM and Historical Talk

- Relevant Talk
- No Talk
- STEM Talk
- Historical Talk
- Connections
  - Personal Connection
  - Other Connection

First Round of Coding: Quantity and Relative Frequency of History and STEM Conversation

In order to identify where and how the features described in the literature review manifested in the conversation data, the team first drafted a list of broad codes (see sidebar) to identify when relevant talk was happening. The first round codes bookmarked instances for later analysis and provided a basic framework for digging deeper. In our first round of coding, we took a time-based segmenting approach, where each transcript was divided into one minute excerpts (as indicated by timestamps on the transcription) as the unit of analysis. Given the length of time visitors spent in the exhibition, roughly 35 minutes, dividing the visit into a standard length of time provided an initial assessment of whether and how much relevant talk was happening in the exhibit.

First Round Coding Scheme

Relevant Talk was the first item coded for. If an excerpt of conversation was in any way related to the exhibition or the experience of being in the exhibition, it was coded as "Relevant Talk." If an excerpt did not include relevant talk, it was coded as "No Relevant Talk." Excerpts including both relevant and not relevant talk were coded as "Relevant talk." Excerpts with no conversation were coded as "No Talk." Codes were applied to the whole minute in a Yes/No dichotomy.

All excerpts coded as relevant talk were assigned "STEM Talk," "History Talk," or "Both STEM and History Talk" codes based on their content. In this round of coding we considered "History Talk" very broadly: this included any time a target individual talked about something history-related or interacted with a costumed staff person in character, even if the conversation was not history-related. "STEM Talk" was defined as references to ideas or processes in STEM, or conversation that indicated the process of engaging in STEM exploration (such as testing, observing, or hypothesizing).

After coding for relevance, excerpts were reviewed to identify if participants were talking or listening to a facilitator (in which case they were given the code "Facilitator Talk"); if a connection was made, the "Connection" code was applied, either as "Personal Connection" or "Other Connection". These two codes were selected because of their importance in both the exhibition design and in learning experiences. Other research (e.g., Dierking & Falk, 1994; Roschelle, 1995) has suggested that making connections between prior knowledge or information can deepen learning and engagement.

First Round Coding: Findings

Table 10: Percentage of One Minute Excerpts Coded Over All 35 Cases

	Number of one minute excerpts (1352) across all cases	% of all excerpts across all cases
Relevant Talk	1305	96%
No Relevant Talk	40	3%
No Talk	7	1%
STEM Talk	1241	92%
History Talk	211	16%
Staff Facilitation	398	29%

Our first round of coding indicated that all 35 cases included significant amounts of conversation relevant to the exhibit (96% of the one minute excerpts). Furthermore, all cases had instances of STEM talk, and 34 of 35 cases exhibited instances of history talk. STEM talk was more prevalent than history talk (92% versus 16% of excerpts). Large portions of conversation were coded as "STEM Talk," as visitors spent significant amounts of time working with the activity tables and experimentation benches. "History Talk" excerpts were typically shorter than "STEM Talk" excerpts. Additionally, 33 cases included staff facilitation, and 34 cases included instances of families making connections (personal or other). This round of coding confirmed that visitors were talking about relevant topics, and we next moved on to an expanded coding structure that was not bound by one minute excerpts to better capture the exchanges between group members and develop sub-codes.

Scaffolding Strategies

- Explanatory Engagement and Modeling [and Procedures]
- STEM Exploration/Investigation
  - STEM facts
- History Exploration/Investigation
  - History facts
- Connections
  - Comparisons
  - Personal Relevance and Identity
  - Between Exhibits at Conner Prairie or Within the *Create.Connect* Exhibition
- Offer of Agency and Response
- Emotional Support

Second Round of Coding: Defining the Qualities of Conversation in *Create.Connect*

The second phase of coding further refined these categories by thinking about the conversational moves that individuals made that pushed thinking or activity further. We called these Scaffolding Strategies to indicate the ways that conversation is and can be generative and supportive. In what ways do visitors scaffold others' thinking by making connections, providing new information, or offering support? These codes help to identify exchanges in conversation that build upon one another, informed by the activity exploration, to support engagement.

Second Round Coding Scheme

In order to develop these new codes, the evaluation team read transcripts of conversation, the reflective interviews and and case memos in context of the literature mentioned above. We looked at studies of conversation in both informal and formal education settings to frame our interpretation of adult support and conversational moves in naturalistic and more intentionally supportive environments. From classroom discourse literature, we looked at the ways in which educators make conversational moves to support students' learning (Roschelle, 1992) and scaffold their thinking (Pea, 2004). From informal learning literature, we applied the ideas of how group members co-construct knowledge (Crowley & Callanan, 1998; Zimmerman, Reeve, & Bell, 2009), how connections to identity and prior knowledge can inform conversation (Feinberg & Leinhardt, 2002), and how to document talk as evidence of learning (Allen, 2002). These codes were applied across minutes for as many exchanges were relevant, with a sentence being the smallest excerpt possible.

One of our first challenges was how to capture long sections where visitors were interacting at the activity tables or benches and talk indicated that visitors were exploring or investigating and trying different approaches (e.g., "Try this." "Oh, that didn't work." "Hmm.") We decided to code these long sections by STEM Exploration/Investigation or History Exploration and then add other codes when sentences or exchanges stood out as different (e.g., "These are like your snap circuits at home. [Connection]"; "The Wright Brothers, their first flight was about 120ft long. [History Fact]"). By applying these codes to long sections of conversation, we were able to look at these sections as a group for our third round of coding to further define moments within those long excerpts that were richly indicative of higher-level thinking within STEM and History and exemplified what was possible in the exhibition (see Domain-Specific Thinking Strategies section below).

After looking at instances coded under Connection we determined there were three types: to their own history, knowledge, or experience (Personal Relevance and Identity), to other exhibit pieces or experiences at Conner Prairie (Between or Within Exhibits), or to other similar objects or activities of any type (Comparisons).

Finally, the role of the adult—either a Conner Prairie facilitator or an adult within the group—was also examined in the ways in which they exhibited behavior that seemed to invite or support children to engage with the exhibit. For example, Conner Prairie interpreters are trained to find out what the visitor might find relevant or significant and provoke interest in the activity. Their role is to endow visitors with knowledge and an experience that enables entrée into a discussion or engagement with the exhibition. The code of "Offer of Agency" refers to the exchange with the visitor where the facilitator "hands off" the activity (or gives agency) to the visitor and the visitor's acceptance (or rejection) of that offer. Also important to the facilitator and visitor relationship is supportive encouragement that they give ("Emotional Support"). With both of these codes we were curious to see if the interpreters' presence encouraged persistence or engagement with the exhibition.

Table 11: Coding Scheme: Scaffolding Strategies

Code	Definition	Example
Explanatory Engagement and Modeling	The phase of conversation where the adult is helping the child understand the ways in which someone can interact with the activity.	Adult: You know what this is, doorbells, basically. Ok, this is a light switch, and somehow you power this. Oh, it's already powered. Just like a light switch. One side's a positive and negative, that's cool. So this right here, you know what this is?
History Exploration/ Investigation	Similar to the domain of "historical thinking skills," such as comparing and contrasting between "then" and "now," imagining what life might be like "back then," or describing/analyzing/evaluating an historical artifact. [16]	Adult: You know the old refrigerators? They used to call them what? Child: Iceboxes. Adult: Why'd they call it an icebox? Child: Because it was a box with ice in it.
STEM Exploration/ Investigation	Draws from the literature on "science process skills" and refers to instances where visitors are interacting with exhibit components through a science lens (looks most often like the engineering design process).	Child: And if we put up the wind-speed. Adult: So, why did you turn the wind-speed off? Child: To see if it'll stay up. Adult: I see. At a lower speed. Child: Yeah, then because when it's higher it stays flat. . .

[16] In the first round of coding we considered interactions with a historical character to be historical because of the costumed interpreter's presence, but in the second round of coding we revised this when it became clear that not all interactions with a costumed facilitator actually include talk about historical content. We were also unable to confirm across all instances when an interpreter was costumed or not.

Table 11: Coding Scheme: Scaffolding Strategies

Code	Definition	Example
History Fact	References to specific information from the past that may or may not be present in the exhibit. These are phrased as "nuggets" of information and are less focused on exploration or investigation and more on quickly communicating content.	Adult: Before the refrigerators, they kept food cold in wells. A few families had iceboxes.
STEM Fact	Explanation of phenomena that goes beyond describing in general terms and brings in other information that ties it to a scientific concept. Like History facts, these comments are intended to quickly communicate content.	Adult: Alright, so this is alternating current. What do you think alternating current means? This is you being able to control how much current you're sending it. There's a fancy word for what this thing is. It's called a "Potentiometer."
Emotional Support	Praise, encouragement, or positive feedback usually given to a child that expresses affirmation of the child's progress.	Adult: Okay. He's a pretty good builder, isn't he? Good job!
Offer of Agency	Adult (parent or facilitator) offers the child the chance to work with activity or materials. Child accepts the offer and engages with the activity.	Child: So, do you connect one to here and one to here? Adult: Well, you tell me. What do you think? Child: Yeah, but I don't know which goes where. I'll try it out.
Connections		
Comparisons	A similarity between like features of two things on which a comparison may be based.	Adult: That's the kind of windmills you see out in the countryside now. The other ones are more like what you see on the farms.
Personal Relevance and Identity Connections	References personally relevant experiences. Also refers to the act of labeling someone as a STEM or History "thinker" or potentially exploring a career in the future.	Adult: That's hot. That just heats it up. It's an iron for your clothes. That's what I used. . .
Connections Within/ Between Exhibit Pieces	Making connecting to objects or experiences outside of the activity but present at Conner Prairie or in *Create. Connect.*	Adult: So, you know the last thing that you wanted to try? What did we not go to in Prairietown in the other place? Remember you wanted to try the telex [telegraph key]? Why don't we set it up?

Second Round Coding: Findings

Nearly all cases showed evidence of the type of talk that the exhibition was intended to prompt: STEM and History Exploration, making Connections of Personal Relevance or Comparisons, and interactions with a facilitator. As described in Table 12, all 35 cases showed evidence of families engaging in STEM Exploration, and 28 cases reflected engagement in History Exploration. Nearly all cases (33) included interactions with a Conner Prairie Facilitator that included Offers of Agency and Connections of Personal Relevance. Fewer groups shared History Facts (21) or STEM Facts (25).

Table 12: Scaffolding Strategies Code Appearance by Case (n=35)

	Percent of Cases	Count
Explanatory Engagement and Modeling	100%	35
History Exploration	80%	28
STEM Exploration	100%	35
History Facts	60%	21
STEM Facts	71%	25
Emotional Support	97%	34
Offer of Agency	94%	33
Comparisons	89%	31
Personal Relevance	94%	33
Connections Within/Between Exhibit Pieces	63%	22

Conversational Patterns

Once our second round of codes had been applied to all cases, we examined how the codes related to one another and if we saw patterns across cases. We looked at the talk during each "stop" visitors made in the exhibition (defined as when conversation indicated that a group started an activity or exploration in a node and when they left that node).

As we saw in our tracking and timing data, children typically led where families went in the exhibition. Typically, the child selected the hands-on activities without any verbal indication of why they were choosing that particular activity. Adults sometimes facilitated the experience by suggesting areas or trying to find areas or activities they had not seen yet, but the decision of where to go was typically left up to the child. Conversations around that object or activity would begin with an adult (staff or visitor) orienting the group (Explanatory Engagement), possibly asking some questions or offering some contextual information before giving the child autonomy to try it themselves (Offer of Agency). During the exploration of the activity or object, adults would offer Emotional Support, make Connections, or add STEM or History Facts. The amounts of Emotional Support and Offers of Agency are fairly consistent within a case, but not as much across cases. In other words, some parents and facilitators offered lots of Emotional Support and Offers of Agency and others did not.

A young visitor works on creating new windmill blades at the Windmill activity table as his grandparents look on.

As described in the introduction, Conner Prairie interpreters are trained to invite visitors into a conversation and build on the visitor's interests (Explanatory Engagement). This initial dialogue is intended to help the visitor feel invited into doing the activity and capable of working independently. In our data, almost always, the child took up the adult on their offer to do something (challenges, invitations to try activities, etc.). Children seemed to understand that the activities were open-ended and they could choose how their finished product would look, and some adults (staff and family members) reinforced this throughout the activity. Children took up offers to say something (make predictions, explain their reasoning) less frequently. In this example of a typical exchange at the beginning of an activity, a staff member was describing what he was doing with the activity (Explanatory Engagement) and then invited the group to participate (Offer of Agency).

Staff: *Hi there!*
Adult female: *Hi!*
Staff: *We're looking at wind power over here. So, we have this windmill here that someone just built. And you can see when the wind blows on it, then it'll turn this, and it'll end up turning the grindstone, right here. So. The goal is just to experiment with different things to see if you can make it less work, I guess. So they had grindstone ones, and that one's a water pump, or even electricity. They still use windmills.*
Adult female: *Uh huh. Uh huh.*
Staff: *So, do you guys want to try your hand building one? You're welcome to.*
Adult female: *Okay, how do we do it?*

After the period of exploration was over, the child typically made the decision of when to move on from an activity or other element, though in some cases there was more adult facilitation and input here than in the decision of where to go to start a new activity. In these instances, adults kept the group moving when they felt it was time to give other children a chance or once the child had completed the activity successfully. Staff also helped families transition to another area or activity by connecting what they had just done to something else in the exhibition. Here a staff member gave praise for the group's persistence and offered another related activity to explore:

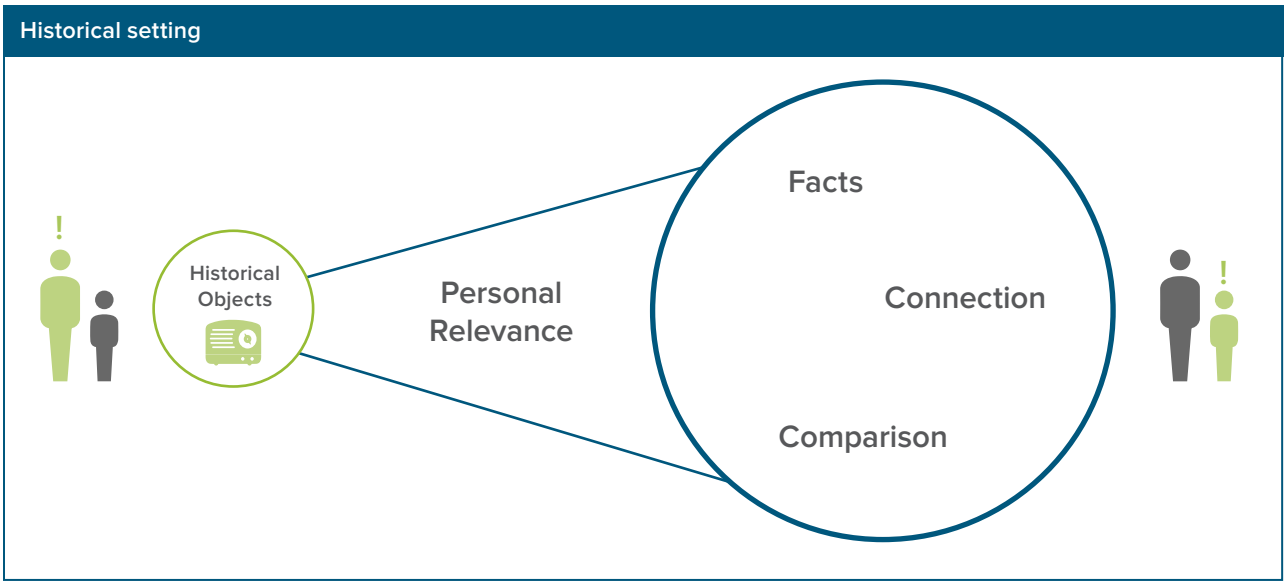
Staff: *The belt got stuck. Well, that happens sometimes. I'm glad you guys got through it. Nice. So, you're going to be an engineer someday?*
Child: [Unintelligible].
Staff: *Oh yes you are. That's so good. Well, (indistinguishable) and you've made this, and you've made one that will actually move very quickly. So if you're still in the making mood, I have an idea that might be worth experimenting. (Transition from windmill activity to wind turbine activity.)*

While the beginning and ending of activity or object exploration looked similar, we did notice differences between History and STEM Exploration, particularly in who initiated the conversation and how connections were used in conversation.

Conversational Patterns: History Exploration

Typically, an object or piece of media, rather than an activity, sparked a period of History Exploration. Conversations around historical objects and other elements of the historical setting were more frequently initiated by adults than stops at activities. Fifty-six of the 104 History-focused conversations around setting pieces were initiated by an adult who drew the child's attention to the object. After directing focus, an adult then pointed out a piece of personally relevant history (e.g., "That's how your grandpa listened to the news" or "Your great grandmother had a fridge like that") and then prompted the target child or others in the group to make connections between their lives and the lives of people in the past (e.g., "They didn't have TV back then. Everyone listened to the radio").

Cycle of Historical object exploration



In cases where the child was attracted to the historical object, adults often scaffolded the child's exploration by explaining the historical significance or context of the object they were looking at. In this exchange, the family is gathered in the Invention node (Patent Office), looking at a tall file cabinet of historical documents.

Child: *What does this say?*

Adult: *That says "Patents."*

Adult: *. . .Here, let's look at some of the Indiana Inventions. That's the top drawer; can you open the top drawer? Let's see what's in here. Television gaming and training apparatus. Cathode-ray tube! Glass blowing machine. See, look. They made up these inventions, William. Look. Somebody made up this invention that washes clothes.*

Child: *Yeah.*

Adult: *Did you know that?*

Child: *Yeah.*

Adult: *And the TV! Somebody had to create that TV.*

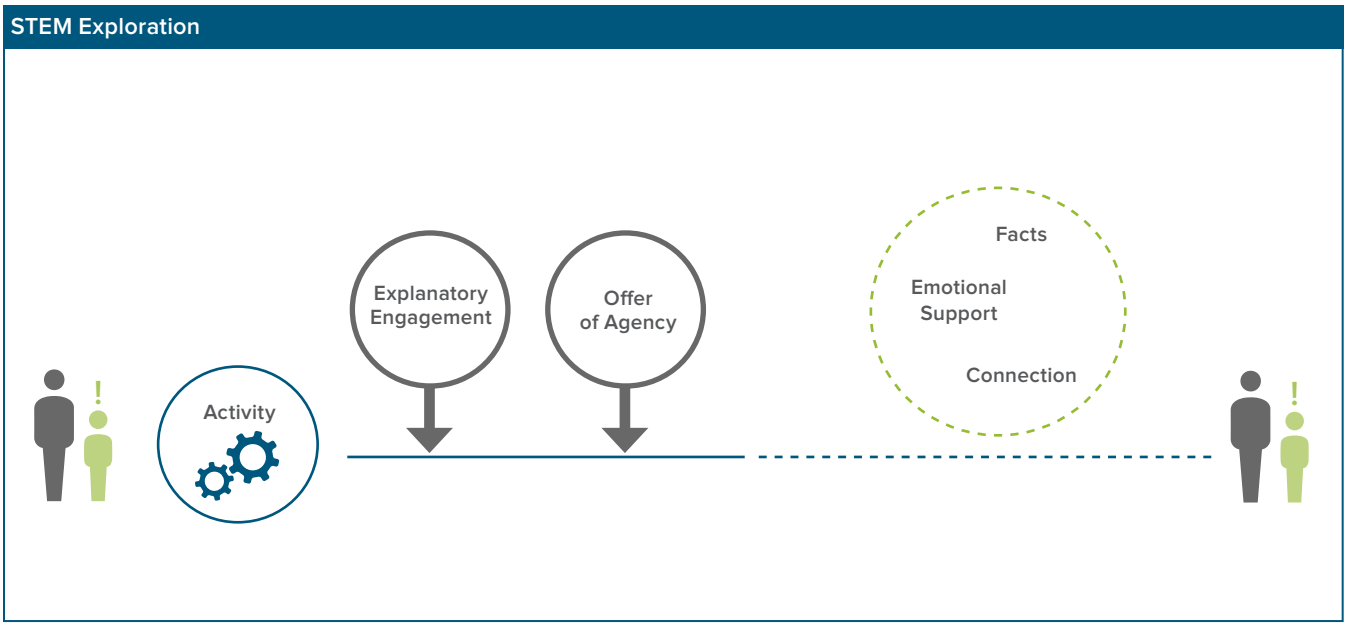
Child: *Yep!*

Adult: *It wasn't just there. Somebody had to come up with the idea of how to get that TV to work.*

Conversational Patterns: STEM Exploration

STEM Exploration usually happened over a large span of time when working at an activity as families tried different ways of engaging with the materials to complete objectives (either set out by the exhibit or devised by the families themselves). Since the hands-on activities often included basic instructions, steps, or at least an introduction to the components, STEM Exploration excerpts commonly started with either a facilitator or an adult in the group initiating conversation around a hands-on activity via Explanatory Engagement. This could be as simple as, "You guys can make airplanes here and shoot [them] to see if you can get at the low clouds," or more involved, such as reading instructions aloud. Explanatory Engagement was a common feature of STEM Exploration, but did not always appear, especially if children were already familiar with the activity from previous visits or experiences. After children in the group were "on-boarded," Offers of Agency, Emotional Support, Connections, and STEM or History Facts usually appeared during the STEM Exploration excerpt as part of the cycle of activity exploration.

Firgure 22: Cycle of STEM Activity Exploration



Frequency of Conversation by Age and Gender

We analyzed the code application by gender and age, since the exhibit components in *Create.Connect* were intentionally designed to be universally appealing and accessible to a range of visitors.

In our sample, data collectors attempted to gather an even gender distribution of target children, with the result of 15 boys and 20 girls in the final sample. There were not substantial differences in the presence of codes by gender, except for the code of History Facts (73% Boys, 50% Girls).

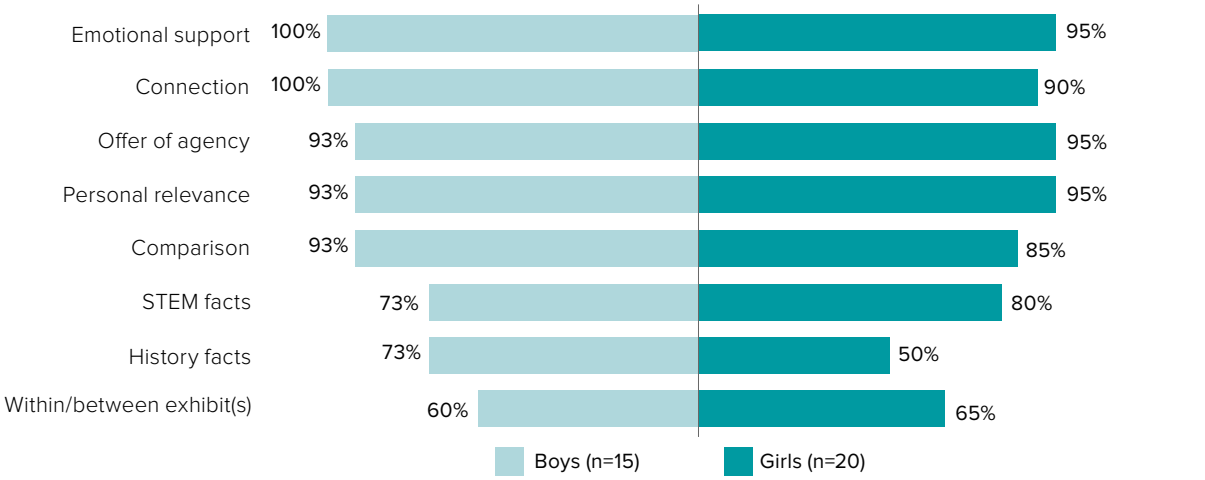


Figure 23: Percentage of Cases Exhibiting Coded Features by Gender

However, in Figure 24 we see differences in some of the sub-codes—not in the number of cases where it occurred, but in the frequency with which it appeared to occur within a case. Of note, cases in which girls were the target child showed a higher concentration, on average, of the codes Emotional Support as well as Connections (Comparison, Personal Relevance, and Within/Between Exhibit). The same pattern of concentration described above continued among the codes History Facts, STEM Facts, and Offers of Agency.

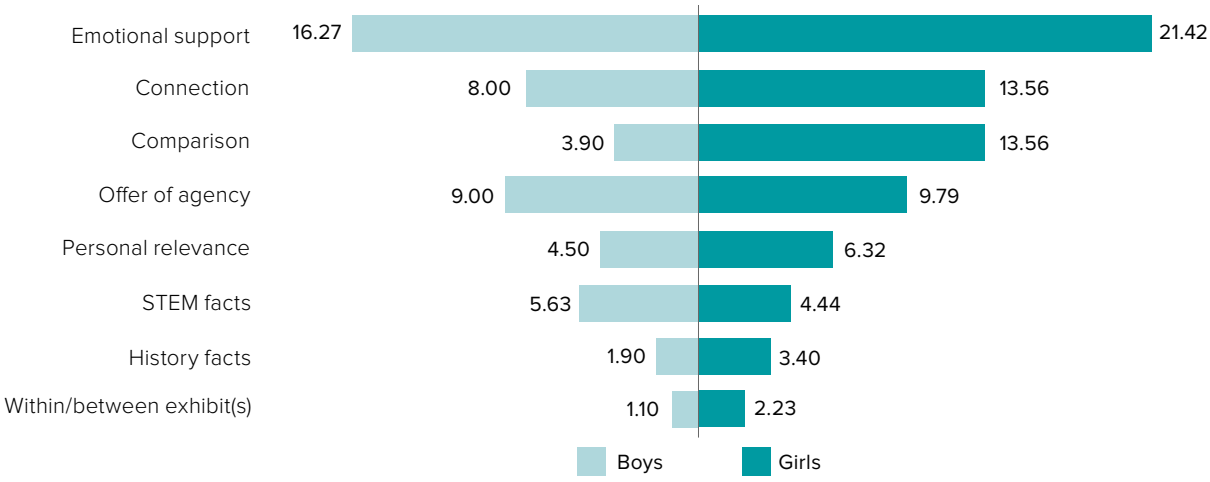


Figure 24: Average Occurrence of Coded Features per Case by Gender

Next, we looked to see if there were any differences in the age groups of the target child. There was no difference between age groups in cases where STEM Exploration was observed, which was present in all cases for all age groups. The trend among History Exploration and STEM & History Exploration was that those codes appeared in larger percentage of cases as the target child age range increased, which makes sense given that the capacity for historical thinking develops in sophistication as children get older.

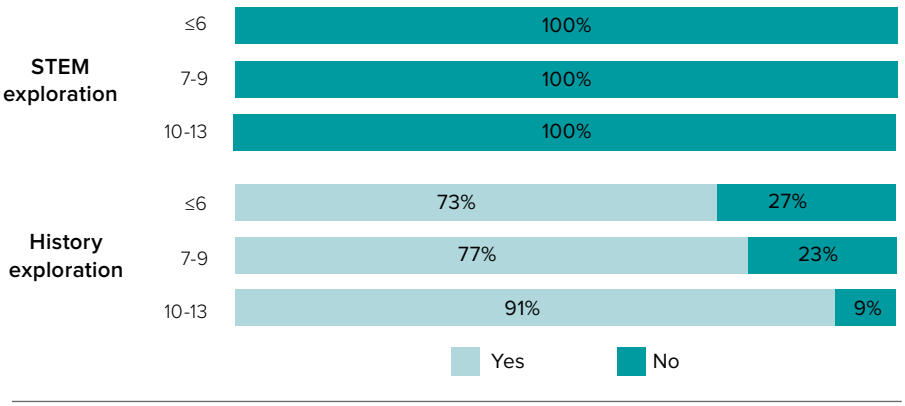


Figure 25: Percentage of Cases with Observed Features by Age

The Family Conversation study was not designed to investigate gender differences specifically, but we wanted to make sure we looked for differences, as boys and girls have historically not received equal opportunity or support in STEM. It appears boys and girls have similar opportunities to engage in History and STEM conversations and received similar support from adults during their time in the exhibition. There may be real differences on a finer scale when looking at how frequently supports and conversation occur within a case, but this will need further study. While we have a gender descriptor for each case, it is tied to the target child only. We recorded, transcribed, and analyzed all comments from group members, which frequently included multiple children of both genders. This same caveat applies to our analysis of age (the age of the target child may differ from others in the group).

Domain-Specific Thinking Strategies

Historical Thinking
- Cause and Consequence
- Change and Continuity
- Empathy
- Personal Relevance

STEM Training
- Cause and Effect
- Comparing
- Good Design
- Identity
- Intentional Process
- Modeling
- Persisting

Third Round of Coding: Defining Evidence of Domain-Specific Thinking Strategies

Finally, we narrowed our definitions of STEM Exploration and History Exploration to pinpoint conversational moves that indicated not just exploration with STEM and History ideas, but that evidenced thinking strategies that showed deep engagement with the disciplines. Our selection of these indicators was informed by existing literature on STEM and History learning: The Six Strands for Informal Science Learning (NRC), Next Generation Science Standards (2013), Strands from *Teaching History with Museums, Strategies for K-12 Social Studies, and Open to Interpretation: Mobilizing Historical Thinking in The Museum* (Gosselin, 2011) which relied heavily on Peter Seixas's Six Concepts of Historical Thinking, a framework intended to identify historical consciousness in formal education environments.

While there was no expectation that all visitor groups would have the same levels of engagement with both scientific and historical thinking, we wanted to know what the range of possible engagement was, especially instances where visitors demonstrated deep interest, knowledge, and skill in the domains of scientific or historical thinking. We wanted to know what about the exhibition experience prompted visitors to use these skills and how elements of the exhibition (the objects, the activities, the facilitation) played a role. In developing this coding scheme, we also consulted developmental frameworks for these domains so our coding could capture age-adjusted examples (NRC, 2013; Reich Rawson, 2010).

Domain-Specific Thinking Strategies Coding Scheme: History
Table 13: Coding Scheme: Historical Thinking Strategies

Code	Definition	Example
Change and Continuity	Comparisons or other statements that reference or acknowledge that life was different in the past. This might include progress, change over time, or recognition that people have the same challenges in the present, but solve them differently.	Adult: The way they used to heat irons in the older days is that you wouldn't plug in, you would heat them on [the stove].
Cause and Consequence	Identifying links between two occurrences; who or what was responsible for the changes in the past; and how actions in the past impact the present.	Adult: Do you think it was a good idea for the government to provide money to help get electricity to farms? Child: Yeah, I think so. Adult: Can you imagine if you didn't have electricity? How boring it would be? Child: Yeah, no TV. No light. No nothing.
Empathy	The idea of taking a historical perspective; putting yourself in someone's shoes; trying to understand what life was like in the past.	Adult: Did you see the tools? Can you imagine making an airplane out of those tools? Child: That would be hard.
Personal Relevance	Finding personal relevance in the exhibit. Evidence of prior knowledge, experiences, or relationships influencing connections to the content or objects and driving personal meaning making.	Child: Whoa! What is this? Adult: OH! Mr. Wizard. I used to watch that when I was a boy. Child: What does he do? Adult: He does science experiments. I forgot about Mr. Wizard.

Domain-Specific Thinking Strategies Coding Scheme: STEM
Table 14: Coding Scheme: STEM Thinking Strategies

Code	Definition	Example
Cause and Effect	Pointing out or discovering a relationship between design choices and outcomes on performance.	Adult: If you do that, it's going to go a lot farther than that hole. Child: It's going to go flying. Adult: Yeah, you better start backing and start. . . You're going to go much farther than that, my dear. You just created . . . with all the kinetic energy that you just set up. We're talking much, much farther. You just created a chain reaction. Child: We'll have this here. So it will stop the ball.
Comparing	Comparing the features of two objects with an exploration of reasons that are age appropriate.	Adult: When they spin from the air moving, it takes about five miles per hour of wind for these to turn in real life.
Good Design	Pointing out or discovering features of good design based on STEM principles.	Adult: Okay, now listen to me. When you had those flat, it's like a wall or piece of paper right? When you put it at an angle, air touches it and pushes it at an angle. So if you have the bowl like this, and you have it like this, put it at a curve, what happens? More air goes by, doesn't it? Well you don't want more air to go by; you want it to move more air, right?
Intentional Process	Open-ended exploration that demonstrates an intentional process of identifying problems or goals and attempts to solve those problems or reach said goals.	Adult: We can do that. We just have to line it up so. . . Watch. When you make it so it goes right, so it's not quite so . . . There we go. Put your hands up. Be ready to catch. Child: How about this? I don't . . . this. Let me get something. Here we can have some walls we can put. . . Let's try it. Ooh. Not quite lined up. We need it like this. Or probably. . . Adult: You see how it's notched out? If you move all those, it'll fit perfectly right there.
Identity	Conversational evidence of identifying oneself or another person in the group as someone who "does STEM" activities or thinking.	Child: Oh my gosh! There are circuits. Yay! I'm awesome at these.
Modeling	Using the activity as a model to demonstrate a real-world technology or science phenomenon by making connections.	Adult: You know how helicopters fly? Helicopters fly by rotating their pitch. So we need to make sure our pitch is right.
Persisting	Conversational evidence of persisting through frustration and challenges.	Adult: So tell me one thing you learned in here. Child: Let's see. I learned how to build a circuit. Adult: You did. Did we get everything right the first time? Child: No. Adult: So what did we have to do then? To make sure we get it right? Child: You have to make a lot of alterations.

Third Round Coding: Findings

All 35 cases had instances where the group was engaged in higher-level STEM Thinking Strategies (see Table 15).

Table 15: STEM Thinking Code Appearance by Case (n=35)

	% of Cases	Count
Cause and Effect	80%	28
Comparing	66%	23
Good Design	77%	27
Intentional Process	69%	24
Identity	11%	4
Modeling	66%	23
Persisting	51%	18

Table 16: Historical Thinking Code Appearance by Case (n=23)

	% of Cases	Count
Change and Continuity	54%	19
Cause and Consequence	9%	3
Empathy	31%	11
Personal Relevance	37%	13

However, fewer groups exhibited higher-level thinking in History (23 cases or 66% of all cases). Within the codes for disciplinary thinking, the two most frequently used were both about change and relied heavily on comparisons—between past and present or between different approaches at the activity tables—for meaning-making (Continuity and Change in History and Cause and Effect in STEM). Some codes appeared much less frequently than the others, most notably Cause and Consequence within Historical Thinking and Identity within STEM Thinking. Understanding causal relationships between historical events requires a rather high degree of knowledge about the past and the multiple factors that shape historical events (for instance, recognizing that the Rural Electrification Act of the 1930s was part of the New Deal, which was a response to the Great Depression). This may be quite challenging for children who are just beginning to learn about historical events and practice abstract thinking. Comments that indicated that someone thought of themselves as a "STEM person," which received the Identity code, were also not very frequent. STEM identity develops and changes over time, often from multiple experiences with STEM practices in and outside of school (Fouak et. al., 2010; Lee, 2002; Weber, 2012). Experiences like *Create.Connect* can contribute to a STEM identity (NRC, 2009), but one would likely not develop a strong STEM identity during a single visit in *Create.Connect*.

Differences in Domain-Specific Thinking Strategies by Gender

There was no difference between boys and girls with regard to STEM Thinking Strategies at the case level; both groups show this code in all cases. However, 16 cases with girls as the target child (80%; n=20) had at least one or more instances of History Thinking Strategies compared to the seven (47%; n=15) cases with boys as the target child.

When looking across all cases exhibiting Domain-Specific Thinking Strategies, there is not a big difference in the average number of times the code is applied within a case in terms of gender, though girls' numbers are slightly higher.

Table 17. STEM and Historical Thinking Strategies by Gender.

	STEM Thinking Strategies (n=35)		Historical Thinking Strategies (n=23)	
	Average	% of Cases	Average	% of Cases
Girls	7.15	100%	3.00	80%
Boys	5.87	100%	2.43	47%

Instances of STEM and History Exploration Co-Existing in Conversations

Our coding process revealed that most groups engaged in periods of STEM Exploration as well as periods of History Exploration. Throughout the coding process we also noted instances when these codes overlapped—that is, where a longer section of STEM Exploration (such as when a group was working at an activity table) also had codes for History Exploration (such as when someone would relate what they were doing to another object from the past). These instances were intriguing both to the evaluation team and to the larger core project team. How did the conversation flow as visitors engaged with STEM and History *within the same conversation*? What effect did this have on the conversation? Who in the group led this inter-disciplinary exploration? We sought to describe these types of conversations and what exhibit elements prompted them.

First, we focused on areas where the two overlapped or occurred simultaneously. This seemed like a good place to start because we were able to clearly recognize it was happening by seeing the two disciplines being used in regard to the same activity, challenge, or object exploration. We found 17 out of our 35 cases that had overlapping codes. In those 17 cases, there were 44[17] excerpts of History Exploration that co-occurred with STEM Exploration. Of these specific instances:

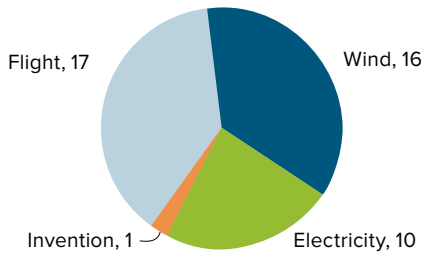


Figure 26. Overlapping STEM and History Exploration, number of excerpts (44)

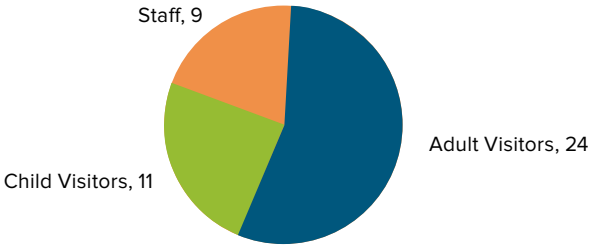


Figure 26. Who Prompts STEM and History Exploration, number of excerpts (44)

Looking qualitatively across these 17 cases, we noticed that comments built on one another that led the group to reach a new understanding of *how* something worked or came to be designed that way, or *why* something happened as it related to history. How does this thing work? Why did people do things like that in the past? For example, an exchange around the wind map began with a historical event ("Do you remember hearing about Hurricane Katrina?") and flowed into a conversation about HOW the storm happened, based on looking at the data on the screen. The windmill was often used to explore WHY people used one ("to pump water") and, in tandem, HOW it was used ("the blades moved around and generated power to move this"). Personal relevance and other connections often bridged the two.

In other words, the conversation—based around objects or activities—involved describing the experience from multiple perspectives drawing from two disciplines. It was the proximity of these statements to one another in the conversation—the volley between a parent making an observation and a child asking a question or between an interpreter offering ideas and a child making a discovery—that made the passages unique and exciting. They were always inspired by investigating objects, information, or activities that often triggered connections or personal memories that seemed to deepen the interest of the other parties in the group.

[17] This number could be inflated or deflated due to coding parameters (i.e., one larger interaction could have been coded as multiple excerpts and multiple interactions could have been coded as one); however, by looking specifically at the History Exploration excerpts (which tend to be shorter), it's possible to more accurately reflect how frequently these conversation domains occur together.

In the following two excerpts we see how groups explored the meanings of objects and activities, often driven by big questions about *how* something worked or *why* things were different in the past.

EXAMPLE 1
Case 18: Father and Daughter (age 10-13)

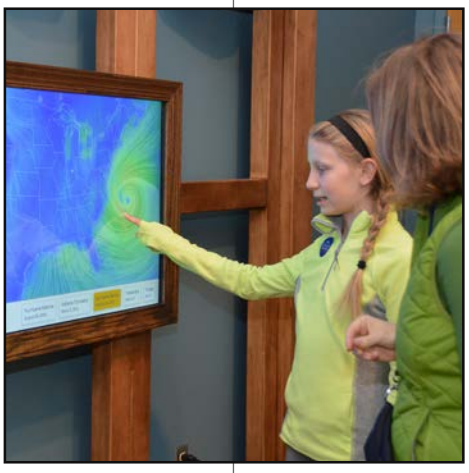
Wind Map

STEM Exploration

Father: Yeah OK, so where are we? Yeah, so is it more windy here or here?
Daughter: There.
Father: Ok, and let's look at it when a tornado happens. Push that button.
Daughter: Whoa!
Father: Yeah, huh that looks just like that.
Daughter: Let's try hurricane.

History Exploration

Father: Do you know what Hurricane Katrina was?
Daughter: Yeah.
Father: That happened before you were born.
Daughter: I know. What about before you were born?
Father: There look.
Daughter: Whoa.
Father: Yeah right. What about Hurricane Sandy?
Daughter: Where is Sandy?
Father: Ah, Over here.
Father: Look at that.
Daughter: Whoa!
Father: Yeah.
Daughter: That's a lot of wind.
Father: Yeah, a lot different than today, huh?



Conner Prairie

In this example, the group was interacting at the digital wind map. The wind map was one of the most popular exhibit pieces to elicit a mix of History and STEM talk, especially without the contribution of a Conner Prairie facilitator. There seems to be something about the process of considering data, both present and historical, that allowed for conversation to flow between what happened (Historical events) and why (Scientific phenomena). Furthermore, using the map, people were able to bring personal relevance into the conversation, pointing out where they lived or naming others who lived through major hurricanes.

There is also a sense that groups were trying to understanding how things work and were comparing realities and possibilities, past and future. This is in no doubt due to the design of the exhibition, which offers STEM activities that illustrate the foundations of key scientific phenomena. As one of the SMM exhibition developers reflected, "Engineering and technology changed but the science [nature] stayed the same." As families talked about past technologies, there was a sense of curiosity and reverence for these old ways of life. This is perhaps due to the STEM activities that explore these foundational scientific concepts on which all technology is built.

Conner Prairie

Young visitors watch the blades rotate at the Wind turbine experiment bench.

Some of these instances occurred when groups were working within the STEM activity and would reference something historical, often prompted by a personal memory or an artifact in the exhibition. In these examples the STEM activity drove conversation and History ideas were applied as an additional layer. As families worked in the activity, their conversations were often driven by the *how* of the scientific phenomena: How does this move? How can I make that light up?

In this next example, a Conner Prairie interpreter prompted the visitor to engage in historical thinking—to imagine what life would have been like in the past because of technological innovation—while they were doing an activity about that technological innovation.

EXAMPLE 2
Case 30: Mom and Daughter (age 9) with Conner Prairie Interpreter

Wind Activity Table	
STEM Exploration	Interpreter: What happened? What's going on now? Other Child: (indistinguishable) going around telling you where the wind's going. Interpreter: You can see that the wind is going. Is it going faster or slower now? Other Child: Faster.
History Exploration	Interpreter: Is it able to do more work now? Yeah! Think of all the amazing things you could do using wind to do the work. Because now you don't have the saw the logs in half. You can let your sawmill do it. You don't have to pump the water. You can let the water mill do it. Isn't that great? Can I get a sci-five? [hands smack]
STEM Exploration	Interpreter: That's a high-five for science. Are you ready to test yours out? Awesome. Very good. Mom: Alright, she's got some big blades on hers. Interpreter: Yeah, I like the blades. Daughter: It might help. They're all, like, triangular. Interpreter: Uh huh? They all have a similar shape.

While examining the coded transcripts for examples of STEM/History co-occurrence, we noticed another way integration may be present: as adjacent utterances. By adjacent, we refer to two excerpts with different codes existing directly beside one another, but not overlapping. Searching for these instances specifically revealed two types of presentations. Type A, which occurred more frequently, was a seamless transition where conversation started in one domain (typically STEM) and seamlessly transitioned into the other in a related way. Visitors were likely not cognizant they were even transitioning between domains because they were focused on the shift from doing a hands-on activity to looking at and exploring objects, but we can only speculate on thoughts and the possibility for making connections. The example below is an especially tidy passage at the telegraph key, which triggers an explanation about methods for communicating in the past; it is imbedded in the activity itself as an example of a switch.

Type A: Seamless Transition

EXAMPLE 2
Case 9: Father and Daughter (6 years old)

Circuit Block Activity Table	
STEM Exploration	**Child:** I need to put this on, there. I put this one there? Adult: Uh huh. What do you think? Do you think it's closed yet or do you think we have one more? Child: No, no. Adult: Ok. One more. Want a black one. A little bit of everything on here. Staff: Well, you've got the wiring down. I just don't know if the fan is working; I've had problems with it earlier. Adult: Oh, have you. So you did it right. Staff: Why don't you try, this light. Adult: Here, yeah. Alright, now try it bud. Ah! Staff: Yeah! Adult: Good job bud. So you had done it right, he had. Staff: It took me a long time to figure out how that switch worked. Adult: Oh yeah. Staff: Then I figured out the whole wire thing. Adult: I kind of want to see the washing machine.
History Exploration	Child: What is this, mama? Adult I think that is to do Morse code, right? Staff: That is, yes. Adult: Do you know what Morse code is? Child: No. Adult: Do you know when people say "SOS"? Child: Yeah. Adult: That's a way that they used to send messages before there were telephones; they would send messages, and, so this is like a long and this is a short. So, SOS.

Checking the connections at the Circuit block activity table.

Type B was not as common; it was characterized by the back and forth volley of STEM and History conversation and engagement. Unless the visitor vocalized it, we cannot know if they picked up on the fact that the activity and STEM ideas they were working with were part of the story they experienced, but they did explore both in related ways by making personal connections, meditating on the past, and demonstrating indicators of STEM inquiry. The example presented below is a case with one child visiting *Create.Connect* with multiple adults, and she had the opportunity to benefit from multiple conversations that present the story of the impact of electricity in rural Indiana.

Type B: Back and Forth Volley

EXAMPLE 2
Case 22: Mother and Son (6 years old)

Circuit Bench — STEM Exploration

Adult: Wanna look at this electricity thing?

[Adult and Child engage with the circuit bench following instructions, try different configurations, and explore concepts of power, Hertz, and AC & DC]

Child: Dad, daddy, dad, look.
Adult: Different motors need different currents, Ok. So matters ascend to make back and forth flow.

REA Setting — History Exploration

Child: I am going to make some cheese. Oh cold.
Adult: It says this stove could burn easily available coal and wood, but could be messy. You put coal in here to heat the stove. That means the house gets really dirty and the ash has to be cleaned out daily.
Staff: What do you think of this nice stove?
Child: Whoa look-it.
Staff: This is where you would have your fire. So you would build a fire with wood or coal.
Child: Is this plastic?
Staff: Yeah.
Child: Good.
Staff: On some of the fireplaces in the village you can see the soot on them.

Circuit Block Activity — STEM Exploration

Child: I am going to make electricity for the house. I'm gonna make electricity for the house, I'm gonna make electricity, electricity. Make electricity for you.

[Adults and Child work with circuit block activity to try and light up certain household features]

Adult 2: What's this? Is this like, uh, a connecter to the tilt switch? Is this the tilt switch again?
Adult 1: This doesn't make any sense to me. Maybe I gotta hook it on this spring.
Adult 1: Right, maybe there's no point in having this switch.

REA Setting — History Exploration

Child: Well look-it mama, today's your birthday. Mom look-it; it's a cabinet look-it.
Adult: Yep.
Child: It's a cookbook. What does it say?
Adult: Do you think it was a good idea for the government to provide money to help get electricity to farms?
Child: Yeah. I think so.
Adult: Can you imagine if you didn't have electricity?
Child: Yeah.
Adult: How boring it would be.
Child: Yeah. No TV, no light. No nothing.

Circuit Block Activity — STEM Exploration

Child: Busted.
Adult: Busted.

[Child and Adults work to light up two lamps on the circuit block activity]

Adult: There they go.
Child: Look-it, I turned on two lamps.
Adult: That one's dim though, because I think it's all the power is finishing off right there. And that's only because, or maybe not. Maybe that one is just a tiny light that takes no electricity whatsoever.

Exploring the tools in the 1930s era kitchen with a costumed interpreter.

As these examples show, the integration of STEM and History comments was a bit like a dance; sometimes the STEM activity would dominate and a historical reference would be dropped in; at other times historical ideas, events or objects were being discussed and the group began to talk about relevant scientific properties or processes. That the exhibition could evoke conversations going both directions is notable and speaks to the features of the exhibition—the layering of content, experience, interpretation, data, activity—that allowed for such variation.

It is important to remind ourselves that visitors' experiences in Create.Connect are just one point in their lifelong learning. We do not know what they bring with them that influences how they engage with the exhibit components, or how they continue to explore STEM and History ideas as a family after their visit ends. Therefore, we should be receptive to multiple ways that integration might be occurring in our pursuit to reveal what it looks like.

Exhibition Features that Promote STEM and History Thinking Strategies

We looked more closely at instances where there was especially rich talk to see what prompted or sustained this talk.

- **Activity Tables:** Cause and Effect codes appeared with regular frequency at most of the areas, but most notably at the Airplane Table, followed by the Wind Turbine Bench, Windmill Table, and Invention Tables. Activity tables were not an exclusive indicator for Persistence but the code did show up more regularly at tables than benches.
- **Experimentation Benches:** Modeling conversation was captured most frequently at the Wind Turbine Bench. Every case at this location exhibited at least one instance of Modeling talk, and many had multiple instances. The Windmill Table and Wind Bench in Flight also showed appreciable modeling conversation.
- **Setting Pieces:** There appeared to be much more History Exploration and History Facts at setting pieces, though there was some noticeable co-occurrence at the Airplane Table for History Exploration and a few more History Facts at the Circuit Blocks Table.

Exhibit Node

STEM Thinking Strategies were present in all nodes of *Create.Connect*, primarily as groups engaged at activity tables and benches (see tables below). Historical Thinking Strategies occurred most often in the Electricity Node, where the setting pieces included a refrigerator, iron, and stove. These historical objects were a primary trigger for Historical Thinking, although some codes were also applied when visitors were working at an activity table or bench.

Table 18. Distribution of STEM Thinking Codes Across All Four Nodes (n=541)

	Count	%
Invention	131	24%
Electricity	112	21%
Flight	146	27%
Wind	152	28%

Table 19. Distribution of History Thinking Codes Across All Four Nodes (n=87)

	Count	%
Invention	15	17%
Electricity	51	59%
Flight	8	9%
Wind	13	15%

Facilitation by Conner Prairie Interpreters and Adult Guidance

Conversation that led groups to STEM and Historical Thinking Strategy talk was largely prompted by an adult, both Conner Prairie interpreters and adults within a group. *Create.Connect* interpreters did not play as large of a role in Historical Thinking Strategy talk. When they were present, it was typically as a costumed character and evoked the idea of Empathy by encouraging families to role play. Children initiated these strategies to a lesser extent, although they did exhibit a fair amount of comparing, describing cause and effect, and expressing identity through an activity. However, even though children did not initiate these conversations as much, they likely benefited from hearing the conversation around them.

Table 20: Historical Thinking Sub-Codes

Sub-code	Primary Instigator of Talk	Location	Features of this Code and Effect on Conversation
Personal Relevance	Adult	Electricity	Adults often put an object in perspective by linking it to someone in the family's past.
Empathy	Adult, Interpreter	All	Adults also used setting pieces as jumping-off points for kids to imagine what life was like in the past.
Change and Continuity	Adult	Electricity	Adults linked the historic version of objects (and their purposes) to contemporary versions or manifestations that children would recognize.
Cause and Consequence [18]	Adult, Interpreter	Electricity, Invention [19]	Media pieces or graphic texts were what typically triggered adults to start conversation around Cause and Consequence.

[18] Small n; <5
[19] No occurrences in Flight or Wind nodes.

Table 21: STEM Thinking Sub-Codes

Sub-code	Primary Instigator of Talk	Location	Features of this Code and Effect on Conversation
Good Design	Interpreter	Electricity, Wind	Interpreters tended to point out Good Design features at the beginning of an activity, whereas parents almost always used this conversation approach in the middle of an activity as a way to explain phenomena and help children solve a challenge/problem.
Intentional Process	Adult, Interpreter	Invention, Flight	Excerpts with this code had a more "back and forth" conversational feel between adults and children as they identified goals/challenges and figured them out together. Interpreters' contributions to these conversations tended to be more "trouble-shooting" in nature and included some guided questions, but a lot of their time was helping kids with the mechanics of the activity (e.g., wires are fussy, stapler won't work) or answering specific questions. This codes popped up in the meaty part of an activity and covered a lot of the conversation in an excerpt.
Modeling	Interpreter	Wind, Electricity, Flight	Modeling comments by interpreters were typically associated with the larger story or context in that section. Modeling sub-codes tended to appear near the end point of an activity and acted as a capstone summing things up (e.g., "Remember this when your car dies out" and "Now you'll never be stuck on a lake no matter which way the wind is blowing"), although they also occurred in the midst of an activity as a hint or suggestion for how to overcome a challenge.
Persisting	Adult, Interpreter	Invention, Electricity	Usually, parents and interpreters were the ones cheering children on, but there were frequent instances of kids powering through on their own or even trying again in spite of their parents.
Comparing	Adults, Interpreters, Children	Wind, Flight	Interpreter use of this conversation feature tended to be geared at helping children recognize patterns and progress through an activity (usually posed as a questions), while the adults used it more as a focusing point and take-away (telling). This is also a code where children contributed a great deal (either as a response to a question or spontaneous observations).

Table 21: STEM Thinking Sub-Codes

Sub-code	Primary Instigator of Talk	Location	Features of this Code and Effect on Conversation
Cause and Effect	Adults, Interpreters, Children	Flight, Wind, Invention	This type of conversation usually happened in the middle of an activity as part of figuring out and iterating. It included a good deal of children making observations (either spontaneously or as a result of prompting by adults or interpreters).
Identity [20]	Adults, Interpreters, Children	All	Conversation where children recognized their identity as someone who uses science/is a maker or other recognition of their capacity to contribute and "do" science occurred in two cases: "There are circuits? Oh my gosh, I'm awesome at these" and, "I'm the inventor!" Adults and interpreters often called out the potential for a child to be an inventor or engineer or stated they were good at something, but this particular code was only intended to capture when the child articulated it.

[20] Small n (n=6), evenly distributed

Summary

The recorded family conversations provide evidence that visitor groups are frequently engaging with Historical and STEM-related ideas and many groups demonstrate domain-specific thinking skills indicative of higher-level thinking. Children received similar amounts of supportive talk from facilitators and the adults in their groups, with some variation by age (less History Exploration for young children) and gender (girls participated in more conversations involving Historical Thinking Strategies, made more Connections and received more emotional support). Some nodes of the exhibit promoted more talk than others (e.g. The Electricity node prompted the most History Exploration conversation as compared with other nodes). Likewise, some exhibit components fostered some types of talk better than others (e.g. setting pieces prompting History Exploration, Activity Tables eliciting Cause and Effect and Persistence codes). Therefore, the more visitor groups explored the exhibition, the more opportunities they had to deepen and expand their engagement with STEM and History ideas.

It is notable that Conner Prairie facilitators and adults within the group prompted group talk in productive ways. Visitors may well be adopting the strategies that facilitators use when explaining exhibit components and how they work. While it was difficult to definitively link talk by adults in the group as inspired by Conner Prairie facilitators, certainly the spirit of experimentation and exploration was evident through all of the cases. And while children initiated talk in sub-categories less frequently than adults, they no doubt benefit from the conversation they hear or engage in that is led by others.

Visitors design their own windmill blade shapes at the Windmill activity table.

As for the substance of the conversations in *Create.Connect*, a key goal was to better understand how STEM and History might be truly integrated in thought and conversation. Roughly half of visitor groups engaged in interdisciplinary conversation at some point during their visit; either through a seamless transition from one idea to the next or by a volley of ideas that were somewhat connected. In defining these conversations and how we analyzed them, we were careful to temper our expectations of what might be possible in terms of the cognitive demands of making these kinds of highly conceptual analogies and the relatively short time that groups spend in the exhibition. While there has been some research on promoting these kinds of conversation in informal settings, much more exists in the formal education settings where and teacher intentionally prompts, facilitates and supports students at age-appropriate levels with carefully selected material. In *Create.Connect*, the exhibition and its interpretation has been carefully crafted to promote STEM and Historical Thinking but much would be left to the visitors and their own experiences and interests.

A hypothetical conversation that would be indicative of people making meaning at the intersection of history and STEM—for example, noting that people in the past sometimes struggled with accepting new technologies, as we still do today—contains many complex ideas. It requires a visitor to first recognize broad societal trends of the past and present and then to recognize similarities between those concepts. This requires not only a knowledge of what is going on in today's society, but high-order abstract thinking that children do not typically begin to practice until they are in middle school. This explains, in part, why the most complex conceptualizations of how STEM and history interact in *Create.Connect* came in interview responses from adults who had time to reflect on the experience (and were asked directly about the connection), rather than in the conversation data. It also is supported by the conversation data that showed that historical thinking was more commonly observed among the older children in the sample. It is quite possible that children and families continued to negotiate STEM and history concepts and how they intersect after their visit, when they have had more time to reflect and situate what they experienced within their existing knowledge. This is not to suggest that children are incapable of making meaning from the past until they have the cognitive abilities to make complex connections on their own. The kinds of connections we saw families making in conversation data—comparisons between objects or noting the personal relevance of historical objects—may in fact be the best approach for supporting younger children in historical thinking without the need to employ abstraction (which parents are likely aware is not yet a strong skill).

As children get older, they begin to be able to envision themselves living in the past, moving toward the historical empathy we see some children beginning to employ in the family conversation data. And even when older children may not be capable of generating abstract connections between ideas on their own, they are able to grasp these connections and analogies when someone else explains it to them. Experiences in informal learning environments like Conner Prairie have potential to increase interest and affinity toward history, so when children do possess more fully-developed abstract cognitive abilities, they are inclined to apply those abilities to thinking and learning about the past. Furthermore, the family conversations data suggests that the hands-on STEM activities provide an entry-point for children and their families to begin their exploration of the intertwined narratives of science, technology, and history.

4) Partner Institution Experience and Perspectives

A key piece of testing out the *Create.Connect* approach to exhibition design, programs, and interpretation was to partner with four other history institutions to adapt elements of the *Create.Connect* exhibition at their sites. In this section, we explore the process of sharing History/STEM exhibition development with the partner sites, their concerns and feedback for developing their own exhibitions, and the impact participating in this project has had on their institutions. The feedback gained from the collaboration among these varied institutions—Conner Prairie, the Science Museum of Minnesota, and these four smaller history institutions —has potential to guide others interested in how the two disciplines of History and STEM can be integrated in an informal learning experience.

The first phase of the process included work by the core project team of exhibit developers at Conner Prairie and the Science Museum of Minnesota to create an exhibition that combined science activities and historical narratives that would fit into the living history museum context of Conner Prairie. Next, partner institutions gathered to experience the exhibition and to begin to plan for their own exhibitions, which opened during the final year of the project. Throughout the process, they received guidance from the core project team and participated in a collective process of planning and iterating their exhibitions. Finally, the core project team reflected on ways that the process could be useful for other history institutions interested in integrating STEM interactive activities.

The four partner sites range in size, content focus, institutional association, and geographic location (see Table 22 below for detail), offering a variety of contexts in which to test this proof of concept that other history institutions can successfully integrate STEM interactive activities into their exhibitions according to the model developed through this project.

Given the pioneering aspects of the project and the diversity of participant sites, challenges—some unique to individual museums, some likely universal in the history museum field—arose along the way to creating successful integrated STEM/History exhibitions at each of the four partner museums. The core project team of Conner Prairie and Science Museum of Minnesota staff was available to provide support via face-to-face workshop time and remotely as part of regularly scheduled exhibition development phone calls. By helping to answer questions with existing evaluation data from *Create.Connect*, their own experiences of prototyping and iterating that exhibition and others, and extensive backgrounds in creating visitor-centered encounters with History and STEM, the core team helped the participants navigate how to integrate new STEM experiences with locally relevant history narratives and to deliver an engaging experience for each museum's audience.

In this section of the report, we describe how the team created a model for others to use, include evidence of success across the board, and share insight into challenges faced along the way. We also explore perspectives from the four sites and from the field at large to suggest how this model might be useful in supporting future work integrating STEM into history sites.

Table 22: Partner Site Summary

	California State Railroad Museum	Mystic Seaport	Oliver H. Kelley Farm	Wabash County Historical Society
Location	Sacramento, CA	Mystic, CT	Elk River, MN	Wabash, IN
Institutional Association	California State Parks	Independent	Minnesota Historical Society	County Historical Society
Mission and Collections Focus	California rail history	American maritime history	19th century Minnesota agriculture	Local history
Visitation	500,000+ annually	250,000 annually	30,000 annually	10-12,000 annually
Exhibition Development Capacity	Medium for development and fabrication	High internal capacity for development and fabrication	Minimal on site, but high for MNHS department that produces exhibits for historic sites	Minimal
Existing Facilitation Model	Volunteer docents	Paid gallery staff (interpretation department)	Third person costumed (interpretation department)	None

Table 23: Partner Site Data Collection Timeline and Sources

	2013				2014				2015	
	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec	Jan-Mar	Apr-Jun
Workshops	1st (at SMM)		2nd (at CP)			3rd (at CP)	AASLH (at SMM)			
Interviews			Round 1 (CP/SMM)		Round 2 (CP/SMM)				Check in with Project Facilitator	Round 3 (All*)
Other							Exhibit Development Calls (July-April)			
Surveys	Workshop		Workshop			Workshop	AALSH			

* Staff from Conner Prairie, Science Museum of Minnesota, and all four partner sites.

Information about the experience of working through the *Create.Connect* project was gathered from staff at all participating sites. (see appendix for full list of staff)

Workshops

Professional learning data was collected throughout the life of the project, starting with a project kick-off meeting in January 2013. Evaluators were present as non-participatory observers at each of the three workshop meetings to audio record conversations and take notes on the proceedings. Each meeting was also followed by an online feedback survey completed by all participants from Conner Prairie, the Science Museum of Minnesota, and the four partner sites. (see appendix for full list of participants)

Interviews

An evaluator on the project conducted three sets of interviews during the project: two to specifically check in with staff at Conner Prairie and the Science Museum of Minnesota during the development phases of *Create.Connect* and one as a wrap-up interview, which included staff from the four partner institutions.

AASLH Workshop

A fourth source of data on professional learning was an online feedback survey administered following the workshop delivered at the American Association for State and Local History (AASLH) annual meeting in September 2014.

Analysis

The professional learning aspect of the *Create.Connect* project was a three-year case study with the experiences of all six institutions converging to give a holistic picture of the initial implementation of the model from start to finish. However, the analysis occasionally addresses the perspectives of a single institution when examining aspects unique to that museum (or type of museum). The majority of data collected from the professionals involved in the project was qualitative, although some quantitative data were collected as part of the workshop feedback surveys, which were primarily used to improve subsequent workshops. Much of the data presented here was drawn from audio transcripts and notes from the workshops, interviews, and project meetings.

We used evaluation questions as a guide to articulate key themes and trends as data came in over the three-year active phase of the project, including:

A. How did Conner Prairie and the Science Museum of Minnesota come to define the *Create.Connect* exhibition and project?
B. In what ways did collaboration and support in the Create.Connect project allow for partner sites to create their own exhibitions?
C. What questions and concerns did partner sites have about adapting the exhibition to their institution?
D. How do partner sites define and plan to document success of their exhibitions?
E. How have partner sites adapted *Create.Connect* to fit their institution's mission, audience, and resources, and how does this process suggest future success of STEM interactives in history settings?

A) Co-developing the Create.Connect Exhibit and Project

The following is a discussion of how Conner Prairie and the Science Museum of Minnesota collaboratively defined what success meant in the context of the *Create.Connect* project. While these conversations sometimes overlapped with the experiences of the partner sites, the focus here is on the dialogue between the two institutions regarding *Create.Connect* and the project as a whole. These conversations formed the foundation for the exhibition framework on which the partner sites designed their local exhibitions.

The core project team refers to staff from both Conner Prairie and the Science Museum of Minnesota. Their roles within their respective institutions included exhibition development and/or fabrication, education, and programming, as well as executive-level. One person affiliated with the Science Museum of Minnesota acted as the project facilitator, coordinating communication and development work between core team staff as well as between the staff at the partner museum and core team. The facilitator's role was intentionally planned as a way to encourage collaboration between all six institutions, but ended up also being instrumental in coordinating the moving and overlapping pieces of the project as the hub of communication who was aware of everyone's progress and needs.

The core team had two roles: to explore what STEM/History integration meant and use that knowledge to craft the *Create.Connect* exhibition and to guide and support the four participant museums as they adapted the framework demonstrated in *Create.Connect* to their own museums.

"Scrambled Eggs": Harnessing the Strengths of both STEM and History Practice

From the start of the project, staff at Conner Prairie and the Science Museum of Minnesota had in mind a mix of exhibits and facilitation that called on the strengths of both STEM and History to create an interdisciplinary learning experience with multiple entry points. Staff at both institutions wanted to avoid creating an exhibition that presented a straightforward narrative of the history of science:

> *I think it was just hard for people to try get past things like, "It's not the history of science. It's not History. It's not Science. [It's not a] Science museum at a history place that doesn't have any reference to history. It's none of those things; it's this stuff all mixed together.*
> —Science Museum of Minnesota (First Interview)

> *Yes, I wanted to see that we could put STEM at a History museum, but I also wanted to see that we could do STEM and Historical learning at the same time. And that that would develop a richer experience, which is, in fact, what we found.*
> —Conner Prairie (Final Interview)

Very early in the life of the project, some members of the core project team struggled with what integrating STEM into a History exhibition should look like. The team agreed on the metaphor "scrambled eggs" to help visualize a mixing of the two disciplines into a cohesive whole, as opposed to a hard boiled egg, where STEM is the yolk with the egg white of History wrapped around it. There was still variation among individuals in thinking about how to integrate STEM and History, and there were different expectations regarding the level of blending that would be achieved. However, the overall shared vision among the team, along with regular communication through the workshops and project calls, helped negotiate places where ideologies rubbed against each other.

Ultimately, the model that emerged out of "scrambled eggs" allowed both disciplines to complement each other and bring topics together for visitors in a way that STEM is integrated with History to round out the bigger picture of how it (STEM) affects people's lives:

> *I think it's not that we only put STEM in a context, but that we integrate the historical learning behind why was this important. How did it affect the community? Why do I care? All of those things that can sometimes be left out of traditional STEM experience. A lot of assumptions can be made both in a historical and a STEM experience. What we're trying to do is give people a sense of place and a time. And why this [STEM innovation] matters, and how it affects their lives at large.*
> —Conner Prairie (Final Interview)

Creating a Vision for *Create.Connect*: Balance and Integration

Striking a successful balance of STEM and History in the final product was a frequent topic of conversation and a necessary facet of success. Initially, there were concerns from Conner Prairie staff not directly affiliated with the project regarding how well a STEM/History exhibition would fit at the institution. There were worries that visitors would be confused seeing STEM activity in a History museum. Exhibition developers at both Conner Prairie and the Science Museum of Minnesota agreed that there needed to be a reason for a STEM activity to be in the exhibition as part of staying true to the mission of a History museum. Thoughtful collaboration between the Science Museum of Minnesota and Conner Prairie exhibition developers and interpreters, which took into consideration feedback from evaluation efforts, resulted in a co-presentation of STEM and History that seemed more natural in a History setting. The following is an excerpt from an interview with a Science Museum of Minnesota exhibition developer describing the process of working with staff at Conner Prairie to make sure the STEM made sense in a particular setting:

> *[Conner Prairie] developed a character to go into each one of these four places. In doing that, they needed to define an awful lot of the story of that setting. That was really great because we're then able to have a shared understanding of who owns that space, and from the Science Museum, then we're able to articulate the type of science that might naturally be in there. Or if there's something that has needed to be shifted in a way to become a natural fit.*
> —Science Museum of Minnesota Staff (Second Interview)

Conner Prairie staff were concerned about the tendency for the STEM components in the exhibition to be "loud and sticky," essentially commandeering guests' attention in a way with which the History couldn't compete, so while the exhibition was an integrated experience, some felt it was not quite balanced.

The concern of achieving appropriate balance with respect to STEM and History has been challenging to address. Evaluation results are difficult to interpret without other benchmarks for comparison, so the question of "What do scrambled eggs look like and are we achieving it?" is still being answered. The core team has done its best to develop what it feels are best practices for an integrated and balanced exhibit.

Conner Prairie's Opening Doors method of interpretation was the answer to making history more engaging in its outdoor areas, and it was also effectively applied in *Create.Connect*. The Opening Doors strategy of interpretation is one driven by visitor curiosity rather than scripted content delivery. Interpreters adapt their interactions to suit the individual based on what the visitor is interested in. This method has helped visitors have a different kind of experience with History narratives than what they're used to in other museums —one that can be just as engaging as STEM activity.[21]

As described in the Introduction, the exhibition framework integrates historical narrative, historical objects and setting, and STEM activities. Articulating these elements enabled the core project team to ground decision-making in a shared vision for the experience. An interpretive staff member at Conner Prairie related their impressions of the framework in action:

> *I believe that our ability to immerse people [in Create.Connect] now in a way that helps them see the "why" of something is making it be an integrated experience instead of "I do this over here and then there's this stuff over here but I don't understand why the two are put in the same place."*
> —Conner Prairie Staff (Second Interview)

Working out the narratives of each setting, fitting story to science activity, and choosing the objects visitors would explore involved intensive collaboration and communication between the exhibition developers at the Science Museum of Minnesota and Conner Prairie, which highlights another key element of successfully integrating STEM and History: cultivating the right partnership to draw on needed expertise. In this case, this was the Science Museum of Minnesota's track record with STEM activities and Conner Prairie's dedication to dynamic storytelling. In this way, the core team was also a fundamental partner to the four participant museums as well. Furnishing the framework described above provided the crucial structure around which the partners could plan their exhibitions.

[21] See Conner Prairie's full description of their interpretation methods at http://www.connerprairie.org/About-Conner-Prairie/Driven-by-Our-Mission/Our-Mission-at-Work#Opening-Doors

B) Adapting Create.Connect for Partner Sites

Along the way to creating successful STEM/History experiences at the four partner museums, the core project team of Conner Prairie and Science Museum of Minnesota staff provided support by answering the partners concerns and questions with evaluation results from *Create.Connect*, their own experience of prototyping and iterating, and extensive backgrounds in creating visitor-centered encounters with History and STEM. While the core team helped the participants meet the challenges of integrating STEM with locally relevant history narratives and delivering an engaging experience for each museum's audience, the opportunity to collaborate with each other was also a huge benefit to the participant institutions.

Workshops

Based on the success of previous experiences with multi-site collaborative efforts like the NSF-funded Nanoscale Informal Science Education Network (NISE Net), the core team decided to gather staff from all six institutions for workshops as a way of introducing the staff to the project, new ideas, and one another, as well as to encourage a collaborative environment where questions could be raised and solutions discussed. Originally, two workshops were planned, but a third was added when it became clear how important the group time was to understanding what the project was about.

Most of the staff from the partner institutions remarked that face-to-face meetings were very important. The partner site participants particularly valued the three workshops as a time to work directly with Science Museum of Minnesota and Conner Prairie staff, and they also benefited from seeing *Create.Connect* at Conner Prairie. These workshops were an effective medium for the core team to hear partners concerns directly and answer questions immediately. Participants appreciated individual attention in addressing site-specific needs as well as the large-group format that allowed for cross-institutional collaboration and conversation. To observing evaluators, the fission-fusion style of full group/small group work and conversation seemed particularly effective at generating and refining ideas.

Staff from the core project team worked with staff from participant museums to generate ideas for their own exhibition. Small group work addressed individual site's needs and helped participants feel more comfortable asking questions. Opportunities to refine ideas as a whole group gave participants access to varied methods and solutions each institution had developed to address the problems they had encountered.

Seeing *Create.Connect*

Participants were introduced to the project nearly a year before they would actually see *Create.Connect* as an example. The ambiguity of what the project was trying to accomplish, along with having little to compare to, was unsettling for some participants during this early stage when the final vision was not clear. Seeing the exhibition in action nine months later, and understanding the process by which the exhibition was being adjusted and refined, was an essential step in the partners' experience. One partner mentioned in post-workshop feedback that "seeing the exhibits in action and our further discussion helped clear up my earlier confusion."

Seeing both the prototype in September 2013 and the final version of *Create.Connect* in May 2014 was an unanticipated benefit. Witnessing the iterative process at work gave the partners a better understanding of how story and activity were integrated:

> *I enjoyed seeing Create.Connect twice. It was incredibly valuable to see the changes and improvements that were made and understand why they were made. Seeing those changes and thinking about our approach gave us latitude in opening our exhibit.*
> –Mystic Seaport (Workshop Feedback)

Access to Science Museum of Minnesota and Conner Prairie Staff

The workshops also provided the partners with face-to-face access to Science Museum of Minnesota and Conner Prairie staff's expertise via presentations (such as evaluation debriefs and facilitation workshops). But the continued exhibition development support was especially valued for very focused, specific idea-generation and as a safe space to ask questions.

Exhibition Development

Overall, participants felt the staff at the Science Museum of Minnesota and Conner Prairie were available and responsive to requests for assistance, and it was helpful to have access to individuals with extensive backgrounds in museum learning and experience in exhibition development and fabrication. While some partners required more intensive support than others (Wabash had very few resources and little expertise in designing and developing exhibit ideas while Mystic Seaport and Oliver Kelley Farm had access to much more sophisticated internal exhibition fabrication departments), all of the participants referenced benefits they received from the regular calls with the Science Museum of Minnesota exhibition staff that kept things front of mind and moving along.

Having strong partners in Conner Prairie and the Science Museum of Minnesota was important to feeling supported in the project. Direct communication with the Science Museum of Minnesota and access to the fabrication expertise was necessary for many of the participants. The fact that the activities being integrated into each exhibit were already tested and proven at both Conner Prairie and the Science Museum of Minnesota was an important aspect of the project design.

Evaluation Resources

Some staff at partner sites were uncomfortable with Conner Prairie's decision to install a prototype—what they felt was essentially an unfinished exhibition—with incomplete setting and temporary graphics on the floor for visitors. Others, however, appreciated seeing how different aspects of the exhibition (for example facilitation and setting) developed in tandem and opened up new ways of thinking about their own approach to exhibition development. In an interview at the close of the project, a Science Museum of Minnesota staffer lauded the prototyping and evaluation efforts by saying that prototyping "*makes people uneasy, but the evaluation informs the end product by substantiating your next move. When it opened, there was no question about if it was going to work. We could have just jumped to the end, but it would have been a crapshoot. This way, we knew that it was going to work.*" Participants also saw the value in prototyping, even though it may not be regular practice:

> *Science museums tend to prototype and revisit exhibits as they go forward, but history museums don't. This is a method we're committed to implementing.*
> –Mystic Seaport (Final Interview)

Some participants gave feedback near the end of the project that they had applied (or planned to apply) lessons from the *Create.Connect* evaluation reports to other exhibits at their sites, and the information continues to support work for other projects. For example, one partner stated during an interview that the success of *Create.Connect* was an incentive to revisit other areas in their museums to update exhibits. Another said seeing how audiences responded to *Create.Connect* made her think about how to make sure her museum's exhibits delivered an audience-centered experience by supporting different ways to engage visitors than what had been the norm. More than one participant was excited to use the evaluation reports when appealing to funders and board members for future work in the same vein as the *Create.Connect* project.

Advice From Partners

As part of the final wrap-up interview, participants were asked what advice they would give to other history museums interested in creating a STEM/History exhibition. Some were broad instructions with a playful warning of challenges to expect such as, "Be prepared to jump in headfirst and embrace the chaos!" and "Plan for the amount of time you're going to have committed to this. You will get distracted from other projects."

Other pieces of advice addressed how to tackle the process:

- "*The idea I would impress on any history museum is that where you start is what is a story or artifact/collection of artifacts that you really want to explore in a different way. That's your foundation on which you can build. Making visible the invisible. This exhibit allows us to show the wind but also designed a copy of the steering mechanism which you can't see on the actual ship (see how the pieces and gears work together). What's a story that's important to your museum? What's something that's frustrating to you that you can't show people with the real artifact, but this type of approach could make visible to your visitors, that they can connect back to the real thing they have a better understanding of how it works?*"

- "*Prototypes are essential. Get people on the team that can prototype (and do it quickly) so you can actually test things.*"

- "*Think really big at first, and try not to say 'We can't do this*,' or '*We can't do that.' Stay open minded at the start and even break a few rules because you can always pull back. Think as big as possible at first.*"

C) Questions and Challenges of Adapting *Create.Connect*

The issues raised and addressed through the process described above can be discussed thematically as well. In this section, we describe commonly raised questions and concerns among the partner sites and how they were resolved.

The topics presented in this section were drawn from conversations at the three *Create.Connect* project workshops and a workshop presented at the AASLH conference in 2014 along with the respective workshop feedback surveys. The discussion below is also informed by interviews conducted with staff of each partner site.

Shifting Paradigms: History Museum Culture

Prevailing history museum culture, institutional buy-in, and shifting existing paradigms were interrelated concerns for all of the participants.

While there were concerns from some staff at Conner Prairie that visitors would reject a STEM exhibition, most of the staff from participant museums did not express concern about that facet of acceptance. They were more concerned with the existing culture and structure of sharp disciplinary division at their own museums, and reported during the first workshop that they expected resistance among their exhibit and floor staff over the introduction of content they were unfamiliar with and felt did not fit the mission of their organization. This concern was mostly unrealized once each partner's exhibitions opened, which is perhaps a testament to the attention paid to finessing the local story connection during the exhibition design process.

A second concern brought up during the first workshop was the question of hands-on and authenticity in regard to expectations from visitors. Participants felt visitors expect to see real artifacts in a history museum and the idea of a "snoopable" setting with reproduction "*non-accessioned*" objects might not sit well. One participant said at the time, "*History museums have a hard time using replicas instead of the real artifact. I have seen some resistance to it.*" These particular concerns about visitor acceptance and institutional fit appear to have vanished upon their first experience with *Create.Connect* during the May 2013 workshop at Conner Prairie.

Support and Preparation for Developing an Exhibit

Participants had seen how well the exhibition worked at Conner Prairie, but the product they would end up with (and how to get there) was still fuzzy following the third workshop. The regular phone calls with Science Museum of Minnesota staff were vital supports during the exhibition development process that provided structure, allowing partners to take responsibility for tasks that needed to happen. During the third round of interviews, participants' reflections of the process indicated that they were unprepared for the amount of time and resources they needed to devote to the nuts and bolts of developing an exhibition in-house.

The core team, and the project facilitator in particular, were aware of and ready to provide the supports the partners needed, but all (core team and participants) realized in the midst of this initial implementation that capacity for the time-intensive development work on an exhibition of a caliber that large institutions like the Science Museum of Minnesota and Conner Prairie regularly produce varies among institutions. In situations where staff have to wear many hats (or all hats), not having a dedicated team to address tasks such as sourcing images or picking carpet colors results in dedicating much more time than initially anticipated.

Facilitation and Staffing

The largest and longest-lingering question through the entirety of the partners' experience was about staff facilitation. Facilitation was presented alongside setting and activity as one of the essential building blocks of the *Create.Connect* exhibition. The expectation set by the core team at the first workshop was that each site would implement costumed character interpretation modeled after Conner Prairie's first-person facilitation style. However, there was concern about the feasibility of having a fully staffed exhibit and the capacity to train staff in such an intensive facilitation method.

While some of the sites had experience with costumed facilitation, they felt full first-person interpretation (taking on the persona of a historical character, speaking and dressing as if they were from a specific time period) was not appropriate for their institution or exhibition. For example, Mystic Seaport has the staff and capacity to train interpreters, but does not use first-person facilitation outside of their village exhibit. Oliver H. Kelley Farm is comfortable with facilitation, but uses third person interpretation (dressing as a historical character but acting and speaking as someone from the present era) and would not want to change that model. Both utilized costumed staff for interpretation on their sites, but utilizing in-character staff does not fit their needs for their exhibitions.

The emphasis on facilitating the exhibition led to anxiety over the idea that the exhibition needed to be facilitated all the time. Just being able to provide reliable full-time staffing for an exhibition was a concern for some. The California Railroad Museum is almost entirely staffed by volunteers, and there were concerns about training, reliability, and buy-in from a volunteer base that is entrenched in the traditionally trained museum paradigm. Wabash was concerned about having the budget to hire any staff for facilitation.

Discussions of "*How are we going to staff this*?" fell away as participants transitioned into the exhibition development phase and focused their attention on the physical exhibition, but there remained some concern (especially among Wabash and California Rail Museum participants) about the necessity of replicating the interpretation style of Conner Prairie in order for their exhibitions to be a success. None of the partner sites implemented first-person interpretation in their exhibitions, and the degree of staffing differs at each location, but the initial conversation about facilitation prompted the core team to prototype simple instruction panels in *Create.Connect*, which were made available to the partners to help families get started with the activities on their own.

The core team ultimately left as a local decision the question of facilitation in the partner institutions. An article written by Conner Prairie describing the framework for exhibition design (Hughes, Mancuso & Cosbey, 2015) strongly encourages staffing an exhibition, but there were no comments from the core project team about the sites that chose not to staff their exhibitions consistently (or at all), other than one Science Museum of Minnesota developer wondering about the sustainability of staffing and if it really was necessary for success.

STEM Content Expertise and Presentation

Prior to visiting the final iteration of the *Create.Connect* exhibition and observing Conner Prairie interpreters, staff from all the participant museums expressed discomfort regarding presenting STEM content; many felt they needed to be experts. In response, the core project team reiterated that

> *. . .understanding and communicating all the facts about a science topic is not the goal of the experiences. [Staff] should be able to explain what is happening in the activity, but it is more important that they encourage visitors to experiment, solve problems, persist through frustration, and discover things on their own than communicate large amounts of STEM content* (AASLH Technical Leaflet, 2015).

The staff member from California reported in his final interview that while initially hesitant, their volunteer docents have embraced facilitating the activities and are taking the initiative to learn more about the processes they are based on.

During their final interview, staff at Mystic Seaport revisited the issue of STEM content, expressing a desire for more guidance about the level of information that would be appropriate to present:

We didn't have a good sense about the level of information that was appropriate for a STEM exhibit—zeroing in on the "Big Idea" that's at the right level for an Informal Science Education experience. History professionals have a good idea about the level regarding history content, but are not familiar with STEM. What is the starting point? What are we hoping that [visitors] get out of it? What's gravy and extra if they get there? What's the real meat and potatoes?
—Mystic Seaport (Final Interview)

While the above quote does not necessarily suggest discomfort with STEM, it highlights another facet of just how challenging integration can be for history professionals who are not familiar with delivering informal science education experiences. Staff at history institutions may still need support in identifying the appropriate level and type of content to present.

D) Documenting Exhibit Use and Success at Partner Sites

There is data from both the public impact evaluation at Wabash and Mystic Seaport and follow-up phone interviews with all the partner sites that support the idea that the exhibitions at each participant site are a success with visitors. Not surprisingly, the definition of success for the exhibition differs between sites due to their individual needs and characteristics, but we considered the different ways each partner described visitor engagement at their exhibitions and were on the look-out for unanticipated successes on an organizational level that contributed to the success of the project on a larger scale.

Institutional Fit

One measure for success of the exhibition is how well it fits into each site's existing installations and serves their audience and mission. There does not appear to be any issue with fit, as the partners feel the STEM dovetails seamlessly with the history. This suggests that the collaborative exhibition development work of crafting a narrative and setting where STEM has a reason to be there is a key aspect of success for all institutions. Additionally, there was no need to shoehorn the experience into the museum because each exhibition was intentionally designed to address the local history connected to the site. Wabash staff report that visitors say the exhibition fits well in the building and is a nice addition: "*The rest of the museum is hands-on, so it fits. The design makes it feel like it's part of the museum.*"

At Oliver H. Kelley Farm, the entire property is an immersive experience where visitors are invited to participate in the daily activities of the farm. According to their Programs Supervisor, Oliver Kelley Farm defines a successful exhibition as one in which visitors accomplish a task or learn a new skill or idea, and facilitators help visitors have a hands-on experience. Their exhibition "*How Do You Power a Farm?*" (about wind and energy transfer) accomplishes this on a smaller scale with fewer variables, but they have adapted it to transition to the rest of the outdoor exhibitions by asking the visitor to find other examples of energy transfer used on the farm.

Similarly, at Mystic Seaport there is a recognizable relationship between the activities in the Discovery Barn (*Force and Motion at Sea*) and the story of the ships where visitors are able to explore the phenomena and simple machines that play an enormous role in life at sea:

> *Originally we had too many topics and concepts to work in, but once we made the connection with the fishing schooner and focused on one vessel and let go of propellers and trying to shoe-horn things in that didn't really fit, that seemed like the route where it all came together. Anyone who's ever been on a ship knows that there's science involved in the design and fabrication and the use of these machines. When you're thinking about integrating STEM into historical topics, it's not an "either or" proposition. What [our staff] managed to do was tell the story of life on a fishing boat using STEM technique as a lens for doing that. The idea I would impress on any history museum is that where you start is what is a story or artifact/ collection of artifacts that you really want to explore in a different way. That's your foundation on which you can build.*
> —Mystic Seaport Staff (Final Interview)

During the final round of interviews, staff at the California State Railroad Museum described how, over the years, nearly all of the interactive components had been removed from the floor. The "A Shift in Power" exhibition is a departure from that model, and the staff member there is hopeful that its success is an indicator that the Railroad Museum can shift its own paradigm toward more visitor-centered experiences.

Data Collection at Partner Sites

The evaluation team had an opportunity to collect data on visitor behavior at Wabash and was able to review data collected at Mystic Seaport. Assessing public impact at Oliver H. Kelley Farm and the California Railroad Museum relied on reports from staff at those institutions during the final round of interviews.

Wabash's *Dr. Charles F. Brush: An Electric Dynamo* exhibition included one activity and several setting elements. The exhibition includes a Circuit Block table, where visitors make working circuits with simple materials. The table is printed with a map of the town of Wabash, and one electric element was designed to resemble the Wabash County courthouse with an electric light at the top. Nearby, an antique desk functions as a "snoopable" object filled with reproduction documents, reproductions, and authentic objects that tell the story of arc lamp technologies and electricity in Wabash. Two flipbooks tell the story of Wabash's electric light and Charles Brush, the inventor of arc lamp technology. A wall graphic shows a life-size electric dynamo.

Mystic Seaport's *Force in Motion at Sea* was substantially more built-up than the other sites, and included multiple activity stations (wind bench, simple and complex machines, and several other activities designed at Mystic). Setting pieces were a flip book, wind map, and media pieces about local commercial fishing history. The exhibition is situated in the museum's Discovery Barn, which has traditionally been a hands-on, family-oriented part of the museum.

Data Collection Procedures

A member of the evaluation team travelled to Wabash County Historical Museum in Wabash, Indiana, on two Saturdays in Fall 2015 to collect timing and tracking data (n=14) in the exhibition and conduct interviews with six visiting families who had experienced the exhibition. At Mystic Seaport, all data collection was carried out by interns at the museum who were trained in observation protocols developed by Mystic Seaport staff with the intent of answering their own questions about the exhibition. They collected data on 38 family groups between June 20th and July 9th, 2015, which they shared with us.

Table 23: Data from Partner Sites

	Wabash (n=14)	Mystic Seaport (n=38)
Activity	All cases interacted with the single electricity activity, which filled nearly all of their time in the exhibition space. Visitors were observed conversing about both STEM and History topics while engaged the activity. History talk was centered around personal relevance connections to the local story of Wabash's electrification.	Observed visitors split their time in the exhibition between the multiple activities in the space, spending between one and five minutes at the components. Longer dwell times were associated with adult or staff facilitation at the activity. Conversations seemed to include only STEM content.
Setting	Three cases were observed briefly interacting with the desk "snoop" in the space, though it was typically adults who did most of the exploration. Similarly, adults were primarily the ones who engaged with the flipbooks while children focused on the activity.	The wind map succeeded in engaging a multi-generational audience, where the flip books and other media pieces were attended to by adults. About one-third of the observed cases stopped at the wind map, and some were observed making personal connections around memories of the storm systems presented.

Visitor Engagement

According to feedback from the partners, visitors appear to be engaging with the interactive aspects at length at all four sites and visitors to each site appear to treat the exhibitions like they belong in their respective museums.

Wabash has cited particular success with teachers, who step into the role of facilitator with their school groups in the absence of dedicated gallery facilitators. Evaluators also observed parents and grandparents stepping into the facilitator role while at the activity, encouraging kids to try again and sharing their knowledge of circuits. Wabash has also has made some adjustments since first opening to enrich the setting with more objects and images and to expand the snoopable environment to better support family groups' exploration of the exhibition.

Mystic Seaport also reports more intensive engagement among its visitors with the "Force and Motion" components compared to previous installments in their hands-on space as well as very dynamic interactions between facilitators and families.

The California Railroad Museum has seen increased dwell times to the point of groups or individuals monopolizing the activities and preventing other visitors from being able to use them during their time in the gallery. Staff there have been exploring ways to encourage families to move through the area more quickly. Finally, the Oliver Kelley Farm has reported great success regarding visitor engagement despite their exhibition's partial installation due to construction of their new visitor center. Even though it is located in an area of about 12 X 18 feet, families still spend between 20 and 30 minutes participating in the activity of building a windmill, and with the help of a facilitator, they are able to explore the connections between the windmill activity and the larger story of Oliver Kelley and his farm.

Impact on Partner Sites

The second manner the partners' participation in the project could be considered a success is in the ways their experience has supported shifts in organizational culture.

At Wabash, STEM education has become part of their strategic vision moving forward. They feel that their participation in a project backed by NSF, the Science Museum of Minnesota, and Conner Prairie gives the museum credibility to say they are serious about this educational focus. They would also like to take lessons learned from their Dynamo exhibition and integrate them into other exhibits they already have: "*We've been talking about what we can do to bring in some of those other activities [used in* Create.Connect*]. It's opened our eyes to what other things we can do in the museum*" (Third Interview).

The California Railroad Museum is also hoping to use their exhibition success as a way to show potential donors and advocates the kinds of things that are possible in the museum and institute a culture shift. They are hoping that their exhibition is the first step in shifting the culture of the museum to more interactive and technology-based exhibits, and will eventually lead to opening a technology center. Additionally, the staff participant at this museum mentioned that participating in the project had pushed him to get involved with AASLH and other groups outside of his usual sphere of knowledge.

Participating in the Create.Connect project had a profound impact on Mystic Seaport's exhibition design process (as mentioned earlier in regard to incorporating evaluation) and facilitation approach. Mystic Seaport had an advantage of having a developed interpretation staff, but seized the opportunity to address some things they had wanted to do in regard to using hands-on components as a catalyst for social learning between parents and their children. The process of exploring and developing their facilitation capacity for the exhibition is also pushing the staff at Mystic Seaport to push for dynamic history learning:

> *Looking through [Create.Connect] material has helped me push myself to think about what goes into making a truly active learning environment. I think that as history museums, often times we do a lot of active learning in terms of posing questions and show and tell, but sometimes because of the nature… the simple fact that we do a lot of work with artifacts, it's tough to really help people engage directly with the material and really become involved in a direct experimental way. Something that I really enjoy about the Discovery Barn is that people are able to build their knowledge with us in a direct hands-on approach. I think that for history museum interpreters, that should be a really exciting thing. It affords us an opportunity to move beyond the age old stand and deliver and 'Here touch this reproduction piece, how does that feel?' approach. It really takes the next step. 'You have a creative mind. Which one of these boat hulls do you think would be the best shape and why?' We are empowering people to be creative problem solvers, and that's really what we should be doing.*
> —Mystic Seaport (Third Interview)

The Oliver Kelley Farm recognized that they already presented a great deal of STEM in telling the story of Oliver Kelley and all of the advances of technology and mechanical improvements he implemented, and their exhibition segues to the outdoor areas. The exhibition is an introduction to energy transfer (wind power), but invites visitors to look for other examples and energy transfer.

> *We already talk about [STEM] and have kids figuring that out. This was the perfect segue to moving things from the historic farm to the modern setting. The STEM is perfectly logical. That was the easy part. The surprising aspects were basic exhibit design.*
> —Oliver Kelley Farm (Third Interview)

Participating in the project is a stepping stone to future projects, and Oliver Kelly Farm hope the association with a successful NSF grant will be an asset when raising funds for future programs and exhibits.

Continuing Success

The experience of the four sites described above points to the likely success of this work in the future. There were challenges associated with the work of actually building an exhibition that addressed the specific needs of four different museums, but the core team was able draw on their experience and expertise as well as overall framework of the project (e.g., workshops and planned evaluations) to provide the necessary supports.

Below, we present information from a wider sample of the History Museum field, revealing that there is not only interest in bringing STEM into their exhibitions, but that staff can already imagine the stories they want to tell in their museums. From their feedback, we are confident that the lessons learned from the first cohort of participant museums are equally applicable to the variety of experiences and challenges that a particular history institution is likely to encounter in adapting a *Create.Connect*-like exhibition for their site.

AASLH Feedback

Members of the core project team led a workshop at the 2014 AASLH (American Association for State and Local History) Conference intended to introduce other history professionals to the project and get them thinking about what bringing a STEM/History integrated exhibit to their institution would entail. Approximately 32 people attended the session.

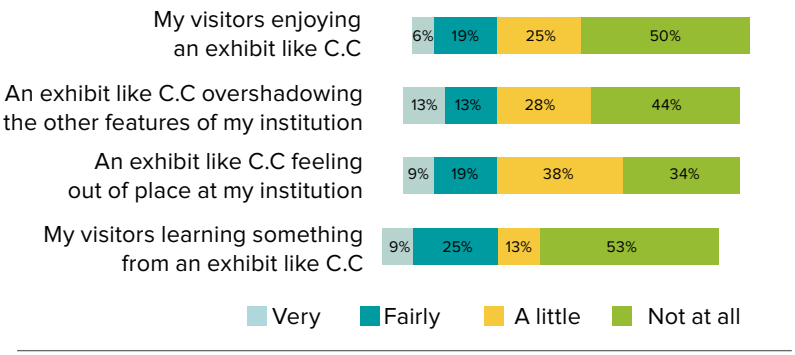


Figure 29: How Concerned are You about the Following? (n=32)

Feedback surveys after the workshop were an opportunity to check in with the larger history field and see what concerns about a project like *Create. Connect* are widespread and what might be site-specific. From this check, we feel confident that challenges encountered among the four partner sites (and Conner Prairie) have covered a lot of ground and speak to what most history institutions will likely experience.

Most survey respondents did not indicate they were overly worried about visitor buy-in, learning, or overall fit in regard to an integrated STEM/History exhibit. (See Figure 29.)

There was some worry about staff capacity to learn and present STEM ideas, but the majority reported they felt comfortable supporting this at their institutions. (See Figure 30.)

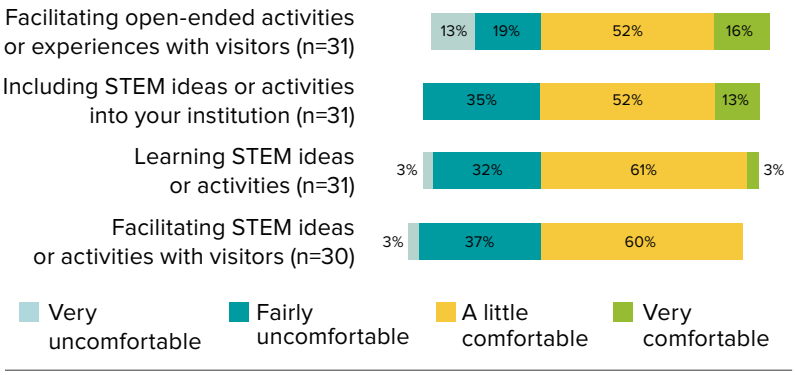


Figure 30: How Comfortable or Not are Your Staff/Volunteers With. . .

Idea generation was not a big concern, and respondents didn't feel they would need a lot of assistance in identifying appropriate STEM concept or generating a narrative around it. The biggest perceived challenge was fabrication; 85% said they would need "a fair amount" or "a lot" of help in this area. Given the wording of the question, we are unsure if this refers to any fabrication, or if it it refers specifically to concerns about fabricating an exhibition that includes STEM portions (or both). There is likely variation among History Museums in regard to capacity to fabricate anything onsite, and some may just be worried about the ability to make STEM activities. Just over half (53%) felt they'd need more than a little help sourcing images and objects. Both of these findings mirror the experience of the partners. (See Figure 31.)

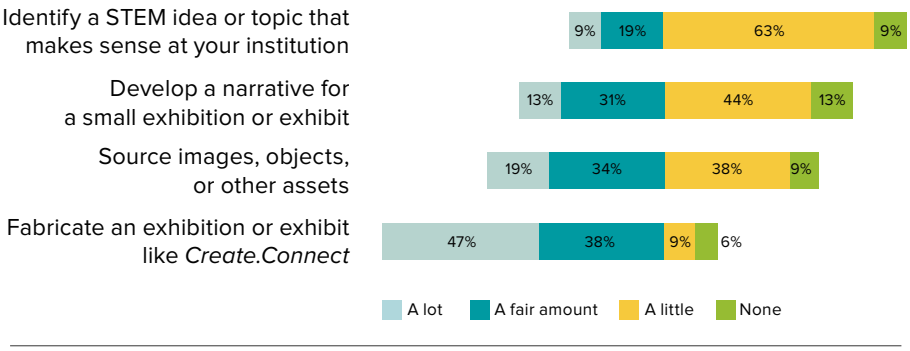


Figure 31: How Much Help Would You Need to Accomplish the Following? (n=32)

Frequently voiced concerns closely mirror those of the partner sites, though the issue of space was something that was gradually addressed and finessed with the partners during the latter exhibition development stage. It was not brought up as an immediate hurdle to overcome.

- **Staffing:** Capacity concerns about an adequate number of staff along with the resources to teach content and methods. Staff competence and comfort with STEM content.
- **Money:** Concern about amassing sufficient funds to develop and build a new exhibition along with capacity to sustain the subsequent upkeep and staffing needs. (The participants were not financially responsible for building their exhibitions, but still needed to manage funds for staff time devoted to development and for upkeep.)

- **Resistance to change internally:** Staff (gallery, curators, educators) and board not buying in to new facilitation methods and/or and exhibit design that deviates from typical history presentations.
- **Space:** Too small, no room with current exhibits, inadequate facilities.

The feedback from History institutions working outside of the *Create.Connect* project suggested a field-wide interest in exhibitions including STEM activities but that some capacity building support would be necessary for their development and implementation.

Network and Model for Replication

As part of the *Create.Connect* project, Conner Prairie and the Science Museum of Minnesota worked to develop a community for professional learning and practice among the six institutions involved. The core project team originally envisioned a network that would help define a model for creating STEM and History exhibitions. This model was intended to be available for national distribution to other museums.

> *A seed of a community has developed. There is clearly broad desire to incorporate STEM stuff in history institutions. There are some now . . . institutions that seem to be sharing information somewhat regularly. I'd say as far as an established network, we're not quite there.*
> —Science Museum of Minnesota Staff (Final Interview)

As the project progressed, there was a growing realization that a larger community of practice needed to grow out of existing history museum communities (such as the American Association of State and Local History) or content-specific affinity groups in other professional organizations) rather than around the original cohort of participants (Science Museum of Minnesota, Conner Prairie, and four participant museums):

Developing a *Create.Connect*-type experience at each of the partner sites resulted in exhibitions that were far more narrative-based and not as simple to pick up and apply to another institution because the content was driven by the local history and each museum's mission. As a result, the network of institutions and model for developing exhibitions like *Create.Connect* have evolved into a framework of what it takes for an institution to get to a place where they can incorporate STEM into their History settings. The same staff person quoted just above commented,

> "I thought it would be simpler to define a catalog that different institutions could order from. But that's not the way it worked to address the individual needs of the institutions. We are saying [Create.Connect] is a way you can mash Science and History."

When asked during the third round of interviews what future work in STEM/History collaboration would look like, all of the Conner Prairie and Science Museum of Minnesota respondents and most (three of the four) of the participants described the development of a network or community that would involve collaboration between groups of institutions with more similarity among them (such as transportation museums or living history farms) and taking advantage of existing networks that already support specific types of museums (e.g., The Association of Tourist Railroads and Railway Museums, The Council of American Maritime Museums, and The Association for Living History, Farm, and Agricultural Museums), implying that with the hard work of figuring out how to integrate STEM and History on a broad level already done, the task of disseminating that framework need not rely on the core team as a driving force.

E) Recommendations for Integrating STEM Interactives in History Settings

Evaluation data gathered through the life of the project show that the four sites, working with the core team, have successfully adapted the model to fit their local settings. Success might look different depending on a site's individual needs and characteristics, but feedback from the four partner museums, along with visitor data from Wabash and Mystic Seaport, reflects high levels of engagement among families in each exhibition and a sense that the integrated presentation of STEM and History fits well with audience expectations for their visits. Additionally, the partners reported their participation in the project supported other institutional endeavors, which was an unexpected benefit.

Sampling the History Museum field at the AASLH workshop, we are confident that the lessons learned from the first cohort of participant museums are equally applicable to the variety of experiences and challenges that a particular History institution is likely to encounter in adapting a *Create.Connect*-like exhibition for their site.

Looking at the possibilities for the future success of STEM interactives in History settings, we make the following recommendations for future work, based on the data from the four partner sites and feedback from AASLH workshop participants:

Collaboration and Communication are Key

The success of the *Create.Connect* exhibitions at both Conner Prairie and the partner sites was achieved against a background of ongoing communication and regular feedback. A necessary precursor was a willingness on the part of all institutions involved to push the boundaries of their disciplines and then "negotiate where ideologies rubbed against each other," as a Science Museum of Minnesota staff member put it. This was a collaborative process from beginning to end that allowed for questions to emerge and be explored. The fission-fusion style of collaborative idea generation and problem solving provided at the workshops was especially effective. Having partners in the Science Museum of Minnesota and Conner Prairie was valuable not only for their knowledge, but as mentors and guides through the process.

Use a Model with Story at its Center

A second building block was the Setting-Activity-Narrative framework that came out of the partnership between Conner Prairie and the Science Museum of Minnesota—specifically, the aspect of developing a well-defined story that articulates the type of STEM that might naturally happen there. It is vital for History museums to stay true to their mission in order to maintain buy-in from audience, staff, and board members.

If Possible, have Other Sites Spend Time at *Create.Connect*, Exploring and Understanding the Model in More Depth

Feedback from participants revealed that ambiguity was a key source of anxiety at the beginning of the project. An opportunity to experience the tangible example of *Create.Connect* and see visitor responses not only quelled concerns about fit and audience, but it clarified goals and expectations. In thinking about this project experience in retrospect, one participant offered this advice: "*Be prepared to jump in head first and embrace the chaos.*" After overcoming the initial hurdle of understanding what they were trying to accomplish, the majority of ongoing challenges and concerns among the partners was related to logistical process, rather than theoretical concerns.

Address and Address Again What STEM Content Looks Like

The belief that an expertise in STEM content was necessary for presenting a STEM experience turned out to be more of a lingering concern than any worries about fit or exhibition development. Despite frequent reiteration to the contrary, staff at some of the partner sites continued to expressed concern about their qualifications to present STEM ideas, and feedback from other history staff surveyed at AASLH indicates this may be a concern among the field.

History professionals are very likely going to be uncomfortable (or at least unfamiliar) with STEM content and how to present it in an informal science education environment. They are seeking guidance, signposts, and assurance that expertise is not a requirement to present or facilitate STEM experiences. The informal science education field has a long track record demonstrating that the formula is more about STEM processes than particular conceptual mastery, but this is a challenging shift for History museums, which have traditionally relied on fluency with the content they present.

Offer Support for Planning Time and Resources as Early as Possible

While larger History sites and museums may have high internal capacity for exhibition development and production, smaller museums and Historical societies likely will not, and they may not realize that they will be asked to accomplish tasks outside of their normal processes that will take more time than they anticipated. Based on the experience of the exhibition development process with the four partner institutions, outlining the expected number of staff hours and type of work needed at each stage will help future partners develop reasonable timelines and allocate staff to prevent stressful and uneven workloads.

Encourage and Support Prototyping and Evaluation if Possible

Evaluation and prototyping eliminated guessing at which decisions were the best ones to make in terms of the exhibition, because they were based on data. Having access to the evaluation reports and experiencing the different iterations of *Create.Connect* also had a positive influence on exhibition design process at some of the partner institutions.

Conner Prairie

A family talks at a prototype version of the Circuit block activity table.

Conclusions and Discussion

The Create.Connect project has had visible impact on Conner Prairie, the Science Museum of Minnesota, the four partner history institutions, and the thousands of visitors to the *Create.Connect* exhibition. For all parties involved, this project has raised new, interesting and challenging questions that have pushed museum professionals to reconsider traditional forms of exhibition development and interpretation. In sum, this line of inquiry has been fruitful and led to additional questions about how the disciplines of Science and History can be integrated in informal learning experiences.

Our Summative Evaluation has shown that visitor behavior, attitudes, and conversation in the *Create.Connect* exhibition suggest that visitors see STEM and History as complementary disciplines and that this interdisciplinary approach can lead to deep engagement and learning. While visitors may not spend balanced amounts of time exploring history and STEM, interview and conversation data show that visitors engage with both during their visits, sometimes in ways that seem to touch on both disciplines simultaneously or in succession. Visitors accept, enjoy, and value the hands-on STEM activities and experiments and the historical setting in *Create.Connect*. Visitors see *Create.Connect* as being about history and STEM, and the focus on hands-on learning is frequently mentioned as well. Visitor conversations and their use of the exhibit components indicate that family groups found multiple ways to engage with both Science and History topics and disciplinary thinking. This is likely due to the multiple supports the exhibition was designed to include, such as narrative stories, accessible materials, open-ended exploration, and adult and staff facilitation.

What does STEM and History Integration Look Like?

While we feel confident that this Summative Evaluation demonstrates that visitors can, and very often do, integrate STEM and History ideas during their visit to *Create.Connect*, clear operational definitions and the appropriate evaluation methods for assessing it remain open questions. Our methodology and analysis here aligns with age-appropriate models of disciplinary thinking and frameworks for family learning in response to the exhibit components and interpretation in *Create.Connect*. The relevance and applicability to other exhibitions or informal learning experiences is a question we hope to investigate in the future.

What we see across our data—through visitor behavior, attitudes, and conversation—is that visitors switch back and forth between STEM and History in both their actions and their conversation. However, how often and when the two disciplines are related to each other varies. That is, some groups make lots of connections between historical objects and STEM ideas, and others make very few. Some nodes within the exhibition seem to support more integration than others, such as the kitchen setting in the Electricity section. We have been able to look across this data and identify patterns of what exhibit features or other supports prompt these questions, but it also true that visitors' own curiosities and interests influence their experience.

What Does This Mean for History Institutions?

For History institutions, the findings from this project suggest some promising new directions that push on traditional forms of exhibition development. Incorporating opportunities to do hands-on STEM activities or to demonstrate STEM principles can be a new way to interpret artifacts—or a new way for artifacts to contribute to telling a different story. History institutions may already offer experiences that align well with this STEM/History framework—for example, interpretation that helps guests explore how an object was used or made that draws on STEM concepts (e.g., a farmer explaining how a windmill activates a pump) or the personal narrative of a historical figure that was skilled in a scientific discipline.

But while History museums can offer interpretation, narratives, and programs that weave together STEM and history, we have learned from working with the four partner institutions that History museums will need guidance selecting and fabricating appropriate STEM hands-on activities as counterparts to historical artifacts or narratives. To expand existing historical experiences to include STEM learning will require an intentional shift away from presenting content and toward an active process of investigating how things work.

As for how to support visitors in an exhibition like *Create.Connect*, our finding that adults contribute to longer stay times suggests that institutions that do not have full-time interpreters should find ways to encourage group interaction. Successful approaches used in *Create.Connect* included multiple opportunities for group members to work together, such as activities that could be used by multiple visitors at once or objects that triggered curiosity by multiple generations.

What Does This Mean for Science Museums?

Science museums also have the opportunity to embed relevant objects (historic and contemporary) into their exhibitions and gallery spaces in ways that help visitors find connections between STEM and their own lives. How can Science museums incorporate narrative into their exhibitions to provide context that for some makes STEM more appealing? What type of narratives are inviting and help bridge the gap between object and activity-based experiences?

Methods of facilitation at Science museums vary just as they do in other museums. In light of the findings here, especially inspired by the facilitation style of Opening Doors, in what ways can Science museums expand the role facilitators currently play to help visitors engage more deeply with STEM experiences?

What's Next?

In this project, many of our lingering questions stem from our curiosity to go deeper in defining what STEM/History integration looks like, how it affects interest and learning, and what factors encourage it. Our three rounds of evaluation as the exhibition was developed suggest that setting pieces, historical narratives, and interpretation might affect the interest in and engagement with the exhibit components. However, in future studies we would like to adjust exhibition settings—in both History institutions and Science museums—to test the impact of elements like setting or facilitation. For example, how much does setting affect dwell time and/or engagement with exhibit components? How does costumed interpretation contribute to engagement and learning in STEM/History settings?

To refine our hypothetical model of STEM and History thinking, we would also like to ask visitors to specifically reflect on the ways in which the historical objects and STEM activities related to one another and/or if interacting with them both led them to new understanding. How does interacting with a STEM activity then impact how visitors interpret historical objects or stories? Or, conversely, how does a historical story or artifact inform how STEM activities are used?

Finally, we continue to be interested in the influence of adult facilitation and support to children when engaging in informal learning experiences. The interpretation model of Opening Doors at Conner Prairie has much to offer for museums of all disciplines, particularly about how objects and activities can prompt inter-generational conversation around familiar objects that hold personal meaning or relevance. Assessing the impact of these conversations is important for understanding how parents introduce historical thinking, particularly for young children.

Preparing to send a ball down its course at the Invention activity table.

References

Alexander, M. (2010), What are the "Six Strands" for History Museums? *Curator: The Museum Journal*, 53: 239–246.

Allen, S. (2002). Looking for learning in visitor talk: A methodological exploration. In G. Leinhardt, K. Crowley, K. Knutson (Eds.), *Learning Conversations in Museums* (pp. 259-303). Mahwah, NJ: Lawrence Erlbaum Associates

Ash, D. (2003). Dialogic Inquiry in Life Science Conversations of Family Groups in a Museum. *Journal of research in science teaching*. 40(2), 138-162.

Beaumont, L. (2010b). *The adult child interaction Inventory: A tool for exhibit development and evaluation*. The Boston Children's Museum, Boston, MA. Retrieved from http://evergreeneresearch.com/s/ACII.pdf. January 31, 2016.

Beaumont, L. (2010a). *Developing the adult child interaction inventory: A methodological study*. The Boston Children's Museum, Boston, MA. Retrieved from http://evergreeneresearch.com/s/Preschoolers_Parents_and_Educators-Developing_the_Adult_Child_Interaction_Inventory.pdf. January 31, 2016.

Borun, M., Dritsas, J., Johnson, J. L., Peter, N. E., Wagner, K. F., Fadigan, K.,...Wenger, A. (1998). *Family learning in museums: The Philadelphia-Camden informal science Education collaborative (PISEC)*. Philadelphia, PA: PISEC, The Franklin Institute.

Burbules, N. & Bruce, B. (2001). Theory and Research on Teaching as Dialogue. In V. Richardson (Ed.), *Handbook of Research on Teaching*, 4th Edition (pp. 1102-1121). Washington, DC: American Educational Research Association.

Cardella, M., Svarovsky, G., & Dorie, B.L. (2013, June). *Gender Research on Adult-child Discussions within Informal Engineering Environments (GRADIENT): Early Findings*. Paper presented at 2013 ASEE Annual Conference Conference, Atlanta, GA.

Crismond, D., (2001). Learning and using science ideas when doing investigate-and-redesign tasks: A study of naive, novice, and expert designers doing constrained and scaffolded design work. *Journal of Research in Science Teaching*, 38, 791–820.

Crowley, K., Callanan, M. A., Jipson, J. L., Galco, J., Topping, K., & Shrager, J. (2001). Shared scientific thinking in everyday parent-child activity. *Science Education*, 85(6), 712-732.

Crowley, K., & Galco, J. (2001). Everyday activity and the development of scientific thinking. In K. Crowley, C. Schunn, & T. Okada (Eds.), *Designing for science: Implications from everyday, classroom and professional settings* (pp. 123-156). Mahwah, NJ: Lawrence Erlbaum Associates.

Crowley, K., & Callanan, M. (1998). Describing and supporting collaborative scientific thinking in parent-child interactions. *The Journal of Museum Education*, 12-17.

Dierking, L. D. and Falk, J. H. (1994), Family behavior and learning in informal science settings: A review of the research. *Science Education*, 78, 57–72.

Feinberg, J., & Leinhardt, G. (2002). Looking through the glass: Reflections of identity in conversations as a history museum. In G. Leinhardt, K. Crowley, & K. Knutson (Eds.), *Learning conversations in museums* (pp. 167-212). Mahwah, NJ. Lawrence Earlbaum Associates.

Fouak, N., Hackett, G., Smith, P., Kantamneni, N., Fitzpatrick, M, Haag, S., & Spencer, D. (2010). Barriers and supports for continuing in mathematics and science: Gender and educational level differences. *Journal of Vocational Behavior*, 77. 361-373.

Gosselin, V., (2011). *Open to interpretation: Mobilizing historical thinking in the museum* (Thesis, University of British Columbia, Vancouver, Canada). Retrieved from https://open.library.ubc.ca/cIRcle/collections/ubctheses/24/items/1.0055355

Gutwill, J. P., & Allen, S. (2010). Facilitating Family Group Inquiry at Science Museum Exhibits. *Science Education*, 94(4), 710-742.

Hughes, C., Mancuso, B., & Cosbey, A. (2015). Technical Leaflet #270: Integrating Science at a History Museum. *History News*, 70(2).

Lee, J. D. (2002). More than ability: Gender and personal relationships influence science and technology involvement. *Sociology of Education*, 75, 349–73.

Leinhardt, G. & Knutson, K. (2004). *Listening in on Museum Conversations*. Walnut Creek, CA: AltaMira Press.

Leinhardt, G., Crowley, K. & Knutson, K. (2002). *Learning Conversations in Museums*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Leinhardt, G., & Crowley, K. (1998). *Museum learning as conversational elaboration: A proposal to capture, code, and analyze talk in museums*. Museum Learning Collaborative. Retrieved from http://museumlearning.org/paperresearch.html

National Council for the Social Studies (2010). *National Curriculum Standards for Social Studies: Chapter 2 – The Themes of Social Studies*. Retrieved from http://www.socialstudies.org/standards/strands

National Research Council (2009). *Learning Science in Informal Environments: People, Places, Pursuits.* Committee on Learning Science in Informal Environments. P. Bell, B. Lewenstein, A. W. Shouse, & M. A. Feder, (Eds.). Board on Science Education, Center for Education. Division of Behavioral and Social Science and Education. Washington, DC: The National Academies Press.

National Research Council. (2013). *Next Generation Science Standards: For States, By States.* Washington, DC: The National Academies Press.

Padilla, M. J. (1990). The science process skills. *Research Matters-to the science Teacher, 9004*. Retrieved from https://www.narst.org/publications/research/skill.cfm

Pea, R. (2004). The Social and Technological Dimensions of Scaffolding and Related Theoretical Concepts for Learning, Education, and Human Activity. *Journal of the Learning Sciences*, 13(3), 423-451.

Rawson, E. R. (2010). It's about them: Using developmental frameworks to create exhibitions for children (and their grown-ups). In D. L. McRainey & J. Russick (Eds.), *Connecting kids to history with museum exhibitions*. Walnut Creek, CA: Left Coast Press.

Rosenthal, E., & Blankman-Hetrick, J. (2002). Conversations across time: Family learning in a living history museum. In G. Leinhardt, K. Crowley, K. Knutson, & L. Erlbaum (Eds.), *Learning Conversations in Museums* (pp 305-30). Mahwah, NJ: Lawrence Erlbaum Associates.

Roschelle, J. (1992). Learning by collaborating: Convergent conceptual change. *Journal of the Learning Sciences*, 2(3), 235-276.

Roschelle, J. (1995). Learning in interactive environments: Prior knowledge and new experience. In J.H. Falk & L.D. Dierking (Eds.), *Public institutions for personal learning: Establishing a research agenda* (pp. 37-51). Washington, DC: American Association of Museums.

Schauble, L., Gleason, M., Lehrer, R., Bartlett, K., Petrosino, A., Allen, A., . . . Street, J. (2002). Supporting science learning in museums. In G. Leinhardt, K. Crowley, & K. Knutson. (Eds.) *Learning conversations: Explanation and identity in museums* (pp. 425-452). Mahwah, NJ: Lawrence Erlbaum Associates.

Schauble, L., Leinhardt, G., & Martin, L. (1998). A framework for organizing a cumulative research agenda in informal learning contexts. *Journal of Museum Education*, 22(2&3), 3-8.

Seixas, P., Morton, T. (2013). *The Big Six Historical thinking concepts*. Toronto, Canada: Nelson Education.

Serrell, B., & Adams, R. (1998). *Paying attention: Visitors and museum exhibitions*. Washington, D.C.: American Association of Museums.

Serrell, B. (2010, March 14). *Paying more attention to paying attention*. Retrieved from http://www.informalscience.org/news-views/paying-more-attention-paying-attention

Tenenbaum, H. R., Prior, J., Dowling, C. L., & Frost, R. E. (2010), Supporting parent–child conversations in a history museum. *British Journal of Educational Psychology*, 80, 241–254.

Weber, K. (2012). Gender differences in interest, perceived personal capacity and participation in STEM-related activities. *Journal of Technology Education*, 21(4), 18-32.

Zimmerman, H. T., Reeve, S., & Bell, P. (2009). Family sense-making practices in science center conversations. *Science Education*, 94(3), 478-505.

APPENDIX 1) Visitor Behavior

Table 24
Average and median dwell times for boys, girls, and all children in Create.Connect in minutes (n=185)

	Boys		Girls		Both	
	Median	Average	Median	Average	Median	Average
Formative 1	06:00	06:53	04:11	07:44	05:19	07:19
Formative 2	10:42	14:26	12:43	14:50	11:52	14:37
Summative	14:42	16:09	14:49	16:16	14:48	08:15

Table 25
P-values* for differences in dwell times across evaluation points

	Kids (n=186)	All Visitors (n=285)
Formative 1 & Formative 2	p<0.001	p<0.001
Formative 1 & Summative	p<0.001	p<0.001
Formative 2 & Summative	p<0.8796	p<0.577

*Tukey's HSD test of significance.

Exhibit Components

Flight, 1910s

This exhibit grouping is focused on early aviation in Indiana. It takes visitors into the rustic workshop of a young woman who dreams of flying and experiments with her own ideas for a better airplane. Visitors see posters, photos, and other reproduced ephemera that provide glimpses into the spirit of the times. They can snoop through a cabinet where they'll find parts of models behind acrylic and objects and materials that can be picked up and even tried on—all providing personal clues about the minds and characters of early aeronautical innovators. In amongst the setting are several STEM activities focused on aerodynamics and fluid dynamics.

Activities

1. Paper plane make-and-test table ("Airplane activity table")

The key objective behind this make-and-test activity is to fold an airplane and launch it toward a target. The more predictable the flight path, the more successful the design. Visitors can start by folding a simple paper airplane then launching it from an angled platform. A rubber band anchored to the platform provides the propulsion. Visitors are encouraged to try different designs with other materials, such as paper clips, drinking straws, and tape.

2. Mini-plane and wind tunnel ("Mini-plane experiment bench")

A small model airplane is secured inside a wind tunnel where it is tethered so that it can only move up and down. Visitors push a button to start the wind, then use simple hand controls to change the angle and shape of the wings. The objective it to play with the principles of lift by flying the plane—taking off, flying level, and landing.

3. Wind and flight exploration bench ("Flight/wind experiment bench")
An array of fans blows an even flow of air over a tabletop. Visitors are prompted to experiment with different airfoils (pieces shaped like wings and sails) and telltales (short lengths of thread, yarn, or ribbon) to see how air moves over and around various shapes. In addition to the open-ended activity, visitors can use small, boat-like pieces to try simple sailing maneuvers, including tacking into the wind. Also, a weight scale at the center of the table measures downward pressure caused by air flowing over an airfoil. Visitors can place a wing with adjustable pitch on the scale and measure the upward or downward lift on the wing.

Setting
4. Early aviation "silent movie" ("Flight video")
5. Aviator's cabinet with historical tools and materials ("Aviator's cabinet")
6. Flipbook of Indiana aviators ("Flight flipbook")
7. Wall flip labels with historical and modern aircraft ("Flight flip labels")

Wind Energy, 1880s and 1890s

As a subject of innovation, wind energy is as relevant today as it's ever been—making it an especially effective connector between STEM and history learning. So when visitors step into a 19th Century setting focused on windmill innovation, the connections between past and present are easily brought to mind. The scene is inspired by the state fair booths set up by windmill sales representatives of the 1880s and '90s. As if selling the latest technical advancements, museum facilitators introduce visitors to the fundamentals of wind-turbine design and construction. Visitors can interact with models and flip through photos and reproduced ephemera in which they can see the state of the art of windmill design then and now.

Activities
18. Windmill make-and-test table ("Windmill activity table")
At this make-and-test activity, visitors construct wind turbines starting with pieces of cardboard that they shape to form blades. They test their turbines by installing them on a scale-model tower in front of an electric fan. The tower features a mechanical energy transfer that links to one of four machines. An effective turbine generates enough power to drive the machine. The four machines are a saw, a water pump, a hammer, and a gear works. Visitors can switch out one machine for another and redesign their turbines for greater speed and/or power.

19. Wind turbine experiment bench ("Wind turbine experiment bench")
The objective here is for visitors to adjust the pitch and number of turbine blades to build an optimally efficient turbine. The exhibit features a small-scale wind-turbine tower with a fixed hub, an electric fan for wind, a supply of variously shaped blades, and gauges for measuring performance. The blades are outfitted with magnets that attach and detach easily from the hub on the tower. Visitors can add up to eight blades and can vary the pitch of each blade in small or large increments. Once they have a turbine design ready to test, they start the fan and observe gauges that measure rotations per minute and the amount of force generated at a given speed.

Setting

20. Shelf holding machines for windmill activity (“Machine shelf”)
21. Interactive map showing past and present wind patterns (“Wind map”)
22. Flip labels showing windmill designs of the past and present (“Windmill flips”)
23. Panel for documentation of successful windmill designs (“Windmill designer photos”)
24. 20-foot-tall “Star” windmill (“Windmill”)
25. Hands-on “Star” windmill mechanism (“Windmill mechanism”)
26. Gobo lights in the shape of wind turbine and windmill (“Gobo lights”)

Rural Electrification, 1930s

Visitors enter the kitchen of a house that’s just been connected to the newly emerging electrical grid. It’s the 1930s and this Indiana family is one of the first in the country to take advantage of the Rural Electrification Act. The new federal program provided for the construction of power lines from urban generating stations to rural homes and farms. Visitors are encouraged to snoop around a recreated kitchen in which appliances such as an electric refrigerator and wood-burning stove provide effective conversation starters among families and facilitators. How did electricity change the lives of rural people in the 1930s, ‘40s, and ‘50s. Ephemera and artifacts (original and reproduced) are labeled with clues that set them in the context of a world suddenly changed by the introduction of electricity.

Activities

8. Circuit blocks make-and-test table (“Circuit blocks activity table”)

Like the circuit bench, this activity provides visitors with the pieces and parts to experiment with circuits in open-ended ways. Battery packs provide the electricity and other blocks hold switches, buzzers, and lights. The blocks are connected using short lengths of variously colored wire with alligator clips at each end. Visitors are also given a supply of parts from which to make their own switches. As with the other make-and-test activities, visitors are encouraged to build circuits and circuit components and test them with the battery-pack power sources. At Conner Prairie, this activity is located in a recreated 1930s kitchen environment. Some of the circuit blocks are labeled with the names of fixtures and appliances visitors see around them, helping to strengthen connections between the activity and the historical narrative.

9. AC/DC electricity experiment bench (“Electricity experiment bench”)

Visitors select from a set of electrical components to build circuits that perform different functions. Each component is about five inches long with magnetic conductors at each end. Some hold switches, and others hold lights, buzzers, and tiny fans. By arranging the components in the right order starting from an electrical source, visitors can build complex circuits that work much like circuits in buildings. Meters are provided for exploring the properties of electrical currents, including the difference between alternating and direct currents.

Setting

10. Flip label on a calendar (“Calendar flip label”)
11. Coal stove (“Stove”)
12. Label on ironing board (“Ironing board”)
13. Before/after flipbook on rural electricity (“Electricity flipbook”)
14. Hoosier cabinet with historical kitchen objects (“Hoosier cabinet”)
15. “Window” with screen showing images of rural Indiana (“Magic window”)
16. Early electric refrigerator (“Fridge”)
17. Radio playing 1930’s music and radio programs about electricity (“Radio”)

Patent Office, 1950s

If you were an Indiana inventor in the 1950s, this is the place where you would register your greatest ideas. The setting is created from elements that suggest a government office of the period, including bookshelves, file cabinets, and a vintage TV that plays a selection of program segments from the 1950s. STEM activities integrated with historical artifacts, photos, and ephemera draw a connection through time between the Sputnik-era concerns about science education and competitiveness and similar concerns today.

Activities

27. Chain reaction invention make-and-test table ("Invention activity table")

This activity invites visitors to design and build Rube Goldberg-like machines that create chain reactions that will guide a Ping-Pong ball from a launching point through multiple maneuvers to an established task, such as ringing a bell or tipping a standing structure. Visitors can select from a set of predesigned ramps, sections of track, and various simple machines to form the basics of their machines. They are encouraged to rummage through bins of miscellaneous pieces and parts to find additional elements to customize their machines.

28. Mechanical "ball run" track experiment bench ("Ball run experiment bench")

The objective here is to move a Ping-Pong ball from one end of the exhibit to the other using a series of simple machines. A vertical surface of perforated metal provides a structure onto which visitors can attach and detach a set of ramps, levers, and mechanical escalators. The starting point is fixed and from there visitors arrange a set of machines that move the ball to the other end of the table—a distance of about four feet. Some of the machines require additional energy provided by a visitor turning a crank.

Setting

29. Cabinet with historical patent models and patent copies ("Patent cabinet")
30. 1950's television playing Mr. Wizard and news program ("TV")
31. Flipbook of Indiana inventors #1 ("Inventor flipbook 1")
32. Flipbook of Indiana inventors #2 ("Inventor flipbook 2")

APPENDIX 2) Visitor Attitudes

Survey open-ended response codes - definitions and examples

Two evaluators reviewed the responses to open-ended questions asked on the lobby and exit surveys and created categories based on response patterns that emerged in the sample. Code definitions were negotiated and clarified between the two evaluators and then all responses were coded. Some responses fit in more than one category and received more than one code.

"Does Create.Connect fit in at Conner Prairie?" codes

Create.Connect is historical

Responses with this code referenced the historical aspects of Create.Connect and connected that to Conner Prairie's focus on history.

[It fits] because of the history tie-in. It definitely fits in with your focus on history and it pulls in the science in a natural... it feels natural that it's here, like we weren't expecting this because we didn't see it last time, it wasn't here yet, and so it just makes sense." (Case 12)

"Because even though it's science-y, I think it goes back into history, the history tie is really nice and it seems like a really good fit because you are learning about things long ago and how they have kinda gotten to where they are today." (Case 6)

Create.Connect is educational

These responses mention the similarities in learning styles between Create.Connect and Conner Prairie as a whole, or simply observe that Create.Connect is an educational experience like the rest of Conner Prairie.

"Overall it engages kids. Whether it's science or history, it's going back in time and encourages learning and creativity and so it fits into that general category and that fits at Conner Prairie."(Case 75)

"I think it does [fit] because a lot things outside and inside are about learning. Things you touch and feel, hands on stuff, and then when you outside there are a lot of activities, they let you pick from the garden, they get really involved. It makes you not just walk by and look at something, you have to actually participate." (Case 54)

Create.Connect is interdisciplinary

Some respondents mentioned the interdisciplinary nature of Create.Connect and the way it ties history together with science or the past to the present. These respondents saw that as a feature of the overall Conner Prairie experience. These responses differ from the "Create.Connect is historical" responses - these are more focused on the integration of history and STEM.

"There is the history standpoint, and the fact that there is the science, the hands on, they're learning how things work, so there's... it ties both in really well and I feel like that's what the whole park does, it ties in the past and lets you know how things work and you get to participate in it." (Case 22)

"I think it fits history in with technology and it kinda puts it all together for you." (Case 53)

Create.Connect offers variety in experiences

Responses that received this code all noted that Create.Connect is different from the rest of Conner Prairie, either because of the focus on STEM or the 20th century time periods presented (all other park areas interpret 19th century history). However, these respondents viewed this difference in a positive way, saying that it added necessary variety to Conner Prairie's experiences or worked particularly well for their children.

> *"Well I know that this is a living history museum, but it's nice to have the other areas because, not that the kids get bored outside, I don't mean that at all, but it's nice to just kind of change it up a little bit."* (Case 43)

> *"Obviously I think there is some history, which fits in with the overall theme. It seems newer than the rest of Conner Prairie, which I don't think is a bad thing. It's just a different area. My kids like this area, again, it's not a negative, just different."* (Case 59)

Create.Connect is Indiana-focused

Conner Prairie interprets the history of Indiana specifically, and comments that received this code mention that the stories told in Create.Connect are based in Indiana as well.

> *"It's Indiana. Indiana is more than farming. It's more than basketball. It kind of kills me that people don't realize what has happened… it's a combination. A potpourri of history and science development of people."* (Case 90)

> *"It just seems Indiana. [Interviewer] It's Indiana-focused? [Visitor] Yea, so I see that kinda how it fits in with the rest of it, it all has to do with Indiana."* (Case 26)

"What is something you feel you or your family learned while in Create.Connect?" codes

The engineering and/or design process

Many respondents did not describe a specific fact or idea that their children learned, but rather explained how the Create. Connect experience helped them understand the process that engineers or designers use when creating and testing something new. Aspects of this process that respondents mentioned included the iterative cycle of testing and adjustment, solving a problem with a goal in mind or simply figuring out how to make something work.

> *"They're learning that you may have to do something 15 times, even if it's conceptually sound. Just because you build a machine, it doesn't mean it's going to work every time. The persistence associated with it."* (Case 72)

> *"I think lots of problems solving and sequencing, and how to figure out what's going wrong and what's not and how to fix that problem."* (Case 19)

STEM facts or ideas

Many respondents mentioned a specific STEM idea or fact that they or their children had learned. These responses received sub-codes that indicate which Create.Connect STEM topic they learned about; **flight/aerodynamics, electricity/circuits, wind power or physics/simple machines.**

> *"I think it was the airplane wings, just how the adjustment of the wing adjusts the flight." (Case 14)*

> *"The electricity, having the cables and learning which are positive and what are negative, and how to get the lights to turn on."* (Case 67)

Historical facts or ideas

Some respondents mentioned facts or ideas that were associated with the historical narratives presented in each space. Responses with this code reference the topics of early flight and electricity, historical windmill technology, inventions, the Space Race or just a general understanding of life in the past or the progression of technology through time.

> *"Yea, well, one, he talked, the gentleman talked a little bit about the space race, and brought in Sputnik which the children were familiar with cause I've talked about that, buts it's good to remind them of that, and how, I don't think they got that far into it, but as far as how the competing nations really helped advance technology through the space race. Even using simple devices and machines and competing against each other can help you create, you know, accelerate creativity and make new things." (Case 9)*

> *"And I learned about all the inventors from Indiana, and the lady that invented the disposable diaper was from Indiana." (Case 53)*

A social/emotional skill

Some responses were not related to STEM or history, but rather described how their children learned or practiced a social or emotional skill such as teamwork, persistence or taking turns.

> *"Cooperation between each other and other people who were playing in here before. Some patience. Waiting to see if someone was done. Waiting and asking." (Case 86)*

> *"And, it was nice that it was like teamwork. [Child] Definitely. [Visitor to child] Because you were working with another guy that you didn't even know. And it worked. [Interviewer] That's great too. [Child] Made new friends." (Case 45)*

"Why would you want to visit Create.Connect again?" codes

100% of respondents to the survey indicated that they would likely return, so codes for this question are all reasons why one would return to Create.Connect.

Value hands-on/interactive learning experiences

Responses with this code mentioned the hands-on nature of the experience in particular when talking about why they would return. These respondents saw the interactive and hands-on activities as fun for children and also effective learning opportunities.

> *"My grandson loves it. My grandson is a very hands-on. He's four-years old. Instead of playing with Teen Age Mutant Ninja Turtles and more commercial type things, it's taking me back and creating innovation for him where he can develop and do things. Typically, most places … the Children's Museum [of Indianapolis] has got some hands on, but you really can't create a dinosaur. You can't create a sail… moving. You touch things, but I see a difference… Something here is a little bit more creativity. There's a lot of things for them to do. Whenever I have out of town guests, I don't care what age they are, I take people here. I had guests from Africa that were visiting academics. We took them here. They were fascinated."* (Case 90)

> *"Because the kids love science, and there's just a lot of hands-on experiments and they like that kind of stuff."* (Case 34)

Extend learning on Create.Connect topics

Some respondents noted that repetition is important for helping their children learn a topic, or that they would be able to dig deeper into a topic on subsequent visits. Some responses that received this code also note the density of information in the nodes and that it would take more visits to explore it all.

> *"To reinforce the things they're learning today. I doubt they'll touch every single exhibit, because there's a lot to do. We want to get outside today too, so trying to balance our day. It's a good reminder to do something again and again. They learn something new because they can't retain everything. It's hands-on so they don't get bored doing the same stuff again."* (Case 82)

> *"I would probably want to come back and maybe concentrate on a certain area and really pick through it and like, read some of the information for them and the kids could put a whole picture on it kinda thing."* (Case 10)

Like indoor experiences

Most of the visitor experiences at Conner Prairie are outdoors, so some visitors mentioned that they enjoy having an indoor option for inclement weather or to add variety.

> *"There's a variety of things to do. We knew that if it rained today we could do enough in here."* (Case 57)

> *"[Child] Because there is more than just one thing to do and outside it's a lot of walking around (laughing). [Adult] And it's air conditioned."* (Case 53)

We just love Create.Connect

These responses were focused on the children's or family's enjoyment of Create.Connect. Many respondents said that Create.Connect was fun for their children and held their attention, and they would like to visit again for this reason.

"The girls would love to come back. They love putting things together and taking them apart." (Case 77)

"My girls loved it, it kept their attention. I think it provides a lot of different things for them to do and explore. It's great." (Case 33)

My kids will enjoy or learn more when they are older

Some respondents felt that their children would have a better experience in Create.Connect if they were a little older, or that their thinking and problem solving would mature over time.

"I think especially if they were older, they could kind of understand or maybe if I had older kids, or when they get older, to be able to kind of explain things a little better and to help them to understand." (Case 13)

"As the kids get older, they'll have more ideas about what to do. There will be more learning for them. The older ones are going to try things that they didn't try before." (Case 73)

There is too much in Create.Connect to see in a day

Responses that received this code mentioned the large number of activities available in Create.Connect and that they would need to come back to see it all. Some referenced the number of Create.Connect areas they visited and that they would have to come back to experience the other areas.

"Well I always want to come in and see what all they have. I don't think we got all the way through every single thing, so we'd go back to make sure we caught everything." (Case 54)

"Well, we focused on three things and there is a lot more to do. So we have to come back. [Child] Definitely." (Case 45)

We prefer this experience to others at Conner Prairie

A few respondents indicated that they prefer the interpretation or content focus of Create.Connect over other Conner Prairie visitor experiences, like our outdoor historic areas.

"[Visitor 1] I think because it's hands on and interactive, [Visitor 2] Absolutely. [Visitor 1] and they can see what's going on they kinda get sometimes, they get a little overwhelmed with the stuff out there with the people talking to them and not being sure... just not being sure of the people talking to them and the fact that they're in a role. [Interviewer] Oh, like, "Can I talk to this person about phones, are they gonna understand me?" That kind of thing? [Visitor 1] Right, right, exactly. [Interviewer] And you felt that that was the case in [CC]? [Visitor 1] No- I mean out [in the historic areas] it feels like that. [Interviewer] Oh, ok. [Visitor 1] A little more intimidating. [Visitor 2] I think [CC] is a little more young kid friendly... [Visitor 1] Yea, exactly, I think it's a little more... [Visitor 2]... Like hands on learning [Visitor 1] ...It's a little more intimidating out there with the people doing the daily activities and not really 100% getting it, in here it's a lot easier for them to understand." (Case 18)

"If you described Create.Connect to a friend, what would you tell them it is about?" codes

Most respondents to this question mentioned a combination of topics, and each topic or idea mentioned was coded with one of the codes below. Data collectors took notes on the responses to this question- the responses were not audio-recorded.

A STEM topic

Many respondents described the conceptual focus of the experience in terms of STEM topics like engineering, aerodynamics, electricity, or wind power.

> *Wind and aerodynamics. How the wind makes things work.* (Case 23)
> *It's a little engineering space.* (Case 97)

A history topic

Some responses mention the historical themes associated with the experience.

> *Stuff from Indiana, Indiana history. This is history too. Indiana's past innovation.* (Case 2)
> *Early machines and the start of technology.* (Case 33)

An engagement style

Many respondents talked about the way they or their children interacted with the activities and elements in Create.Connect. Responses that received this code mentioned topics like hands-on learning, independent learning by children, experimentation or problem solving.

> *Hands-on education for small kids, and adults, too.* (Case 72)
> *Interactive learning. Kids can see the real results of their actions.* (Case 79)

DATE: _____ REFUSALS (tally): _____ Survey Number _____

Lobby Survey Instrument

[See recruitment script] Today I am trying to find out more about the types of people who come to the museum. Will you help me out with a short survey?

[If Yes] *Thanks, I have a short survey here that you can fill out. I will ask you a few questions, then hand it over. The survey is anonymous.*

[Ask the adult questions 1-5 and write down the responses]

1. Is this your first visit to Conner Prairie?

o Yes
o No

2. What made you want to come to Conner Prairie today?

[If this is their FIRST VISIT, skip to QUESTION 6 and hand over the survey]

3. Think about Conner Prairie. What does you family [or group] value about a trip to Conner Prairie.

We have a new exhibition called Create.Connect. Here it is.
[show pictures of Create.Connect or point to it so they know what it is]
Create.Connect opened to visitors at Conner Prairie in March of 2013 – so a little more than a year ago.

4. First, before today, how many times have you visited Conner Prairie since March of 2013?
It's ok to estimate.
Write one number: _____

Have you visited Create.Connect before? [if no, write zero in Q5, if yes, ask Q5]
5. How many times have you visited the Create.Connect exhibit since March of 2013?
It's ok to estimate.
Write one number: _____

I will hand over the survey and you can complete the rest on your own. We are only surveying adults today so please answer for yourself.

[Flip to the next page and HAND OVER THE SURVEY]

CONNER PRAIRIE
CONNERPRAIRIE.ORG

6. **Who is in your group today?**
   - o Just me
   - o Adults only
   - o Adults and children

7. **How would you rate your interest in history on a scale of 0 to 10?**

No interest										Extreme interest
0	1	2	3	4	5	6	7	8	9	10

8. **In the past two years, how many times have you visited other museums (or places like museums) where you learn about history?**
Write one number: _____

9. **How would you rate your interest in science on a scale of 0 to 10?**

No interest										Extreme interest
0	1	2	3	4	5	6	7	8	9	10

10. **In the past two years, how many times have you visited other museums (or places like museums) where you learn about science?**
Write one number: _____

11. **Are you or your family a member of Conner Prairie?**
   - o Yes
   - o No
   - o No, but we have been in the past.
   - o I'm not sure

12. **What is your zip code?** _____

Thank you for your help!

Please hand the survey back to the person who gave it to you.

DATE: _____ REFUSALS (tally): _____ Audio File: _____ Survey Number _____

Exit Survey Instrument

[See recruitment script] *Hi. How are you doing today? My name is_____ and I work at the museum. Today I am trying to find out more about our visitors' experiences at Conner Prairie. Will you help me out?*
[At this point do not identify that the survey is about Create.Connect]

[Yes] *Thanks, I have a short survey here that you can fill out. I will ask you a few questions, then hand it over. At the end, I'll ask you a few more questions. The survey is anonymous.*

[Ask the adult and write down the responses]

1. Is this your first visit to Conner Prairie?
- o Yes
- o No

2. What made you want to come to Conner Prairie today?

[If this is their FIRST VISIT, skip to QUESTION 6]

3. Think about Conner Prairie. What do you value about a trip to Conner Prairie.

The exhibit you were just in is new to Conner Prairie.
Create.Connect opened here in March of 2013 – so a little more than a year ago and we've been making changes to it since then.

4.First, before today, how many times have you visited Conner Prairie since March of 2013?
It's ok to estimate.
Write one number: _____

Have you visited Create.Connect before? [if no, write zero in Q5, if yes, ask Q5]
5.How many times have you visited the Create.Connect exhibit since March of 2013?
It's ok to estimate.
Write one number: _____

[Skip to HERE if they this is their FIRST VISIT; continue with Q6]
6.If you had to describe this exhibit to a friend, what would you tell them it is about? [Alternate Probe: What do you think is the big idea?]

I will hand over the survey and you can complete a few survey questions on your own. We are only surveying adults today so please answer for yourself. I have a few interview questions to ask you when you are finished.
[Flip to the next page and HAND OVER THE SURVEY]

CONNER PRAIRIE
CONNERPRAIRIE.ORG

7. For you, how interesting was the exhibit you just saw?

- o Very interesting
- o Interesting
- o A little interesting
- o Not at all interesting

8. For you, how enjoyable was the exhibit?

- o Very enjoyable
- o Enjoyable
- o A little enjoyable
- o Not at all enjoyable

9. How interesting was the exhibit you just saw for the children in your group?

- o Very interesting
- o Interesting
- o A little interesting
- o Not at all interesting
- o I'm not sure

10. How enjoyable was the exhibit you just saw for the children in your group?

- o Very enjoyable
- o Enjoyable
- o A little enjoyable
- o Not at all enjoyable

11. If, or when, you visit Conner Prairie in the future, would you like to use this exhibit again?

- o Definitely yes
- o Probably yes
- o I'm not sure
- o Probably no
- o Definitely no

12. Have you visited the rest of Conner Prairie either today of during a previous visit?

o Yes → **13. Does this exhibit seem like it fits in or does not fit in here at Conner Prairie?**

- o It completely fits in
- o It mostly fits in
- o It mostly does not fit in
- o It completely does not fit in

o No

14. Compared to the rest of Conner Prairie is this exhibit more or less interesting to you?

- o Much more interesting
- o A little more interesting
- o About the same
- o A little less interesting
- o Much less interesting

15. Does this exhibit seem "science-y" or not?

- o Very science-y
- o Somewhat science-y
- o A little science-y
- o Not at all science-y

16. How would you rate your interest in history on a scale of 0 to 10?

No interest — Extreme interest

0	1	2	3	4	5	6	7	8	9	10

17. In the past two years, how many times have you visited other museums (or places like museums) where you learn about history?

Write one number: _____

18. How would you rate your interest in science on a scale of 0 to 10?

No interest — Extreme interest

0	1	2	3	4	5	6	7	8	9	10

19. In the past two years, how many times have you visited other museums (or places like museums) where you learn about science?

Write one number: _____

Please hand the survey to the person who gave it to you.

Interview

I have a few interview questions for you. Is it ok if I audio record your responses so that I don't have to take notes? We won't use the recording for anything other than collecting your responses. [If they decline, take written notes instead.]

20. Can you give me an example (or two) of something that your family really enjoyed doing in the exhibit? [Alternative prompt: Something that really stood out?]

21. What do you think your family learned about while you were doing that – either big or small?

You said in the survey that this exhibit [fits/does not fit] in here at Conner Prairie.

22. Can you tell me a little more what it is about this exhibit that makes it seem like it [fits/does not fit]? [Prompt: Tell me more about that.]

You said that you would [probably/probably not] want to visit this exhibit in a future visit to Conner Prairie.

23. Can you tell me a little bit more about why you would [probably/probably not] want to visit it again? [Prompt everyone: Does this exhibit seem like the type of thing you want to do at Conner Prairie when you come? Tell me more about that.]

[If they said it was science-y] You said that the exhibit seemed "*science-y.*"
24. In this exhibit, how did your family learn about or do science?

[If they said it was NOT science-y] You said that the exhibit did not seem "*science-y.*"

25. What do you think would make the exhibit more "science-y?" [Prompt: What would it have to have to make it "science-y?"

APPENDIX 3) Visitor Conversation and Evidence of Learning

Group Type

Group Type	Number of Cases	%
1 Adult/ 1 Child	7	20%
Multiple Adult/Multiple Children	14	40%
Multiple Adults/1 Child	4	11%
1 Adult/Multiple Children	10	29%

Target Adult Relationships

Relationships	Number of Cases	%
Parent	28 (9 Father/19 Mother)	80% (26%/54%)
Grand Parent	6 (1 Grandfather/5 Grandmother)	17% (3%/14%)
Non-Family	1	3%

FIRST ROUND CODING DEFINITIONS:

Relevant Talk

Talk is counted as relevant if it is related in any way to the exhibition or the experience of being in the exhibition. This includes:

- Talking about the exhibition elements or features.
  - o *"They have a lot of those things, it's a wind farm."*
  - o *"What's this do? Oh it will go slower and so that will go down there."*
- Talking about the experience of being in the exhibition.
  - o *"Gosh, look at her, does she, did she draw her own wing?"*
  - o *"Oh! You can build it yourself. You build it yourself. See watch. You can move them around."*
  - o *"Take a video with your phone of what we did. Take it, get your phone and take the video."*
- Reading instructions or labels out loud.
  - o *"No, that says LED."*
  - o *"Okay. This is from Purdue. 'Contestants at Purdue competition prepare the Rube Goldberg machine.' This object here is to build a system of chutes and mechanical lifts to move the ball from start to finish."*
- Talking about ideas or connections that were generated from the exhibition.
  - o *"You sure you don't wanna be an engineer when you grow up? You're very good at this."*
  - o *"OH! [with excitement] I'm doing this stuff in, um, science, yeah!"*
  - o *"When I was a little girl that's the kind of radio we had."*
- Talk that reflects engagement in actions or activities in the exhibition.
  - o *"Adult: You got one, now, put it up. Child: Do something else. Adult: Are you just putting the big ones on?"*

STEM

Relevant Talk was coded as STEM if it included references to ideas or processes in STEM content, or indicates the process of engaging in STEM exploration – such as testing, observing, or hypothesizing. This code is broadly applied to conversation if it is apparent that groups are working with STEM interactives.

- *"There's different resistors in there to make sure that it's the right amount of power."*
- *"Right now, we have a circle for our electricity, right?"*
- *"Child: Do you connect one to here and one to here? Adult: Well, you tell me. What do you think?"*
- *"We want it blowing a lot right here."*

History

Relevant Talk is coded as history if it includes references to ideas or processes in history, or indicates the process of engaging in history exploration – such as imagining, observing, comparing.

- *"Can you imagine making an airplane out of those tools?"*
- *"Well, right here. You can see this is the alphabet you use when you're using a telegraph key."*
- *"You know the old refrigerators? They used to call them what?"*

Not Relevant Talk

Talk is not relevant if it is about a topic separate from the exhibition or the experience of being in the exhibition. This includes:

- Talk about outside and unrelated topics,
  - o *e.g. what to have for dinner that night.*
- Talk about Conner Prairie features or the logistics of the visit that are not related to Create.Connect.
  - o *"Mommy, I wanna go outside and see all the stuff."*
- Talk that is purely logistical or about wayfinding in the exhibition.
  - o *"Let's go that way and look around, OK?"*
  - o *"I'm finished."*
  - o *"Yep, let's be helpful and put all of our little scraps in there."*

No Talk

There is no talking during the minute.

Facilitator Talk

The participants talk with or listen to a facilitator in the exhibition. This does not include talk with any evaluation staff.

Adult Facilitation

An adult in the group contributes in a way that helps the child to continue with the activity or exploration in the exhibit. This is especially evident with the use of questions. This does not include wayfinding, suggestions about which exhibit pieces to visit, or other purely logistical talk.

- *"What if you turned it this way?"*
- *"It's getting stopped, let's fix that. What are you gonna do. [gasp] will it go up on this?"*
- *"What do you think's making it do that? Look here. Are they lined up? Try it now. Try it now. Aha! Good job. You tweaked it."*
- *"Could you imagine having to iron clothes all the time with that?"*
- *"You know the old refrigerators? They used to call them what?"*

Connection

Connection is a parent code for two types of connections: personal and other. We take the definitions of these connection from the book, Listening in on Museum Conversations (2004) where they are called "personal synthesis" and "synthesis."

Personal Connection

Identifying and linking an object or experience in the exhibition to something personal. For example, "When I was a little girl that's the kind of radio we had." This kind of personally relevant comment about something in the exhibition synthesized the visible object with a remembered experience.

- *"When I was a little girl that's the kind of radio we had."*
- *"They're circuits. You remember the Snap Circuits that we have?"*
- *"Yeah, we learned that in school. Red...to the same. And green."*
- *"So, you look at different power supplies for your Kindles and stuff?"*
- *"Your grandma's got something like this. Doesn't she?"*

Other Connection

The group selecting one or more dimensions of an object, set of objects, or experience, and relating them to the same dimension of a different object or experience in the exhibition or another venue.
The group connects two things in the exhibition together, two things in an exhibit/activity together or any other kind of connection between something in the exhibit and something else that is not a personal experience.

- *"So if this was on a farm, you could take your tools and sharpen them against the stone."*
- *"See up there, those different kind of windmills like they used to have in Corpus?"*
- *"That's that kind of windmills you see out in the countryside now. The other ones are more like what see on the farms."*
- *"And then, I should be able to use the same battery for a fridge. Oh. No. Whoops."*

SECOND ROUND FAMILY CONVERSATION CODING

Scaffolding Strategies/Conversational Moves

This code can be applied to either a facilitator or an adult. It refers to the phase of conversation where the adult is helping the child understand what to do in the activity. This can refer to the materials, what can be done with the materials, and modeling what happens with the materials. It can also include issuing challenges. In essence, this code refers to talk that is about the ways in which someone can interact with the activity ("Here we have materials to build a windmill") but not yet reflecting on how one has used the activity.

Length of code: Likely several exchanges between an adult and child at the beginning of an activity.

Note: The code of "Offer of Agency" might be applied during this longer conversation.

- *"We're looking at wind power over here. So, we have this windmill here that someone just built. And you can see when the wind blows on it, then it'll turn this, and it'll end up turning the grindstone, right here. So. The goal is just to experiment with different things to see if you can make it less work I guess. So they had grindstone ones, and that one's a water pump, or even electricity. They still use windmills."*
- *"You guys can make airplane here, and shoot it and see if you get at the low clouds, the high clouds, or the even higher clouds. So, here's one that somebody made."*
- *"Adult: What's this Kaley? Experiment with a blade... Child: You click. Hold on. Adult: Well, wait till he gets his blades on. Child: I think it goes up top. Adult: Ooh. We could create our own windmill."*

STEM Exploration

This code draws from the construct of "science process skills" and refers to instances where visitors are interacting with exhibit components through a science lens (most often this looks like the engineering design process). For example: building, testing, observing what happens, hypothesizing, predicting, asking about process.

Note: This primarily applies to talk between the target child and target adult, but can also apply to the facilitator if he/she brings in language that goes beyond general activity description.

- *"Adult 1: Let's see what's going on today. The wind's blowing this way. Adult 2: It is, isn't it. That's weird. I never thought that. I thought it always went this way. Child: This is cool. Adult 1: It is cool. Yeah. Adult 2: That explains why you go up and over. Adult 3: Yeah, but look here Jake. It's coming down and out and around. This looks like the eye of a hurricane. Doesn't it? That's cool. Adult 2: I like the tornado better."*
- *"Adult: And we have to have it up, don't we? The short, there's over there. Let's do a long. Okay. It has to be. Here babe. Hold this up. Child: I'm raising this, or should I put it lower. Adult: I don't know. Hmm. You want to try that? Child: I don't know how you do this. Okay, we need another hub. We need to scoot this closer. There. And then get this back. Adult: Why would they only have one ball to work with and they have four stations? That doesn't make sense."*
- *"Adult 1: This object here is to build a system of chutes and mechanical lifts to move the ball from start to finish... Child: Up high. Adult 1: You need a longer one. Do you see a longer one? Aa ha ha! Adult 2: There's more. Child: Let's go over to the other side and see if it... Adult 1: Okay. He's a pretty good builder, isn't he? Good job. Child: What goes here? You took all of them! Adult 1: Oh, it comes off. Oh, it's magnetic. It's magnetic. Oh cool. Child: I don't think we can do this. Adult 1: How'd you discover that? Child: I don't know. Oh, I think I see it."*

History Exploration

Similar to the domain of Historical Thinking Skills, such as comparing and contrasting between "then" and "now", imagining what life might be like back then, or describing/analyzing/evaluating a historical artifact. This primarily refers to conversation within the family group, but can also involve a facilitator.

Length of code: Likely a few exchanges where there is a comment or question posed to another member of the group but could also be a single sentence.

- *"Adult: Mmhm. You know the old refrigerators? They used to call them what? Child: Iceboxes. Adult: An icebox. Why'd they call it an icebox? Child: Because it was a box with ice in it."*
- *"This looks like maybe a small oven, or something. Or maybe a warming thing. That's the oven. Let's see, 'Most farmers kept their coal or wood burning stoves even after their houses were powered. Why do you think they didn't upgrade to an electric stove?' Why do you think that? Why do you think that you would keep your wood-burning stove? Even if you had electricity, why do you think you would do that?"*
- *"Adult: Now what else do you remember Hurricane Katrina? Do you know about that? Child: Hum sort of. Adult: It hit New Orleans, where's New Orleans, here? Child: It's down here. Adult: Yep so watch. For that."*

History facts

References to specific information from the past that may or may not be present in the exhibit. Could include a facilitator talking in character and referring to events of the past, or a parent telling a child what life was like "back then" or an event that occurred in the past. Could include reading from text panels that reference specific historical information.

Note: History facts and History exploration codes are only applied to a costumed interpreter when they are calling out the past or historical environment/context. Talking like James Riggs and introducing oneself as James Riggs, is not enough on its own. He'd have to talk about how he sells windmills or other meatier parts of the character. [Note: We agree that this helps with setting a context of history, but it is not always possible to know if a facilitator is in character or not].

Length of code: Typically just one or two sentences. Likely will occur during a longer History Exploration/ Investigation exchange.

- *"This was invented by a man from Indiana. Nathanial Weber, in Paoli, Indiana. I've been there!"*
- *"This is Morse Code."*
- *"But you can see, we made the frame out of wood, and then the wings are made out of... this is called muslin."*

STEM facts

Explanation of phenomena that goes beyond describing in general terms (e.g. "Look, it's going faster because of the tape we added.") and brings in other information that ties it to a scientific concept. May or may not include information present in the exhibit (e.g. could include reading text panels or could include a description of how parallel circuits work). Might include using "science language" like labeling the circuits as parallel circuits. Typically this looks like a moment of "direct teaching" ("This is what we call a parallel circuit. Do you know what that means?") Another way to think of it is a shifting of tone - stepping back from exploring and doing in an activity and giving a bit of information or context about what's being done.

Length of code: Typically just one or two sentences. Likely will occur during a longer STEM Exploration/ Investigation exchange.

- *"At home, our power is not in series. It's parallel. So, you can have many many circuits. "*
- *"Okay, so the blue is a concave angle. A curved angle."*
- *"(Adult) What is a revolution? Do you remember? (Child) I have no clue. (Adult) Revolution is a turn.*

Emotional Support

Praise, encouragement. Affirmation of kid being on the right track. Also include moments where there is confirmation between parties: "Like this?" "Yes, there you go." Positive feedback on activity/work. Includes the parent responses like "Uh huh" if a kid asks for support or help

- *"Some spokes fell off, but that's ok."*
- *"Ooh! That's a good one. All the way up!"*
- *"(Adult) Can you do it this time? (Child) I think so. (Adult) I bet you can."*

Offer of Agency and Response

Adult (parent or facilitator) offers child the chance to work with activity or materials. Could include phrases like, "Do you want to try?" "You can explore any of this here." (If it's a prediction - "What do you think will happen next?" - that can also be coded as STEM exploration) Child accepts the offer and engages with the activity. This often reads like a hand-off from the facilitator or other adult to the child to get started on the activity.

This code does not include comments or questions from an adult or facilitator that resemble directions ("Push this button"). Rather, the offer must communicate that the child is welcome to explore, choose what they want to do, and try their own way.

- *"(Adult) This is called 'One Wing or Two?' Do you want to move some things around? What happens if you do this? What happens if you do it that way? (Child) Its... (Adult) What happens, if you put this this way? (Child) Oops. That was mine."*
- *"So, I'm going to let you work on this, and if you get it in the cup, I want you to go 'Whooo!' real loud."*
- *"If you want to test some of these out before you start making, so you know what the different things do?"*

Length of code: Include both the offer and the acceptance ("Do you want to try?" "Sure"). Sometimes there is no verbal response, so can include coding the next comment that is made that indicates that the child accepted.

Connection

Personal relevance or identity

References to personally relevant experiences (I have this, I have seen this. My grandmother had this, do you remember when this happened?) or labeling a person as an "engineer" either in activity or as a future identity.

Note: Does not refer to references to historical facts or context.

- *"(Child) Dad, look at me! (Adult 1) He's an aviator. (Adult 2) You're an old school aviator."*
- *"You seem like you're a sailor, yeah? Of course you are!"*
- *"I wood carve, so this would come in very handy."*

Comparison

A similarity between like features of two things, on which a comparison may be based. This differs from personally relevant comments ("Do you remember when we saw this?") because it calls attention to the features or behavior of an object or activity. Comments that compare "then and now" may be double coded under History Conversation.

- *"It's like a sailboat"*
- *"It's like your Snap Circuits"*
- *"They're doing science."*

Connections within *Create.Connect* exhibit pieces OR anything at Conner Prairie

Connecting to things (like the setting pieces) outside the activity.

- *"It is awesome. So, you know what the last thing that you wanted to try? What did we not do in Prairie Town in the other place? Remember you wanted to try the telex? Why don't we set up. Why don't we set that up for you?"*
- *"Now look up at this, big, giant one. See the angle? Can you make your blade all at that angle?"*
- *"Now, remember what we did over there with the tilting of the blades? And how that helped? You might find that might help you now too."*

THIRD ROUND DOMAIN SPECIFIC THINKING STRATEGY CODING

Historical Thinking Strategies

Our understanding of Historical Exploration and Historical Thinking in *Create.Connect* was based on Mary Alexander's idea of the six learning strands for history museums --as analogous to learning strands described for Informal Science environments (2010) and a model of Historical Thinking Concepts developed by Viviane Gosselin to describe how visitors to history museums make sense of the past when they are put in an exhibition situation but are not required to apply formal historical thinking. Her framework is based on Peter Sexias's Six Concepts, which were intended for application in formal classroom settings (2013). Obviously engagement with historical content in an exhibition space is different than when it occurs in a classroom, so not every aspect of the formal education frameworks are applicable and it cannot be expected to mimic the work of historians or history students. Following are the aspects of the two frameworks that were most applicable to identifying and understanding Historical Thinking present in family conversation within the context of an interactive exhibit.

Six Concepts of Historical Thinking (Gosselin, 2011)

1. Historical Significance: What is worth including in an historical narrative.
2. Evidence and Epistemology: Engaging with and interrogating historical evidence.
3. Cause and Consequence: Who and what provided changes in the past as well as the repercussions of these changes.
4. Historical Perspective: Adopting the viewpoint of historical individuals and groups.
5. Continuity and Change: Determining elements that have changed and aspects that have not.
6. Ethical Judgment: Making ethical assessment about the relative merits or downfalls of historical actions while considering historical contexts in which the actions occurred.

Learning Strands for History Museums (Alexander, 2010)

1. Interact with real objects, documents and settings.
2. Assess data (written, aural, visual and three-dimensional) to support an argument.
3. Use evidence to explicate abstract concepts such as progress, nationalism, manifest destiny.
4. Appreciate the impact of place on human interactions (landscape, architecture, personal and private environments).
5. Sense the consequences of change on individuals and institutions.
6. Be inspired to pursue a new interest and learning adventure.

Continuity and Change

Comparisons or other statements that reference or acknowledge that life was different in the past. This might include progress, change over time, or recognition that people have the same challenges in the present, but solve them differently.

- *"The way they used to heat irons in the older days is that you wouldn't plug in, you would heat them on [the stove]."*
- *"The [refrigerator] solved a problem of keeping food safe and fresh."*
- *"Windmills used to bring water from the ground."*

Cause and Consequence

Identifying links between two occurrences; who or what was responsible for the changes in the past; and how actions in the past impact the present.

- *"(Adult) Do you think it was a good idea for the government to provide money to help get electricity to farms? (Child) Yeah, I think so. (Adult) Can you imagine if you didn't have electricity? How boring it would be? (Yeah, no TV. No light. No nothing.)"*
- *"(Child) Why do you think the didn't upgrade to an electric stove? (Adult) Maybe the stove made heat too... Maybe they want the stove to heat up the house."*
- *"Somebody made up this invention that washes clothes. Did you know that? And the TV! Somebody had to create that TV. It wasn't just there. Somebody had to come up with the idea of how to get that TV to work."*

Empathy

The idea of taking a historical perspective; putting yourself in someone's shoes; trying to understand what life was like in the past.

- *"(Adult) Did you see the tools? Can you imagine making an airplane out of those tools? (Child) That'd be hard."*
- *"Can you imagine in 1936 this farm got electricity. And they could only have three running at the same time. What three things would you have running at your house?"*
- *"[The refrigerator] doesn't hold very much does it? It's a lot smaller than yours at home."*

Personal Relevance

Finding personal relevance in the exhibit. Evidence of prior knowledge, experiences, or relationships influencing connections to the content or objects and driving personal meaning making.

- *"Oh! Mr. Wizard! I used to watch that when I was a boy."*
- *"You know, when I was a little girl, that's the kind of radio we had."*
- *"See how they used the old iron? You know I plug in the iron now. In the old days, they put it on the burner and heated it up."*

STEM Thinking Strategies

There was a much more robust foundation of literature on which to build our understanding of STEM exploration and STEM thinking in Create.Connect. The most applicable resource was the Six Strands for Informal Science Learning presented in *Learning Science in Informal Environments* (NRC, 2009), however our definitions also informed by basic Science Process Skills (NARST, 1990) and the Engineering design process.

Six Strands for Informal Science Learning (NRC, 2009)

1. Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.
2. Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.
3. Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.

4. Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena 5
5. Participate in scientific activities and learning practices with others, using scientific language and tools
6. Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science.

Basic Science Process Skills (NARST, 1990)

1. Observing: using the senses to gather information about an object or event.
2. Inferring: making an "educated guess" about an object or event based on previously gathered data or information.
3. Measuring: using both standard and nonstandard measures or estimates to describe the dimensions of an object or event.
4. Communicating: using words or graphic symbols to describe an action, object or event.
5. Classifying: grouping or ordering objects or events into categories based on properties or criteria.
6. Predicting: stating the outcome of a future event based on a pattern of evidence.

The Engineering Design Process (EiE)

The Engineering Design Process (EDP) is a cycle of steps to come up with a solution to a problem. EDP is flexible, so the steps need not occur in order, and there is no definitive beginning or end point. The process of iterating (design-troubleshoot-modify-test) is very common and a very important aspect of EDP. The following steps were taken from the Engineering is Elementary (EiE) materials intended for use in the classroom with young children:

1. Ask: What is the problem? How have others approached it? What are your constraints?
2. Imagine: What are some solutions? Brainstorm ideas. Choose the best one.
3. Plan: Draw a diagram. Make lists of materials you will need.
4. Create: Follow your plan and create something. Test it out.
5. Improve: What works? What doesn't? What could work better? Modify your design to make it better. Test it out.

Persisting

Conversational evidence of persisting through frustration and challenges.

- *"(Adult) So tell me one thing you learned in here. (Child) Let's see. I learned how to build a circuit. (Adult) You did. Did we get everything right the first time? (Child) No. (Adult) So what did we have to do then? To make sure we get it right? (Child) You have to make a lot of alterations."*
- *"(Child) Okay. Let's try this. (Adult) Do you reckon? Ooh! So close! (Child) Ugh. (Adult) Alright, so this. What about... (Child) It needs to go under. (Adult) Yeah. If it goes under, then that has to go like that. What do you think now? (Child) Let's see. Nope. (Adult) Alright. So let's... what about. Should we try a little more gravity?"*

- *"(Adult) It's ok, let's line it up see if it works, hang on. (Child) Tell me when to fire. (Adult) Whenever you're ready buddy. (Child) Fire. (Adult) Uh-Oh, so that didn't work. (Child) Now let me do my way. (Adult) Ok. (Child) Can you get that. (Adult) I can try, where'd it go. (Child) Ooh. I think we need this, don't need the ball. (Adult) Here, we'll try a smaller one. (Child) Ok, that's good. (Adult) What if we do this, do this, but then you can do that. (Child) Ooh, yeah. (Adult) We just need something to hold it in place. (Child) Like this. Try it. (Adult) Uh-Oh, TC you gotta watch the ball. Thank you. (Child) Do it now. (Adult)Say when. (Child) When. It did it?"*

Good Design

Pointing out or discovering features of good design based on STEM principles.

- *"When you had those flat, it's like a wall or piece of paper right? When you put it at an angle, air touches it and pushes it at an angle. So if you have the bowl like this, and you have it like this, put it at a curve, what happens? More air goes by, doesn't it? Well, you don't want more air to go by; you want it to move more air, right?"*
- *"The other thing we've been learning today is that number of blades isn't quite as important as the angle, so if you look up at the windmill we have here, they're all turned the same way. That's what really makes them spin."*
- *"It's making a circuit. When that metal touches that metal it completes the circuit. Because the metal, see."*

Intentional Process

Open-ended exploration that demonstrates an intentional process of identifying problems or goals and attempts to solve those problems or reach said goals.

- *"(Adult) We can do that. We just have to line it up so. . . Watch. When you make it so it goes right, so it's not quite so . . . There we go. Put your hands up. Be ready to catch. (Child) How about this? I don't . . . this. Let me get something. Here we can have some walls we can put. . . Let's try it. Ooh. Not quite lined up. We need it like this. Or probably. . . (Adult) You see how it's notched out? If you move all those, it'll fit perfectly right there."*
- *"(Adult) It landed right about here... Do you think we should try to knock over a tower, or should we try and catch it in one of these little tubs? (Child) We should try to catch it. (Adult) So we'll just leave the one, but we'll line some up. Can you help me? I'm going to need to measure where the hammer will go. So just push the hammer gently. Move it back just a little more. Okay that looks good. You think?"*
- *"So, that needs to go lower, right? Wouldn't that go low to lift? Because look. Remember what do we want to do? At the end of the day, this has to drop in here, right?"*

Modeling

Using the activity as a model to demonstrate a real-world technology or science phenomenon by making connections.

- *"You know how helicopters fly? Helicopters fly by rotating their pitch. So we need to make sure our pitch is right."*
- *"That's how a toaster really works. It's just all made that way."*
- *"[Alternating current] is the kind of power that's in the house because it pulses. It goes some the other way. You can see the difference."*

Comparing

Comparing the features of two objects with an exploration of reasons that are age appropriate.

- *"When they spin from the air moving, it takes about five miles per hour of wind for these to turn in real life."*
- *"(Adult) Now, what's different about your [sail boat] and his? (Child) It's bigger? I mean smaller. (Adult) It is smaller... but your location [on the table]?"*
- *"Look at the different power supplies for your Kindles and stuff. There's different resistors in there to make sure that it's the right amount of power."*

Cause and Effect

Pointing out or discovering a relationship between design choices and outcomes on performance.

- *"(Adult) You're going to go much farther than that, my dear. You just created . . . with all the kinetic energy that you just set up. We're talking much, much farther. You just created a chain reaction. (Child) We'll have this here. So it will stop the ball.*
- *"That controls the wings, and make it go up or down, basically. Down makes it go up."*
- *"You could block the wind. Now see how this one will travel without the wind? See how it slows down?"*

Identity

Conversational evidence of identifying oneself or another person in the group as someone who "does STEM" activities or thinking.

- *"Oh my gosh! There are circuits. Yay! I'm awesome at these."*
- *"I see. You look like a weather girl. Alright, what are you predicting here?"*
- *"(Child) I'm a fixer. The stuff wasn't rolling before. (Adult) Look, your stuff is rolling!"*

Visitor Conversation Interview

FIRST QUESTIONS
1) Have you visited this exhibit before? How often?
2) What was your favorite part today?

3) I noticed you _____ [do up to 3 of these, try to find one science and one history topic to talk about] _____

Examples: A) I noticed you stepped in to help your child when he was trying to adjust the blades of the turbine. B) . . .said that the turbine is like a windmill. C) . . .mentioned a few times that the windmill is making energy.

4) What were you trying to accomplish by_____?

Examples: A) ...stepping in at that point? B) ...making the connection from the turbine to a windmill? C) ...mentioning energy throughout the interaction?

5) What triggered_____ ?

Examples: What triggered you to jump in at that point? ...to mention that the turbine is like a windmill? ...to talk about energy?

6) Have you ever talked about this kind of thing before with your child?
[or] Have you two worked with wind or energy a lot before?

Example: ...talked about wind or windmills with your child?

7) Did you have enough information from the exhibit to _____?

Examples: A) ...to give your child the guidance she needed at that point? B) ...make the connection between the turbine and windmill? C) ...talk about energy with your child in the way you wanted?

8) What did you want your child to take away from _____ ?

Example: ...to take away from your experience at the wind turbine?

9) What is something simple you could do at home with your child to continue what you did in this exhibit today?

LAST QUESTIONS
9) Think about your visit today. What made you want to come to SMM today?
10) Think about the Science Museum. What does your family (group) value about a trip to the Science Museum?

Date: ME:	Recorder #: Original File Name:	Server File Name:	Family Identifier:	Case ID:
Steps in/out	Gives an explanatoid	Asks a question	Previous knowledge	Looks or sounds confused

☐ Theme

Notes/Observations

APPENDIX 4) Partner Institution Experience and Perspectives

Data was collected from staff at the following institutions (those marked with an asterisk were fully involved for the entire duration of the project). The active phase of the project spanned nearly three years, so there were some changes in group composition as individuals joined and left the project on account of career changes or shifts in responsibilities within their institutions:

Conner Prairie (CP)

- Cathy Ferree* - Vice president of exhibits, programs, interpretations and facilities
- Brian Mancuso* – Director of exhibits
- Jason Adams* - Science Interpretation Manager
- Catherine Hughes - Director of Interpretation
- Chris Petrelli - Director of Programs and Education
- Gail Brown - Program Developer
- Allison Cosbey – Evaluation Coordinator

Science Museum of Minnesota (SMM)

- Mark Dahlager* - Director of Exhibit Design and Development
- Bette Schmit* - Director Exhibit Development
- Jim Roe* – Project Facilitator
- Marjorie Bequette* - Director Life Long Learning
- Keith Braafladt - Director Learning Technologies
- Lucinda Frantz - Project Production Manager
- Molly Phipps – Senior Evaluation and Research Associate (left museum in 2013)

Oliver H. Kelley Farm (OHK)

- Bob Quist – Site Director
- Ann Bercher* - Program Supervisor

Mystic Seaport (MS)

- Elysa Engelman* – Director of Exhibits (promoted from Exhibit Researcher/Developer during project)
- Jonathan Shay – Former Director of Exhibits (retired during project)
- Erik Ingmundson - Supervisor of Interpretation
- Jeff Crewe – Exhibit Designer

Wabash County Historical Museum (WCHM)

- Mitch Figert - Executive Director
- Tracy Stewart – Former Executive Director (left museum in 2013)
- Emily Perkins – Associate Director (left museum in 2014)

California State Railroad Museum (CSRM)

- Philip Sexton* - State Park Interpreter III
- Kendra Dillard – Director of Exhibits, Capital District

[1]Jim Roe is not an SMM employee, but is contracted as a project manager and facilitator for the Prairie Science project.

Workshop Participants

Workshop 1 (January 2013)	Workshop 2 (September 2013)	Workshop 3 (May 2014)
Ann Bercher (OHK)	Allison Cosbey (CP)	Allison Cosbey (CP)
Bette Schmit (SMM)	Ann Bercher (OHK)	Ann Bercher (OHK)
Bob Quist (OHK)	Bette Schmit (SMM)	Bette Schmit (SMM)
Brian Mancuso (CP)	Bob Quist (OHK)	Bob Quist (OHK)
Cathy Feree (CP)	Brian Mancuso (CP)	Brian Mancuso (CP)
Chris Petrelli (CP)	Catherine Hughes	Catherine Hughes
Elysa Engelman (MS)	Cathy Feree (CP)	Cathy Feree (CP)
Gail Brown (CP)	Chris Petrelli (CP)	Elysa Engelman (MS)
Jason Adams (CP)	Elysa Engelman (MS)	Jason Adams (CP)
Jim Roe (SMM)	Emily Perkins(WCHM)	Jim Roe (SMM)
Jonathan Shay (MS)	Gail Brown (CP)	Jonathan Shay (MS)
Keith Braafladt (SMM)	Jason Adams (CP)	Lucinda Frantz (SMM)
Kendra Dillard (CSRM)	Jim Roe (SMM)	Marjorie Bequette (SMM)
Marjorie Bequette (SMM)	Jonathan Shay (MS)	Mark Dahlager (SMM)
Mark Dahlager (SMM)	Keith Braafladt (SMM)	Mitch Figert (WCHM)
Molly Phipps (SMM)	Kendra Dillard (CSRM)	Philip Sexton (CSRM)
Philip Sexton (CSRM)	Marjorie Bequette (SMM)	
Tracy Stewart (WCHM)	Mark Dahlager (SMM)	
	Mitch Figert (WCHM)	
	Philip Sexton (CSRM)	

Interviews

Round 1	Round 2	Round 3
Bette Schmit (SMM)	Bette Schmit (SMM)	Ann Bercher (OHK)
Brian Mancuso (CP)	Brian Mancuso (CP)	Cathy Ferree (CP)
Cathy Ferree (CP)	Cathy Ferree (CP)	Elysa Engelman (MS)
Jason Adams (CP)	Jason Adams (CP)	Erik Ingmundson (MS)
Marjorie Bequette (SMM)	Mark Dahlager (SMM)	Jeff Crewe (MS)
Mark Dahlager (SMM)		Jim Roe (SMM)
		Mark Dahlager (SMM)
		Mitch Figert (WCHM)
		Phil Sexton (CSRM)

Creating Connections Workshop Survey

AASLH Conference, September 17th, 2014

Purpose

The Prairie Science team is thinking about how best to help other history professionals incorporate something like CREATE. Connect into their institutions. This survey is part of the project's summative evaluation for this project.

For the following questions, think about what you have seen here today and how it may work in your own institution. If you are not currently working at a history institution, please answer generally.

Consent

Your responses on this survey are anonymous. No personal information is collected.

Your participation in this survey is completely voluntary. By submitting this survey, you are consenting to be a part of the study and your participation in the study ends at that time.

You may contact Al Onkka, aonkka@smm.org, 651-312-1758, if you have questions about this study and your participation in it

1. Do you currently work at a history institution?

☐ Yes

☐ No (please answer the following questions generally)

2. How important are the following reasons for why you might want to include an exhibit like CREATE.Connect at your institution? You can add other reasons on the next page.

	Not at all important	A little important	Fairly important	Very important	Not *applicable*
Provide informal STEM learning experiences for audiences who have limited access to science centers	☐	☐	☐	☐	☐
Foster repeat visitation by providing more open-ended learning experiences	☐	☐	☐	☐	☐
Better serve families with children 4 – 13 by increasing interactivity in the exhibits	☐	☐	☐	☐	☐
Attract new audiences not otherwise interested in history and culture exhibits	☐	☐	☐	☐	☐
Expand funding opportunities by providing STEM learning opportunities	☐	☐	☐	☐	☐
Meet the requirements for broader range of school standards—including STEM	☐	☐	☐	☐	☐

3. What else is exciting to you about the potential of an exhibit like CREATE.Connect at your institution? Did we miss anything in the first question?

Imagine your organization was committed to developing an exhibition like Create.Connect and you have the time and money to do it.

4. How much help, if any, would your institution need to accomplish the following:

	No help	A little help	A fair amount of help	A lot of help	Not *applicable*
Identify a STEM idea or topic that makes sense at your institution	☐	☐	☐	☐	☐
Develop the narrative for a small exhibition or exhibit	☐	☐	☐	☐	☐
Source images, objects, or other assets for a small exhibition or exhibit	☐	☐	☐	☐	☐
Fabricate an exhibition or exhibit like CREATE.Connect	☐	☐	☐	☐	☐
Find other institutions who might like to partner with you on the project	☐	☐	☐	☐	☐

5. For your institution, how comfortable or uncomfortable are your staff or volunteers with the following:

	Very uncomfortable	Fairly uncomfortable	Fairly comfortable	Very comfortable	Not *applicable*
Learning STEM ideas or activities	☐	☐	☐	☐	☐
Including STEM ideas or activities into your institution	☐	☐	☐	☐	☐
Interacting with visitors	☐	☐	☐	☐	☐
Facilitating open-ended activities or experiences with visitors	☐	☐	☐	☐	☐
Facilitating STEM ideas or activities with visitors	☐	☐	☐	☐	☐

6. How concerned, if at all, are you about the following:

	Not al all concerned	A little concerned	Fairly concerned	Very concerned	Not *applicable*
My visitors enjoying an exhibit like CREATE.Connect	☐	☐	☐	☐	☐
My visitors learning something from an exhibit like CREATE.Connect	☐	☐	☐	☐	☐
An exhibit like CREATE.Connect feeling out of place at my institution	☐	☐	☐	☐	☐
An exhibit like CREATE.Connect overshadowing the other features of my institution	☐	☐	☐	☐	☐

7. What other challenges would you encounter including or developing an exhibit like CREATE.Connect at your institution?

8. Do you have any other questions or comments about this project?

Thank you for your help!

This project has been reviewed and approved by the Heartland Institutional Review Board. Questions concerning your rights as a participant in this research may be addressed to the Executive Director at Heartland IRB. Office: (866) 618-HIRB [4472]; Fax: (866) 414-0517; or by emailing director@heartlandirb.org.