



**Museum Visitor Studies, Evaluation & Audience Research**

Randi Korn & Associates, Inc.  
118 East Del Ray Avenue  
Alexandria, VA 22301

# **Exhibit Evaluation**

**Summative Evaluation of Three Exhibition Galleries:**  
*Engineering America*  
*Towpath Town*  
*Waterworks*

*Prepared for the*  
**National Canal Museum**

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# EXECUTIVE SUMMARY

This report presents the findings from a summative evaluation conducted by Randi Korn & Associates, Inc. (RK&A), of National Science Foundation-funded exhibits for the National Canal Museum (NCM) in Easton, Pennsylvania. The Museum developed many of the exhibits for permanent inclusion in two exhibition galleries, *Towpath Town* and *Waterworks*, and some others for temporary inclusion in its *Engineering America* exhibition gallery before it is used as a traveling exhibition. All the new exhibits are the result of the Museum's efforts to better serve family audiences by providing "hands-on" opportunities for science-related learning in a history setting. Data collection took place in May and June 2006. The evaluation documents the exhibits' impact and effectiveness using timing and tracking observations, exit interviews, and stationed observations.

**Selected highlights of the study are included in this summary. Please consult the body of the report for a detailed account of the findings.**

## PRINCIPAL FINDINGS: TIMING AND TRACKING OBSERVATIONS

### BACKGROUND

- ◆ RK&A observed 150 walk-in visitors, ages 6 years and older, in three exhibition galleries: *Engineering America*, *Towpath Town*, and *Waterworks*. Data collection occurred on weekdays and weekends, including Memorial Day, in May and June 2006. The majority of observations took place in the afternoon during light to moderate visitation conditions.
- ◆ In both *Engineering America* and *Towpath Town*, the majority of observed visitors were female (55 percent and 59 percent, respectively). In contrast, more men were observed in *Waterworks* (52 percent) than women (48 percent).
- ◆ Over two-thirds of visitors in both *Engineering America* (78 percent) and *Towpath Town* (70 percent) were adults (18 years of age and older), whereas in *Waterworks*, 62 percent of observed visitors were adults. In all three galleries, the majority of child visitors were between the ages of 6 and 11 years.
- ◆ Most visitors in all three galleries (over 80 percent) came in groups of adults and children, while slightly less than one-fifth (16 percent in *Engineering America* and 12 percent in both *Towpath Town* and *Waterworks*) visited in adult-only groups.

### OVERALL VISITATION PATTERNS

- ◆ Visitors spent a median time of 12 minutes in *Waterworks*, over eight minutes in *Engineering America*, and almost seven minutes in *Towpath Town*. The shortest time a visitor spent in any of the three galleries was 21 seconds (in *Towpath Town*); the longest was over 35 minutes (in *Engineering America*).
- ◆ Male visitors spent more time in *Waterworks* (mean = 14 minutes, 40 seconds) than did female visitors (mean = 10 minutes, 29 seconds).
- ◆ Among age groups, children (visitors younger than 18 years) spent the most time in *Waterworks* (mean = 17 minutes, 36 seconds), while adults between 35 to 54 years old spent the least time (mean = 8 minutes, 17 seconds).

- ◆ Not surprisingly, visiting groups with children spent the most time in *Waterworks* compared with adult-only groups. Multigenerational—or family—groups spent almost 14 minutes (mean = 13 minutes, 44 seconds) in the gallery, while adult-only groups spent just over one-third of that time (means = 4 minutes, 44 seconds).
- ◆ In *Waterworks*, visitors under the age of 18 years stopped at more exhibit components (mean = 3) compared with other age groups. However, in *Engineering America*, visitors 55 years or older stopped at the highest mean number of exhibits (mean = 7).
- ◆ Visitors with children stopped at a greater number of exhibit components in the *Waterworks* gallery (mean = 3) than did visitors without children (mean = 2).

#### VISITOR BEHAVIORS

- ◆ Most visitors interacted with others while they were in the galleries. Almost all visitors to *Towpath Town* (96 percent) and *Waterworks* (94 percent) were observed interacting with others, while 86 percent of visitors to *Engineering America* did the same.
- ◆ With the exception of *Waterworks*, far fewer visitors interacted with docents. Almost three-quarters of visitors to *Waterworks* (72 percent) interacted with docents during their experience, whereas less than 10 percent interacted with docents in *Towpath Town*.
- ◆ The only incidences of exhibit misuse—using an exhibit in ways developers did not intend—occurred in *Waterworks* (by 4 percent of visitors).
- ◆ Visitors interacted with others at more exhibits in *Towpath Town* (median = 4) than they did in *Engineering America* (median = 3), or *Waterworks* (median = 2).
- ◆ Female visitors to *Towpath Town* interacted with others at more exhibits (mean = 5) than did male visitors (mean = 4).

#### VISITATION OF EXHIBITS BY TYPE

- ◆ Almost all visitors stopped at the interactive exhibits in all three of the galleries studied (100 percent in *Towpath Town* and *Waterworks*, 98 percent in *Engineering America*). Over one-half of *Engineering America* visitors (52 percent) stopped at artifacts or display case exhibits, while less than one-half of *Towpath Town* visitors (42 percent) stopped at similar exhibit types.
- ◆ In *Engineering America*, almost all visitors 55 years or older (90 percent) stopped at an artifact or display case, whereas less than one-fifth of visitors 17 years or younger (18 percent) stopped at the same exhibit type.
- ◆ Visitors spent the most time at interactive exhibits: *Waterworks* visitors spent over 10 minutes (10 minutes, 11 seconds), *Engineering America* visitors spent almost five minutes, and *Towpath Town* visitors spent almost four minutes.
- ◆ *Engineering America* visitors spent almost twice the amount of time at artifacts or display cases than did *Towpath Town* visitors (47 seconds and 25 seconds, respectively). *Engineering America* and *Towpath Town* visitors spent approximately 20 seconds at panels (24 seconds and 21 seconds, respectively). *Towpath Town* visitors spent a median of 17 seconds at video exhibits.
- ◆ Significant relationships emerged between *Waterworks* visitors according to gender. For instance, male visitors spent more time using interactives in *Waterworks* (13 minutes, 36 seconds) than did female visitors (8 minutes, 42 seconds).

- ◆ In all three galleries, visitors with children spent more time at interactive exhibits than did visitors without children.

#### VISITATION OF INDIVIDUAL EXHIBITS

- ◆ Activity-based exhibits experienced the longest dwell times. Visitors spent over eight and one-half minutes at the Model Canal System and almost four minutes at Build This Arched Aqueduct. Boats Displace Water, the Water Table, and the Captain’s Game also experienced high dwell times of over two minutes.
- ◆ The exhibits at which visitors spent the least time were panels. A non-panel exhibit that also experienced a short dwell time was John Arner’s Tool Box artifact (7 seconds).
- ◆ The exhibits that had the strongest attraction power were all activity-based exhibits such as the Model Canal System (100 percent), the Water Table (78 percent), and Build the Canal (74 percent). Over two-thirds of visitors stopped at the Mule Stable and Harnessing and the Big Pulley Station activities (72 percent each).
- ◆ Exhibits attracting less than one-quarter of visitors were mostly panels and some video and artifacts. The Acknowledgments panel, the Mules Pulled Boats panel, and the Toll Collector’s Office Rates Chart artifact (very similar to a panel) were not visited by any observed visitors.

## PRINCIPAL FINDINGS: EXIT INTERVIEWS

#### BACKGROUND

- ◆ RK&A conducted open-ended interviews with 68 eligible visitors—15 children (age 8 and older) and 53 adults comprising 30 visitor groups—as they exited the Museum. The majority of interviewees were females. Almost all interviewees were visiting in multigenerational groups.

#### OVERALL VISITOR EXPERIENCE

- ◆ The majority of interviewees said their visit to The Crayola Factory brought them to the Museum. Several said they were local residents, including a couple of repeat visitors and a Museum member.
- ◆ Overwhelmingly, interviewees enthusiastically described the Museum as a “hands-on,” “interesting,” and “informative” experience for visitors of all ages with different interests.
- ◆ About three-quarters of interviewees said they visited all three galleries: *Engineering America*, *Towpath Town*, and *Waterworks*. Among the remaining one-quarter, most said they visited two galleries and a couple said they visited one gallery.

#### ENGINEERING AMERICA

- ◆ Most interviewees who visited *Engineering America* responded positively to its name. They said the name accurately described the gallery’s topic and activities. However, a few said the name was not specific enough and, as a result, that the exhibition did not meet their expectations.
- ◆ When asked which activity in *Engineering America* most interested them, interviewees most frequently described Loading the Freight Crane and the Water Table, followed by Build a Masonry Aqueduct, then Build a Lock computer interactive, and then Build a Suspension Bridge and Build a Canal.
- ◆ About one-half of interviewees who visited *Engineering America* broadly said its key message used engineering concepts to show how things work or how things were built. Several said the gallery showed visitors the history of canals, including a comparison of old and new transportation methods.

Several others said they did not know what the gallery showed visitors, whereas a few identified *Engineering America's* key message as both the engineering and the history of canals.

### **TOWPATH TOWN**

- ◆ Interviewees who visited *Towpath Town* varied in their reactions to its name depending on their familiarity with the term, “towpath.” A few said they had no opinion because they did not see the title displayed.
- ◆ The majority of interviewees described Mule Harnessing as *Towpath Town's* most interesting activity, followed by dress-up and play areas in general (e.g., washing clothes, collecting eggs), Big Pulleys, Tiller Steering, and the Captain's Game computer interactive.
- ◆ Nearly three-quarters of interviewees said *Towpath Town's* key message related to history. Among these interviewees, many described the history of canals and/or of people who worked the canals, whereas many others more generally referenced the history of transportation, the history of the local community, or “how people lived back then.” The remaining interviewees said they either could not remember or did not know what *Towpath Town's* activities were trying to show or tell visitors.

### **WATERWORKS**

- ◆ Most interviewees who visited *Waterworks* said the name reflects the gallery's activities because each one involves water. Among these interviewees, few specifically referred to canals. Some said they either did not know the gallery had a name until told or said the name should explicitly reflect the gallery's focus on how canals work.
- ◆ Interviewees overwhelmingly described aspects of the Model Canal System, particularly the locks and the changing water levels, as *Waterworks's* most interesting activity. A few participants each mentioned Boats Move Heavy Loads and Boats Displace Water as the most interesting activity.
- ◆ Interviewees' understanding of *Waterworks's* activities' key message varied. Most discussed specific aspects (e.g., how locks work) and/or functions of a canal (e.g., moving cargo), although several more generally described how a canal system works and/or its purpose. A few described the history of canals as *Waterworks's* key message rather than the operation or functionality of canals.

### **VISITOR UNDERSTANDING**

- ◆ Interviewees were asked to identify and reflect upon the stories, exhibits, and/or artifacts about the people who built and operated canals presented throughout the Museum. The majority said they did not recall coming across anything about the people who built and operated canals or “canal people” while in the Museum, often explaining that their children made it difficult to pay attention to anything.
- ◆ Among interviewees who recalled coming across these “canal people,” most identified stories or information they had read or learned from doing the activities rather than the exhibits or artifacts they had used or viewed, although a few identified specific exhibits, including the Captain's Game computer interactive, the Mule Harnessing video, and Tiller Steering.
- ◆ When asked to identify one or more key ideas they would take away from their museum visit, most interviewees identified science-related ideas, ranging from the specific (e.g., how locks work) to the broad (e.g., engineering concepts), although few clearly articulated the scientific ideas or concepts they identified. Some identified key ideas relating to both science and history, whereas others described ideas only about the history of canals.
- ◆ When asked to recall any new information they discovered about canals during their museum visit, nearly one-half of interviewees described learning how locks work. Several discussed general

information they learned about canal systems, while several others said they learned about specific aspects of canals, including aqueducts, towpaths, water displacement, and canal construction.

## PRINCIPAL FINDINGS: STATIONED OBSERVATIONS

### BACKGROUND

- ◆ NSF-funded interactive exhibits were developed to appeal to a range of generations and were intended to promote behaviors and conversations associated with learning science in a history setting. To provide a detailed account of how visitors used the activities and to determine whether their usage reflected science-related learning in a history setting, RK&A observed visitors at four exhibits identified by museum staff as among the most frequently used: Build a Masonry Aqueduct (*Engineering America*); Model Canal System (*Waterworks*); and, Big Gear Reducer and Tiller Steering (*Towpath Town*).
- ◆ RK&A observed a total of 570 visitors\* at all four exhibits over 12 hours.

### BUILD A MASONRY AQUEDUCT

- ◆ Children and adults working together were the primary users of Build a Masonry Aqueduct. Nearly all children immediately began deconstructing the aqueduct (if already built) or building it (if disassembled) without looking at the accompanying instruction panel. In contrast, most adults watched their children's usage and/or viewed the instructions before helping build the aqueduct.
- ◆ Visitors generally constructed the aqueduct in pairs or groups, rarely collaborating with visitors outside their familiar social groups. Most adults and children who attempted to build the aqueduct together successfully completed the activity. Adult visitors who approached the exhibit without children did not try the activity.
- ◆ The evaluator identified a variety of conversational trends among visitors using Build a Masonry Aqueduct, including a few related to learning science in a history setting. Most often visitors, primarily adults, used building- and/or engineering-related language to introduce the activity and/or upon completion, to explain its significance. Similarly, adults typically used canal-related language to explain the exhibit to children.

### MODEL CANAL SYSTEM

- ◆ Children, playing together with adults, other children, and/or independently, were the primary users of the Model Canal System. Accompanying adults guided children through the activity verbally, and, if necessary, physically.
- ◆ Many children used the canal section under observation (i.e., "Farm Town") multiple times, including some who returned to the area alone or in child-only groups after initially navigating their boats with adult assistance. In contrast, the evaluator observed adults using the exhibit only when accompanied by children—rarely navigating their own boat—and typically ending the exhibit experience before children were ready to stop playing.
- ◆ The evaluator identified a variety of conversational trends among visitors using the Model Canal System, including a few related to learning science in a history setting. Overwhelmingly, science-related visitor conversations focused on the canal's locks. Throughout the activity, visitor conversations also reflected the canal's history setting by referencing exhibit elements related to people or places.

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\* The evaluator attempted to track repeat users of the exhibits to avoid counting them more than once; however, the total number of visitors observed likely includes some repeat users for each exhibit.



## **BIG GEAR REDUCER/ TILLER STEERING**

- ◆ Owing to their close proximity, RK&A observed Big Gear Reducer and Tiller Steering simultaneously. Children and adults, working together and independently, were the primary users of both exhibits. Nearly all visitor groups used first one exhibit then the other—the order determined by the direction from which they first approached. Visitor groups under observation typically engaged with Big Gear Reducer and/or Tiller Steering for 30 seconds or less per exhibit.
- ◆ Most often an adult verbally led the Big Gear Reducer activity and/or explained its significance to other group members, including children and/or other adults. Likewise, an adult typically led visitor groups of all ages in using Tiller Steering. Although children almost always initiated and ended exhibit usage, few used either one without adult assistance. While adults most often used the two exhibits with children, some continued usage after their children moved on to other exhibits. Additionally, several adults without children approached and used the exhibits alone or with other adults.
- ◆ Although visitors spent more time doing the activity than talking about it, the evaluator identified several conversational trends among visitors using Big Gear Reducer. Nearly all of these trends related to learning science, but not in a history setting. Specifically, visitors discussed the exhibit's two gears—identifying, comparing, and experimenting with them to determine the stronger one.
- ◆ Despite visitors' typically brief encounters with Tiller Steering, the evaluator identified several conversational trends among visitors doing the activity. Most of these trends related to learning science in a history setting, primarily regarding identifying and operating the canal boat. Adults initiated most conversations relating to the boat and/or how to operate it. Adults and some older children verbally directed children's use of the tiller, explaining how to steer the boat, and yet no one referred to the tiller by name.

History museums often struggle to engage children. Similarly, many adults think of history museums as having text-heavy exhibitions that lack interactivity. So it is noteworthy that the National Canal Museum, primarily owing to its new National Science Foundation-funded exhibits, proved compelling to children and their families. Through a variety of interactive and “hands-on” learning activities, the Museum’s new exhibits successfully engage multigenerational groups in science-related learning within a historical context. Visitors explored the science and history of canals by: experimenting with exhibits based on simple machines; engaging in activities related to the operation of canals, such as harnessing a mule and steering a boat; and, manipulating locks and other engineering mechanisms while using water-based exhibits. When docents were available, they, too, communicated the science and history of America’s towpath canals.

### MULTIGENERATIONAL LEARNING THROUGH INTERACTIVE EXHIBITS

Unlike many other historic sites and museums, the National Canal Museum attracts many families because The Crayola Factory is in the same building. As a result, the Museum’s audience more closely resembles a children’s museum than it does a history museum. While enviable in many respects, the Museum’s popularity with young families compounds the challenge of engaging children and adults in content, particularly when presented in the form of a text panel. Parents alluded to this challenge repeatedly during interviews by explaining that “chasing after” their children prevented them from noticing gallery signage.

Through interactive exhibits, the Museum has created a space where families fully participate and have satisfying experiences. Findings show that the interactive exhibits significantly affected visitors’ exhibition experiences in all three galleries studied: *Engineering America*, *Towpath Town*, and *Waterworks*. Almost all visitors stopped at the interactive exhibits in all three of the galleries. The interactive components were the most frequently visited exhibits and those with the highest dwell times. Interviewees of all ages corroborated these findings, noting that they gravitated toward interactive exhibits and explaining that these exhibits made the Museum unique and enjoyable because they got to do a lot of things on their own instead of having someone do it for them. Interviewees praised specific interactive exhibits, including the Model Canal System, Mule Harnessing, and Loading the Freight Crane, as favorite museum experiences because they provided “something for everyone in the family” to do.

Observational data demonstrate that the Museum succeeds as a multigenerational learning venue. In all three galleries, visitors with children spent more time at interactive exhibits than did visitors without children. Nearly all visitors with children discussed exhibit content and/or engaged in parent-child coaching interactions—behaviors indicative of multigenerational learning—while using four interactive exhibits: Build a Masonry Aqueduct, Model Canal System, Big Gear Reducer, and Tiller Steering. Children as young as 4 years old actively engaged in these activities, and some of the older children even took over the coaching role from adults by, for example, helping other children use the Model Canal System.

## LEARNING SCIENCE IN A HISTORY SETTING

By doing the exhibit activities, visitors gained a greater appreciation for the *science*-related concepts and skills that people used in the past to build and operate canals—an important accomplishment in light of the Museum’s mission and given its primary identity as a history museum. Interviewees of all ages described learning new science-related information in all three galleries, including one child who added, “Mommy did not know how the water raised and lowered [in the canal].” While many interviewees had difficulty articulating the key science-related concepts beyond a simple description, one adult noted, “The activities do a great job of illustrating how things worked so you can at least value the underlying mechanisms [of canals], even if you do not understand it all.” Interviewees’ basic recognition of the science concepts related to canals is a great success, given one of the Museum’s goals—to help visitors better understand and appreciate how a canal system operates (i.e., its overall complexity and, specifically, use of locks).

In contrast, few interviewees discussed learning about the history of canals except with regard to *Towpath Town*, the gallery that provides the most historical setting by focusing on the people who operated the canals. Both the observational and interview data help explain why most visitors recalled learning about science, not history, in the Museum overall. Interactive exhibits—the most popular of all exhibit types among visitors—provided primarily science-related information, whereas text panels—the least popular—provided historical information. Visitors with children, in particular, underutilized the panels. To better communicate the history of canals, the Museum may need to better integrate “canal people” and their stories into exhibit activities. For example, visitors responded positively to the Captain’s Game computer interactive because, by assuming the identities of “real” people, they experienced history in a more meaningful way compared with reading about costs associated with operating a canal boat.

Docents presented a comprehensive history-learning experience for families in the *Waterworks* gallery and in the other galleries to a much lesser extent. Not only did docents provide interpersonal interaction, but they used interactive exhibits to facilitate a greater understanding of historical context for visitors of all ages. For example, observational data indicate that when docents actively engaged visitors while they were using the Model Canal System, their actions and words set off a chain reaction: docents modeled correct usage for visitors who, in turn, modeled correct usage, both directly and indirectly, for other visitors in the exhibit area, and so forth. Docent assistance typically included introducing visitors to the canal’s history and the canal’s relationship to people, introducing correct terminology (e.g., “aqueduct”), and explaining how to operate the canal system. Although text and graphics panels located throughout the exhibit area provided much of the same information, visitors who used the exhibit without docent assistance typically referenced little, if any, of the history during usage. Instead, most who viewed the panels referred to their instructional content. Furthermore, after docents left visitors to use the exhibit independently, visitors continued to use the information learned from the docent throughout their exhibit experience.

By watching visitors in the National Canal Museum and talking to them about their experiences, RK&A found that the National Science Foundation-funded interactive exhibits transformed the Museum’s galleries into family-friendly, active learning environments from traditional exhibition spaces featuring glass-encased displays and text panels. As museums—particularly history museums—continue to evolve and combat the antiquated stereotypes of hushed marble hallways and untouchable artifacts, the National Canal Museum has proven that its family visitors are welcome and valued. Equally important, the Museum’s interactive exhibits provide visitors with a better understanding of the science and unique history of America’s towpath canals. While it is difficult to present cross-disciplinary content through exhibits, the National Canal Museum has succeeded in conveying to visitors that understanding and appreciating the “who, what, where, when, and why” of canals requires learning more than one content area.

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# INTRODUCTION

This report presents the findings from a summative evaluation conducted by Randi Korn & Associates, Inc. (RK&A), of National Science Foundation-funded exhibits for the National Canal Museum (NCM) in Easton, Pennsylvania. The Museum developed many of the exhibits for permanent inclusion in two exhibition galleries, *Towpath Town* and *Waterworks*, and some others for temporary inclusion in the *Engineering America* exhibition gallery before it is used as a traveling exhibition.

Data collection took place in May and June 2006. The evaluation documents the Museum's impact and effectiveness by examining visitors':

- ◆ Use of the exhibits (at which exhibits they stopped; how much time they spent at individual exhibits and in each exhibition gallery; whether groups used exhibits together; whether groups discussed exhibit content; and whether groups interacted with docents in the exhibition galleries);
- ◆ Opinions of individual exhibits, exhibition galleries, and the Museum as a whole;
- ◆ Understanding of and meaning constructed from their Museum experiences, specifically:
  - How a canal system operates (i.e., its overall complexity and, specifically, use of locks);
  - How people lived and worked along the canal;
  - How people who operated the canal used simple machines (e.g., an incline plane) to make their work easier and faster; and,
- ◆ Level of engagement, group dynamics, and conversational trends fostered by select exhibits intended to communicate science content within a historical context.

## METHODOLOGY

RK&A used three data collection strategies to assess visitors' experiences in all three exhibition galleries: timing and tracking observations, cued exit interviews, and stationed observations.

### TIMING AND TRACKING OBSERVATIONS

Visitor observations provide an objective and quantitative account of how visitors behave and react to exhibition components. Observational data indicate how much time visitors spend within each of the exhibition galleries and suggest the range of visitor behaviors.

All visitors 6 years of age and older were eligible to be unobtrusively observed in the galleries. For each gallery, the evaluator selected visitors to observe using a continuous random sampling method. In accordance with this method, the observer stationed herself at the gallery's entrance(s), and observed the first eligible visitor to enter, following the selected visitor through the room, recording the exhibits used, noting select behaviors, and logging total time spent in the gallery (see Appendix A for the observation forms). When the visitor completed his or her visit, the observer returned to the entrance to await the next eligible visitor to enter the gallery.

In addition to recording stops made and time spent at each exhibit, the data collector also noted specific behaviors listed on the observation form. The behaviors included misusing an exhibit—using an exhibit in ways not intended by the developers. Appendix B provides definitions of misuse and broken exhibits.

## EXIT INTERVIEWS

Open-ended interviews produce data rich in information because interviewees are encouraged and motivated to describe their experiences, express their opinions and feelings, and share with the interviewer the meaning they constructed during a visit. Upon entering one of two pre-designated Museum exit locations, visitors 8 years old and older were eligible to be selected for participation following a continuous random sampling method, as described above. Eligible visitors were invited to answer several questions about their museum experiences post-visit (see Appendix C for the exit interview guide). The interview guide was intentionally open-ended to allow interviewees the freedom to discuss what they felt was meaningful. All interviews were audio-recorded with participants' permission and transcribed to facilitate analysis.

## STATIONED OBSERVATIONS

To provide a more detailed analysis of experiences at a specific activity, RK&A conducted stationed observations at four interactive exhibits: Build a Masonry Aqueduct (*Engineering America*), Model Canal System (*Waterworks*), and Big Gear Reducer and Tiller Steering (*Towpath Town*). During stationed observations, the evaluator watched as visitors used the activity, writing a detailed description (called "thick description" in the anthropology field) about what visitors did, how they interacted with other visitors, and, when possible, recording the dialogue. In addition to the exhibited behaviors, the observer also noted the approximate ages and genders of observed visitors.

The evaluator unobtrusively watched visitors in each of the exhibit areas for four hours, so that she would not impact visitors' experiences.

## DATA ANALYSIS

### QUANTITATIVE ANALYSIS

The quantitative observational data were entered into a computer and analyzed statistically using SPSS 12.0 for Windows, a statistical package for personal computers. Frequency distributions were calculated for all categorical variables (e.g., gender, age group). To examine the relationship between two categorical variables (e.g., use of an exhibit and age group), cross-tabulation tables were computed to show the joint frequency distribution of the two variables, and the chi-square statistic ( $X^2$ ) was used to test the significance of the relationship.

Summary statistics, including the mean (average), median (data point at which half the responses fall above and half fall below), and standard deviation (spread of scores: "±" in tables), were calculated for the time data.\* To compare the means of two or more groups, an analysis of variance (ANOVA) was performed. The level of significance was set at 0.05 because of the moderate sample size. When the level of significance is set to  $p = 0.05$ , any relationship that exists at a probability ( $p$ -value) of  $\leq 0.05$  is "significant." When a relationship has a  $p$ -value of 0.05, there is a 95 percent probability that the relationship being explored truly exists; that is, in 95 out of 100 cases, there would be a relationship between the two variables (e.g., gender and preferences for visiting). Conversely, there is a 5 percent probability that the relationship does not exist; in other words, in 5 out of 100 cases, a relationship would appear by chance. Within the body of the report, only statistically significant results are discussed.

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\* For the most part, medians rather than means are reported in this document because, as is typical, the number of components used and the time spent by visitors were distributed unevenly across the range. For example, whereas most visitors spent a relatively brief time with exhibition components, a few spent an unusually long time. When the distribution of scores is extremely asymmetrical (i.e., "lopsided"), the mean is strongly affected by the extreme scores and, consequently, falls further away from the distribution's central area. In such cases, the median is the preferred measurement because it is not sensitive to the values of scores above and below it—only to the number of such scores.

## QUALITATIVE ANALYSIS

The interview data are qualitative, meaning that results are descriptive, following from the interviews' conversational nature. In analyzing the data, the evaluator studied responses for meaningful patterns, and, as patterns and trends emerged, grouped similar responses. To illustrate interviewees' thoughts and ideas as fully as possible, this report includes verbatim quotations (edited for clarity).

## REPORTING METHOD

The data in this report are both quantitative and qualitative. For the quantitative data, information is displayed in tables and graphs. Percentages within tables may not always equal 100 owing to rounding. The findings within each topic are presented in descending order, starting with the most-frequently occurring.

The interview data are presented in narrative. The interviewer's remarks appear in parentheses, and, for visitors, an asterisk (\*) signifies the start of a different speaker's comments. At the end of each quotation, the interviewee's status (adult or child) is indicated in brackets. Trends and themes in the interview data are also presented from most- to least-frequently occurring.

### FINDINGS IN THIS REPORT ARE PRESENTED IN THREE MAIN SECTIONS:

- ◆ Timing and Tracking Observations
- ◆ Exit Interviews
- ◆ Stationed Observations

# PRINCIPAL FINDINGS: TIMING & TRACKING OBSERVATIONS

## BACKGROUND INFORMATION

From May 20 to June 11, 2006, RK&A-trained data collectors observed 150 visitors, 6 years and older, in three exhibition galleries: *Engineering America*, *Towpath Town*, and *Waterworks*. Data collection occurred on weekdays and weekends, including Memorial Day. Fifty visitors were observed in each of the three galleries, resulting in a total of 150 observed visitors. As shown in Table 1, the majority of observations took place in the afternoon, under light to moderate crowding conditions.

**TABLE 1**  
**DATA COLLECTION CONDITIONS**

CONDITION ( <i>n</i> = 50)	PERCENT OF VISITORS		
	ENGINEERING AMERICA	TOWPATH TOWN	WATERWORKS
<b>Day of the Week</b>			
Weekday	74.0	28.0	26.0
Weekend/Holiday	26.0	72.0	74.0
<b>Time of Day</b>			
A.M.	10.0	10.0	14.0
P.M.	90.0	90.0	86.0
<b>Crowding Level</b>			
Light	44.0	20.0	40.0
Moderate	36.0	66.0	42.0
Crowded	20.0	14.0	18.0

## VISITOR DEMOGRAPHICS

In both *Engineering America* and *Towpath Town*, the majority of observed visitors were female (55 percent and 59 percent, respectively). In contrast, the evaluator observed more men in *Waterworks* (52 percent) than they did women (48 percent). Also, over two-thirds of visitors in both *Engineering America* (78 percent) and *Towpath Town* (70 percent) were adults (18 years of age and older), whereas in *Waterworks*, 62 percent of observed visitors were adults. In all three galleries, the majority of child visitors were between the ages of 6 and 11 years old (see Table 2, next page).



**TABLE 2****VISITOR DEMOGRAPHICS**

CHARACTERISTIC (n = 50)	PERCENT OF VISITORS		
	ENGINEERING AMERICA	TOWPATH TOWN	WATERWORKS
<b>Gender*</b>			
Female	55.1	59.2	48.0
Male	44.9	40.8	52.0
<b>Age (in years)</b>			
6-11	18.0	28.0	30.0
12-17	4.0	2.0	8.0
18-34	34.0	22.0	28.0
35-54	22.0	36.0	22.0
55+	22.0	12.0	12.0

\*The percentages of men and women observed are based on a total sample size of 49 for both the *Engineering America* and *Towpath Town* galleries.

Most visitors in all three galleries (over 80 percent) came in groups of adults and children, while slightly less than one-fifth (16 percent in *Engineering America* and 12 percent in both *Towpath Town* and *Waterworks*) were in adult-only groups (see Table 3).

**TABLE 3****VISITING GROUP COMPOSITION**

COMPOSITION (n = 50)	ENGINEERING AMERICA (%)	TOWPATH TOWN (%)	WATERWORKS (%)
Adults and children	84.0	88.0	88.0
Adults only	16.0	12.0	12.0

**OVERALL VISITATION PATTERNS****TOTAL TIME SPENT IN THE EXHIBITION**

Visitors spent a median time of 12 minutes in *Waterworks*, over eight and one-half minutes in *Engineering America*, and almost seven minutes in *Towpath Town* (see Table 4). The shortest time a visitor spent in any of the three galleries was 21 seconds (in *Towpath Town*); the longest was over 35 minutes (in *Engineering America*).

**TABLE 4****TOTAL TIME SPENT IN EACH GALLERY**

GALLERY (n = 50)	MEDIAN	MINIMUM	MAXIMUM	MEAN	±
<i>Waterworks</i>	12 min., 8 sec.	57 sec.	32 min., 20 sec.	12 min., 39 sec.	7 min., 14 sec.
<i>Engineering America</i>	8 min., 40 sec.	1 min., 6 sec.	35 min., 47 sec.	11 min., 34 sec.	8 min., 17 sec.
<i>Towpath Town</i>	6 min., 47 sec.	21 sec.	22 min., 39 sec.	8 min., 19 sec.	5 min., 44 sec.

When the total mean time spent in each of the three galleries was compared by group composition and demographic characteristics, several statistically significant relationships emerged among *Waterworks* visitors (see Table 4a). Male visitors spent more time in *Waterworks* (mean = 14 minutes, 40 seconds) than did female visitors (mean = 10 minutes, 29 seconds). Children younger than 18 years spent the most time in the gallery (mean = 17 minutes, 36 seconds), while adults between the ages of 35 to 54 years spent the least time (mean = 8 minutes, 17 seconds) in *Waterworks*.

**TABLE 4a**

**DIFFERENCE IN TOTAL TIME SPENT IN WATERWORKS BY VISITOR DEMOGRAPHIC**

CHARACTERISTIC	n	MEAN	±
<b>Gender<sup>1</sup></b>			
Male	26	14 minutes, 40 seconds	8 minutes, 31 seconds
Female	24	10 minutes, 29 seconds	4 minutes, 48 seconds
<b>Age<sup>2</sup> (in years)</b>			
< 18	19	17 minutes, 36 seconds	7 minutes, 52 seconds
18-34	14	11 minutes, 3 seconds	5 minutes, 33 seconds
35-54	11	8 minutes, 17 seconds	4 minutes, 24 seconds
55+	6	8 minutes, 46 seconds	3 minute, 19 seconds

<sup>1</sup>F=4.465; p=.040

<sup>2</sup>F=6.966; p=.001

Not surprisingly, visiting groups with children spent the most time in *Waterworks* in comparison with adult-only groups (see Table 4b). Multigenerational—or family—groups spent almost 14 minutes (mean = 13 minutes, 44 seconds) in the gallery, while adult-only groups spent just over one-third of that time (means = 4 minutes, 44 seconds).

**TABLE 4b**

**DIFFERENCE IN TOTAL TIME SPENT IN WATERWORKS BY GROUP COMPOSITION**

GROUP COMPOSITION	n	MEAN	±
With children	44	13 minutes, 44 seconds	6 minutes, 57 seconds
Without children	6	4 minute, 44 seconds	3 minute, 13 seconds

F=9.645; p=.003

No significant relationships were found among visitors to *Towpath Town* or *Engineering America*.

**TOTAL NUMBER OF EXHIBITS STOPPED AT**

The three galleries varied in the number of exhibit components at which visitors could stop: *Towpath Town* included 28 exhibit components, *Engineering America* included 20 exhibit components, and *Waterworks* included five exhibit components. For this evaluation, a “stop” was defined as a visitor standing for three seconds or longer in front of a component. If a visitor returned to a component at which s/he had previously stopped, this return was not counted as an additional stop, but the amount of time spent was included in the total time spent at the component.

In *Tonpath Town*, visitors stopped at between one and 13 exhibit components. The median number of exhibit components visitors stopped at in this gallery was six, meaning one-half of visitors stopped at fewer than six components and one-half stopped at more than six components. In *Engineering America*, visitors stopped at between one and 12 exhibit components and stopped at a median number of 4.5 exhibit components. Finally, visitors stopped at between one and five exhibit components in *Waterworks* and visited a median of three exhibit components (see Table 5).

**TABLE 5**  
**TOTAL NUMBER OF EXHIBITS VISITED IN EACH GALLERY**

<b>GALLERY (n = 50)</b>	<b>MEDIAN</b>	<b>MINIMUM</b>	<b>MAXIMUM</b>	<b>MEAN</b>	<b>±</b>
<i>Tonpath Town</i>	6.0	1.0	13.0	6.1	3.1
<i>Engineering America</i>	4.5	1.0	12.0	5.0	2.7
<i>Waterworks</i>	3.0	1.0	5.0	2.8	1.0

Analysis found that in *Waterworks*, visitors younger than 18 years stopped at more exhibit components (mean = 3) compared with other age groups (see Table 5a). However, in *Engineering America*, visitors 55 years or older stopped at the most exhibits (mean = 7) (see Table 5b).

**TABLE 5a**  
**DIFFERENCE IN TOTAL NUMBER OF EXHIBITS VISITED IN WATERWORKS BY AGE**

<b>AGE (IN YEARS)</b>	<b>N</b>	<b>MEAN</b>	<b>±</b>
<18	19	3.4	1.0
18-34	14	2.6	1.0
35-54	11	2.1	0.7
55+	6	2.7	0.8

F=5.084; p=.004

**TABLE 5b**  
**DIFFERENCE IN TOTAL NUMBER OF EXHIBITS VISITED IN ENGINEERING AMERICA BY AGE**

<b>AGE (IN YEARS)</b>	<b>N</b>	<b>MEAN</b>	<b>±</b>
<18	11	4.1	1.6
18-34	17	4.9	2.7
35-54	11	3.9	2.2
55+	11	7.2	2.9

F=4.107; p=.012

As shown in Table 5c, visitors with children stopped at a greater number of exhibit components in the *Waterworks* gallery (mean = 3) than did visitors without children (mean = 2).

**TABLE 5c**  
**DIFFERENCE IN TOTAL NUMBER OF EXHIBITS VISITED**  
**IN WATERWORKS BY GROUP COMPOSITION**

GROUP COMPOSITION	n	MEAN	±
With children	44	2.9	1.0
Without children	6	2.0	0.9

F=4.510; p=.039

Again, no significant relationships were found among visitors to *Towpath Town*.

### COMPARISON OF GALLERIES

To further compare the three galleries, RK&A calculated the percentage of exhibit components visitors used in each gallery (see Table 6). Almost one-half of the total population of observed visitors (46 percent) stopped at 25 percent or less of the exhibits in the gallery they visited. Conversely, 7 percent of visitors stopped in more than three-quarters of the exhibits in the gallery they visited.

**TABLE 6**  
**PERCENTAGE OF EXHIBITS VISITED**

PERCENT OF EXHIBITS USED (n = 150)	TOTAL (%)
25% or less	46.0
50 – 26%	23.7
75 – 51%	14.0
100 – 76%	7.3

Further analysis found that significant differences existed between the percentage of exhibits visitors used and the gallery they visited (see Table 6a). All or most of the visitors to *Towpath Town* and *Engineering America* stopped at 50 percent or less of the exhibits in the gallery (100 percent and 96 percent, respectively). In contrast, over one-half of the visitors to *Waterworks* (60 percent) visited more than 50 percent of available exhibits.

**TABLE 6a**

**DIFFERENCES IN PERCENTAGE OF EXHIBITS VISITED BY GALLERY VISITED**

PERCENT OF EXHIBITS USED	PERCENT OF VISITORS			TOTAL (n = 150)
	<i>WATER-WORKS</i> (n = 50)	<i>TOWPATH TOWN</i> (n = 50)	<i>ENGINEERING AMERICA</i> (n = 50)	
50% or less	40.0	100.0	96.0	78.7
Over 50%	60.0	0.0	4.0	21.3

$\chi^2=67.055$ ;  $df=2$ ;  $p=.000$

## VISITOR BEHAVIORS

Observers noted four behaviors: interacting with staff, interacting with other visitors, misuse, and using audio (at the Interactive Map activity only). Detailed information about behaviors at individual exhibits is provided in Appendix B.

### SUMMARY OF BEHAVIORS

As presented in Table 7, most visitors interacted with others while they were in the galleries. With the exception of *Waterworks*, far fewer visitors interacted with docents. Almost all visitors to *Towpath Town* (96 percent) and *Waterworks* (94 percent) were observed interacting with others, while 86 percent of visitors to *Engineering America* did the same. Almost three-quarters of visitors to *Waterworks* (72 percent) interacted with docents during their experience, whereas less than 10 percent interacted with docents in *Towpath Town*. The only incidences of exhibit misuse (see Appendix B for detailed descriptions) occurred in *Waterworks* (by 4.0 percent of the visitors). In *Engineering America*, two percent of visitors used the audio in the Interactive Map activity.

**TABLE 7**  
**PERCENTAGE OF VISITORS WHO EXHIBITED BEHAVIORS IN EACH GALLERY**

BEHAVIOR	PERCENT OF VISITORS		
	ENGINEERING AMERICA (n = 50)	TOWPATH TOWN (n = 50)	WATERWORKS (n = 50)
Interact with others	86.0	96.0	94.0
Interact with docent	48.0	6.0	72.0
Misuse	0.0	0.0	4.0
Use audio*	2.0	n/a	n/a

\* Only possible at the Interactive Map activity in *Engineering America*

No statistically significant relationships were found when visitor behaviors were compared according to demographic characteristics or group composition.

### FREQUENCY OF BEHAVIORS

#### SOCIAL INTERACTION

As indicated in Table 8, visitors interacted with others at more exhibits in *Towpath Town* (median = 4) than they did in *Engineering America* (median = 3), or *Waterworks* (median = 2).

**TABLE 8**  
**FREQUENCY OF SOCIAL INTERACTION**

GALLERY	NUMBER OF POSS. OPPORTUNITIES	n	FREQUENCY				
			MEDIAN	MIN.	MAX.	MEAN	±
<i>Towpath Town</i>	28	48	4.0	1.0	9.0	4.6	2.2
<i>Engineering America</i>	20	43	3.0	1.0	8.0	3.2	1.7
<i>Waterworks</i>	5	47	2.0	1.0	5.0	2.4	1.01

Analysis of visitor interaction with others in *Towpath Town* shows that a significant relationship existed between this behavior and gender (see Table 8a). Female visitors to *Towpath Town* interacted with others at more exhibits (mean = 5) than did male visitors (mean = 4). No other significant relationships were found.

**TABLE 8a**  
**DIFFERENCES IN FREQUENCY OF SOCIAL INTERACTION IN**  
**TOWPATH TOWN BY GENDER**

GENDER ( <i>n</i> = 48)	MEAN	±
Female	5.1	2.3
Male	3.8	1.9

F = 4.430; *p* = 0.041

**DOCENT INTERACTION**

In all three galleries, visitors who interacted with docents did so at a median of one exhibit (see Table 9). When the number of exhibits at which visitors interacted with docents was analyzed by demographic characteristic and group composition, no statistically significant relationships emerged.

**TABLE 9**  
**FREQUENCY OF DOCENT INTERACTION**

GALLERY	NUMBER OF POSS. OPPORTUNITIES	<i>n</i>	FREQUENCY				
			MEDIAN	MIN.	MAX.	MEAN	±
<i>Engineering America</i>	20	24	1.0	1.0	3.0	1.4	0.6
<i>Towpath Town</i>	28	3	1.0	1.0	1.0	1.0	0.0
<i>Waterworks</i>	5	36	1.0	1.0	3.0	1.4	0.6

## VISITATION OF EXHIBITS BY TYPE

Together, the three galleries include four main exhibit types: panels, interactives (including computer interactives), artifacts (including display cases), and videos.

### STOPS AT EACH EXHIBIT TYPE

Almost all visitors stopped at the interactive exhibits in all three of the galleries studied (100 percent in *Towpath Town* and *Waterworks*, 98 percent in *Engineering America*) (see Table 10). Over one-half of *Engineering America* visitors (52 percent) stopped at artifacts or display case exhibits, while less than one-half of *Towpath Town* visitors (42 percent) stopped at those exhibit types. About one-quarter of *Towpath Town* visitors (26 percent) stopped at a video exhibit. Finally, less than one-third of *Engineering America* and *Towpath Town* visitors stopped at panels.

**TABLE 10**  
**PERCENTAGE OF VISITORS WHO STOPPED AT EACH EXHIBIT TYPE**

EXHIBIT TYPE (n = 50)	NUMBER OF EXHIBITS AVAILABLE	PERCENT OF VISITORS WHO STOPPED
<b>Interactives</b>		
<i>Towpath Town</i>	11	100.0
<i>Waterworks</i>	4	100.0
<i>Engineering America</i>	8	98.0
<b>Artifacts/cases</b>		
<i>Engineering America</i>	5	52.0
<i>Towpath Town</i>	9	42.0
<b>Video</b>		
<i>Towpath Town</i>	3	26.0
<b>Panels</b>		
<i>Engineering America</i>	7	32.0
<i>Towpath Town</i>	5	12.0

Further data analysis shows that few significant relationships exist between the types of exhibits visitors stopped at according to either their demographic characteristics or their group composition. The only statistically significant difference that exists is among the different age groups represented in *Engineering America* (see Table 10a). In this gallery, almost all visitors 55 years or older (90 percent) stopped at an artifact or display case; whereas less than one-fifth of visitors 17 years or younger (18 percent) stopped at the same exhibit type.

**TABLE 10a**  
**DIFFERENCE IN THE PERCENTAGE OF VISITORS TO *ENGINEERING AMERICA* WHO STOPPED AT ARTIFACTS OR DISPLAY CASES BY AGE**

EXHIBIT TYPE (n = 50)	PERCENT OF VISITORS IN AGE GROUP				TOTAL (%)
	≤17	18-34	35-54	55+	
Artifact/case	18.2	47.1	54.5	90.1	52.0

$\chi^2=11.907$ ;  $df=3$ ;  $p=.008$



### TIME SPENT AT EACH EXHIBIT TYPE

As shown in Table 11, visitors spent the most time at interactive exhibits: *Waterworks* visitors spent over 10 minutes, *Engineering America* visitors spent almost five minutes, and *Tonpath Town* visitors spent almost four minutes. Interestingly, *Engineering America* visitors spent almost twice the amount of time at artifacts or display cases than did *Tonpath Town* visitors (47 seconds and 25 seconds, respectively). Both *Engineering America* and *Tonpath Town* visitors spent approximately 20 seconds at panels (24 seconds and 21 seconds, respectively). Finally, *Tonpath Town* visitors spent a median of 17 seconds at video exhibits.

**TABLE 11**  
**TIME SPENT AT EACH EXHIBIT TYPE**

EXHIBIT TYPE (N=164)	NUMBER OF EXHIBITS AVAILABLE	NUMBER OF VISITORS WHO STOPPED	MEDIAN TIME
<b>Interactives</b>			
<i>Waterworks</i>	4	50	10 min., 11 sec.
<i>Engineering America</i>	8	49	4 min., 59 sec.
<i>Tonpath Town</i>	11	50	3 min., 58 sec.
<b>Artifacts/cases</b>			
<i>Engineering America</i>	5	26	47 sec.
<i>Tonpath Town</i>	9	21	25 sec.
<b>Panel</b>			
<i>Engineering America</i>	7	16	24 sec.
<i>Tonpath Town</i>	5	6	21 sec.
<b>Video</b>			
<i>Tonpath Town</i>	3	13	17 sec.

Statistical analysis of the time visitors spent at each exhibit type shows that the only difference among visitors lies in their use of interactives. When compared by demographic characteristics, significant relationships emerged between *Waterworks* visitors according to gender (see Table 11a). For instance, male visitors spent more time using interactives in *Waterworks* (13 minutes, 36 seconds) than did female visitors (8 minutes, 42 seconds).

**TABLE 11a**  
**DIFFERENCES IN TIME SPENT AT INTERACTIVES IN WATERWORKS BY GENDER**

GENDER (n=50)	MEAN	±
Male	13 min., 36 sec.	8 min., 10 sec.
Female	8 min., 42 sec.	4 min., 25 sec.

Mann-Whitney U = 206.00;  $p = 0.040$

Analysis also uncovered significant relationships between visitors' use of interactives and their group composition (see Table 11b). In all three galleries, visitors with children spent more time at interactive exhibits than did visitors without children.

**TABLE 11b**  
**DIFFERENCES IN TIME SPENT AT INTERACTIVES BY GROUP COMPOSITION**

<b>GALLERY</b>	<b>PREDICTOR VARIABLE</b>	<b>MEAN</b>	<b>±</b>
<i>Engineering America</i> (n = 49)	<b>Group composition<sup>1</sup></b>		
	With children	8 min., 20 sec.	6 min., 57 sec.
	Without children	3 min., 10 sec.	2 min., 21 sec.
<i>Tombpath Town</i> (n = 50)	<b>Group composition<sup>2</sup></b>		
	With children	5 min., 33 sec.	4 min., 35 sec.
	Without children	2 min., 11 sec.	1 min., 32 sec.
<i>Waterworks</i> (n = 50)	<b>Group composition<sup>3</sup></b>		
	With children	12 min., 13 sec.	6 min., 51 sec.
	Without children	4 min., 7 sec.	3 min., 10 sec.

<sup>1</sup>Mann-Whitney U = 71.000; *p* = 0.030    <sup>2</sup>Mann-Whitney U = 63.000; *p* = 0.039    <sup>3</sup>Mann-Whitney U = 29.000; *p* = 0.002

## VISITATION TO INDIVIDUAL EXHIBITS

### TIME SPENT AT EACH EXHIBIT

As shown in Table 12, activity-based exhibits experienced the longest median times (i.e., they had the longest dwell times). Visitors spent over eight and one-half minutes at the Model Canal System and almost four minutes at Build This Arched Aqueduct. Boats Displace Water, the Water Table, and the Captain's Game also experienced high dwell times of over two minutes.

**TABLE 12**  
**EXHIBITS AT WHICH VISITORS SPENT MORE THAN 60 SECONDS**

EXHIBIT	GALLERY	NUMBER OF VISITORS WHO STOPPED	MEDIAN TIME SPENT (SEC.)
Model Canal System activity	<i>Waterworks</i>	50	517.5
Build This Arched Aqueduct activity	<i>Engineering America</i>	16	228.0
Boats Displace Water activity <sup>1</sup>	<i>Waterworks</i>	12	136.5
Water Table activity	<i>Engineering America</i>	39	129.0
Captain's Game computer interactive	<i>Tonpath Town</i>	13	126.0
Boat Names activity	<i>Tonpath Town</i>	20	93.5
Interactive Map activity <sup>2</sup>	<i>Engineering America</i>	7	93.0
Toll Collector's Office artifacts	<i>Tonpath Town</i>	1	77.0
Build a Crane activity	<i>Engineering America</i>	22	67.5
Use the Crane to Load and Unload Cargo activity	<i>Engineering America</i>	17	62.0
Inclined Plane activity <sup>3</sup>	<i>Tonpath Town</i>	7	61.0

<sup>1</sup> The Boats Displace Water activity was broken during 11 observed visits ( $n=39$ ).

<sup>2</sup> The Interactive Map activity was broken during one observed visit ( $n=49$ ).

<sup>3</sup> The Inclined Plane activity was broken during 31 observed visits ( $n=19$ ).

See Table 13 for a list of the exhibits at which visitors spent between 60 and 30 seconds.

**TABLE 13**  
**EXHIBITS AT WHICH VISITORS SPENT BETWEEN 60 AND 30 SECONDS**

EXHIBIT	GALLERY	NUMBER OF VISITORS WHO STOPPED	MEDIAN TIME SPENT (SEC.)
Build a Canal activity	<i>Engineering America</i>	37	60.0
Boats Moved Heavy Loads activity	<i>Waterworks</i>	16	59.5
Big Pulley Station activity	<i>Tonpath Town</i>	36	49.5
Tiller Steering activity	<i>Tonpath Town</i>	27	45.0
Build a Suspension Aqueduct activity	<i>Engineering America</i>	28	44.5
Dress-up Play activity	<i>Tonpath Town</i>	22	41.5
Locks Opened Up the Canals panel	<i>Engineering America</i>	2	39.0
Water Reduces Friction activity	<i>Waterworks</i>	26	38.5
Big Gear Reducer activity	<i>Tonpath Town</i>	27	36.0
Hand-washing Station	<i>Waterworks</i>	35	35.0
Build a Canal Tools and Photographs case	<i>Engineering America</i>	10	31.5
Bridges Spanned Deep Valleys panel	<i>Engineering America</i>	8	31.0

As shown in Table 14, visitors spent the least time at panels. A non-panel exhibit that also experienced a short dwell time was John Arner’s Tool Box artifact (7 seconds).

**TABLE 14**  
**EXHIBITS AT WHICH VISITORS SPENT LESS THAN 30 SECONDS**

<b>EXHIBIT</b>	<b>GALLERY</b>	<b>NUMBER OF VISITORS WHO STOPPED</b>	<b>MEDIAN TIME SPENT (SEC.)</b>
Canal Life: My Name is Jeremiah video	<i>Tonpath Town</i>	10	29.0
Locktender’s Laundry activity	<i>Tonpath Town</i>	16	28.0
Boat Names artifacts	<i>Tonpath Town</i>	3	27.0
Cranes Did Heavy Lifting on the Canal panel	<i>Engineering America</i>	2	25.0
Mule Stable and Harnessing activity	<i>Tonpath Town</i>	36	24.5
Locktender’s Chicken activity	<i>Tonpath Town</i>	21	24.0
Building Locks computer interactive	<i>Engineering America</i>	10	22.5
Dog House case	<i>Tonpath Town</i>	4	21.5
Tiller Steering video	<i>Tonpath Town</i>	1	21.0
Building Canals Required Many Skills panel	<i>Engineering America</i>	4	20.0
Families Worked the Locks panel	<i>Tonpath Town</i>	2	20.0
Delaware Aqueduct Model case	<i>Engineering America</i>	21	19.0
What Am I? case	<i>Engineering America</i>	7	17.0
Pulleys Helped Lighten the Load panel	<i>Tonpath Town</i>	4	16.5
Bridges Carried Canals panel	<i>Engineering America</i>	5	16.0
Tools and Models case	<i>Engineering America</i>	9	15.0
Reading area	<i>Tonpath Town</i>	2	14.5
Canal Cargo case	<i>Tonpath Town</i>	6	14.5
Mule Stable and Harnessing artifacts	<i>Tonpath Town</i>	3	14.0
Canal Boat Construction artifacts	<i>Tonpath Town</i>	2	14.0
Inclined Planes Eased the Load panel	<i>Tonpath Town</i>	2	13.5
Mule Stable and Harnessing video	<i>Tonpath Town</i>	4	13.0
Locktender’s House artifacts	<i>Tonpath Town</i>	5	12.0
Lehigh Coal & Navigation Co. Coal Boat model	<i>Tonpath Town</i>	11	11.0
Tillers Gave Captains Leverage panel	<i>Tonpath Town</i>	1	10.0
John Arner Tool Box artifact	<i>Engineering America</i>	4	7.0
Canals Connected our Young Nation panel	<i>Engineering America</i>	1	5.0

## STOPS MADE AT EACH EXHIBIT

See Table 15 for a list of the exhibits at which the most visitors stopped (i.e., exhibits that had the strongest attraction power). Again, these exhibits were all activity-based exhibits such as the Model Canal System (100 percent), the Water Table (78 percent), and Build the Canal (74 percent). Over two-thirds of visitors stopped at the Mule Stable and Harnessing and the Big Pulley Station activities (72 percent each).

**TABLE 15**  
**EXHIBITS AT WHICH MORE THAN 25 PERCENT OF VISITORS STOPPED**

EXHIBIT ( <i>n</i> = 50)	GALLERY	PERCENT OF VISITORS WHO STOPPED
Model Canal System activity	<i>Waterworks</i>	100.0
Water Table activity	<i>Engineering America</i>	78.0
Build a Canal activity	<i>Engineering America</i>	74.0
Mule Stable and Harnessing activity	<i>Tonpath Town</i>	72.0
Big Pulley Station activity	<i>Tonpath Town</i>	72.0
Hand-washing Station	<i>Waterworks</i>	70.0
Build a Suspension Aqueduct activity	<i>Engineering America</i>	56.0
Big Gear Reducer activity	<i>Tonpath Town</i>	54.0
Tiller Steering activity	<i>Tonpath Town</i>	54.0
Water Reduces Friction activity	<i>Waterworks</i>	52.0
Build a Crane activity	<i>Engineering America</i>	44.0
Dress-up Play activity	<i>Tonpath Town</i>	44.0
Delaware Aqueduct Model case	<i>Engineering America</i>	42.0
Locktender's Chicken activity	<i>Tonpath Town</i>	42.0
Boat Names activity	<i>Tonpath Town</i>	40.0
Inclined Plane activity <sup>1</sup>	<i>Tonpath Town</i>	36.8
Use the Crane to Load and Unload Cargo activity	<i>Engineering America</i>	34.0
Boats Moved Heavy Loads activity	<i>Waterworks</i>	32.0
Build This Arched Aqueduct activity	<i>Engineering America</i>	32.0
Locktender's Laundry activity	<i>Tonpath Town</i>	32.0
Boats Displace Water activity <sup>2</sup>	<i>Waterworks</i>	30.8
Captain's Game computer interactive	<i>Tonpath Town</i>	26.0

<sup>1</sup> The Inclined Plane activity was broken during 31 observed visits (*n*=19).

<sup>2</sup> The Boats Displace Water activity was broken during 11 observed visits (*n*=39).

As shown in Table 16, exhibits that attracted less than one-quarter of visitors were mostly panels and some video and artifacts. The Acknowledgments panel, the Mules Pulled Boats panel, and the Toll Collector’s Office Rates Chart artifact (which is similar to a panel) were not visited by any observed visitors. Other exhibits that experienced low attraction power were the Canals Connected Our Young Nation panel, the Toll Collector’s Office artifacts, the Tiller Gave Captains Leverage panel, and the Tiller Steering video (2 percent each).

**TABLE 16**  
**EXHIBITS AT WHICH LESS THAN 25 PERCENT OF VISITORS STOPPED**

<b>EXHIBIT (n = 50)</b>	<b>GALLERY</b>	<b>PERCENT OF VISITORS WHO STOPPED</b>
Lehigh Coal & Navigation Co. Coal Boat model	<i>Towpath Town</i>	22.0
Building Locks computer interactive	<i>Engineering America</i>	20.0
Build a Canal Tools and Photographs case	<i>Engineering America</i>	20.0
Canal Life: My Name is Jeremiah video	<i>Towpath Town</i>	20.0
Tools and Models case	<i>Engineering America</i>	18.0
Bridges Spanned Deep Valleys panel	<i>Engineering America</i>	16.0
Interactive Map activity*	<i>Engineering America</i>	14.3
What Am I? case	<i>Engineering America</i>	14.0
Canal Cargo case	<i>Towpath Town</i>	12.0
Bridges Carried Canals panel	<i>Engineering America</i>	10.0
Locktender’s House artifacts	<i>Towpath Town</i>	10.0
Building Canals Required Many Skills panel	<i>Engineering America</i>	8.0
John Arner Tool Box artifact	<i>Engineering America</i>	8.0
Mule Stable and Harnessing video	<i>Towpath Town</i>	8.0
Pulleys Helped Lighten the Load panel	<i>Towpath Town</i>	8.0
Dog House case	<i>Towpath Town</i>	8.0
Mule Stable and Harnessing artifacts	<i>Towpath Town</i>	6.0
Boat Names artifacts	<i>Towpath Town</i>	6.0
Cranes Did Heavy Lifting on the Canal panel	<i>Engineering America</i>	4.0
Locks Opened Up the Canals panel	<i>Engineering America</i>	4.0
Canal Boat Construction artifacts	<i>Towpath Town</i>	4.0
Reading area	<i>Towpath Town</i>	4.0
Inclined Planes Eased the Load panel	<i>Towpath Town</i>	4.0
Families Worked the Locks panel	<i>Towpath Town</i>	4.0
Canals Connected Our Young Nation panel	<i>Engineering America</i>	2.0
Toll Collector’s Office artifacts	<i>Towpath Town</i>	2.0
Tillers Gave Captains Leverage panel	<i>Towpath Town</i>	2.0
Tiller Steering video	<i>Towpath Town</i>	2.0
Acknowledgments panel	<i>Engineering America</i>	0.0
Mules Pulled Canal Boats panel	<i>Towpath Town</i>	0.0
Toll Collector’s Office Rates Chart artifact	<i>Towpath Town</i>	0.0

\*The Interactive Map activity was broken during one observed visit (n=49).

# PRINCIPAL FINDINGS: EXIT INTERVIEWS

## BACKGROUND INFORMATION

RK&A conducted open-ended interviews with visitors during the mornings and afternoons of Friday, May 30 through Sunday, June 11, 2006. Of 43 groups intercepted, 13 declined to participate in the study, which is a 30 percent refusal rate and higher than average for museum evaluations. This discrepancy is likely owing to the Museum's large number of visitor groups with young children, an audience demographic less inclined to participate in on-site interviews. The evaluator interviewed 30 visitor groups, comprised of 68 individuals.

### VISITOR DEMOGRAPHICS

Data collectors interviewed 53 adults and 15 children eligible for participation (age 8 and older), comprising 30 visitor groups. More than one-half of the 68 interviewees were female (36 interviewees) and less than one-half were male (32 interviewees). Adults ranged in age from 18 to 80 years, although about one-half (26 interviewees) were 25 to 44 years old and adults' median age was 38 years. Children who participated in interviewees ranged in age from 8 to 17 years, with a median age of 10 years. Almost all interviewees were visiting in multigenerational groups. One-half of interviews took place near the third floor exit for the *Waterworks* gallery, whereas the remaining one-half were conducted near the fourth floor exit for the *Engineering America* gallery.

## VISITOR EXPERIENCE

### REASON FOR VISIT

The majority of interviewees said their visit to The Crayola Factory brought them to the NCM (see the first quotation below). Several said they were local residents, including a couple of repeat visitors and a Museum member (see the second quotation). A few said they were visiting the NCM because of advertising (i.e., AAA tour book, highway signage, and word of mouth) (see the third quotation).

(What brought you here today?) The Crayola Factory. I did not even know this [the NCM] was here. We just started on the top floor and it happened to be canals, all canals and trains, so we are working our way back down [to the Crayola Factory]. [adult]

We live nearby and were just looking for something to do on a Sunday afternoon. [adult]

We were driving through this area and actually saw a sign and . . . so we added [the NCM] as a side trip. [adult]

### OVERALL RESPONSE

Overwhelmingly, interviewees enthusiastically described the Museum as a “hands-on,” “interesting,” and “informative” experience for visitors of all ages and with different interests (see the first and second quotations below).

[The Museum] was cool because you get to do a lot of things on your own instead of having someone do it for you. In other museums and the [Crayola] factory, you do not interact with stuff, you watch other people do it. [child]

[The National Canal Museum] is a hands-on museum with something for people of all ages. . . . You have, essentially, playing in the water for the smallest kids up to understanding some of the principles of physics with the pulleys and gears and some of those things for older kids and adults . . . as well as the history for those people who are into the history of the development of transportation. [adult]

In particular, interviewees said they enjoyed the Museum's broad range of activities, unique content, and family-friendly environment (see the first, second, and third quotations below). Interviewees did not provide any negative feedback, except one who suggested adding more interactive exhibits to the Museum.

I would say [the Museum] is very likeable, very interesting. Overall, there are so many different things you can do. I definitely like [the Museum]. [adult]

I think [the Museum] is very interesting because I learned a lot of things I did not know before. [child]

[The Museum] is innovative, creative and a great place to bring your family. We had a really great time. [adult]

## EXHIBITION GALLERY EXPERIENCES

About three-quarters of interviewees said they visited all three galleries: *Engineering America*, *Towpath Town*, and *Waterworks*. Among the remaining one-quarter, most said they visited two galleries and a couple said they visited one gallery. Of 30 visitor groups interviewed, 28 said they visited *Towpath Town*, followed by *Waterworks* (27 groups) and *Engineering America* (25 groups). For each exhibition gallery visited, interviewees were asked a series of questions about the gallery's name, activities, and key message.

### ENGINEERING AMERICA

#### GALLERY NAME

Most interviewees who visited *Engineering America* responded positively to its name. They said the name accurately described the gallery's topic and activities (see the first and second quotations below). However, a few interviewees said the name was not specific enough and, as a result, the exhibition did not meet their expectations (see the third and fourth quotations).

(How well do you think the name *Engineering America* reflects what you saw and did while you were there?) Very well. All the concepts had to do with engineering in there. [adult]

[The gallery's name is] good because building a lock was engineering and operating a crane was engineering. [child]

[The gallery's name] said *Engineering America* so I expected a whole separate exhibit but it was part of the canals. [adult]

[The name is] okay, except [the gallery] showed only a small slice of engineering in America; the canals pushed us West but that was not all. [adult]

#### MOST INTERESTING ACTIVITIES

When asked which *Engineering America* activity was most interesting, interviewees identified a variety of activities. The most frequently identified activities were Loading the Freight Crane and the Water Table. Interviewees indicated they enjoyed both of these activities because younger children in their visitor groups could participate. Several said Build a Masonry Aqueduct was most interesting, while some others said Building a Lock on the computer interested them most. They explained that these activities provided a challenge for older children and adults. Citing the same reason, a few interviewees said Build a Suspension Bridge and Build a Canal were the most interesting activities.



## UNDERSTANDING OF KEY MESSAGE

About one-half of interviewees who visited *Engineering America* broadly said its key message used engineering concepts to show how things work or how things were built (see the first and second quotations below). Several interviewees said the gallery showed visitors the history of canals, including a comparison of old and new transportation methods (see the third quotation). Several others said they did not know what the gallery showed visitors, whereas a few identified *Engineering America's* key message as the engineering and the history of canals (see the fourth quotation).

(In your opinion, what are *Engineering America's* activities trying to show or tell visitors?) How things work. [Engineers] used very basic principles to do a lot of this stuff and we do not even think about it. [adult]

[*Engineering America's* activities show] the use of engineering to solve problems of transportation. [adult]

[*Engineering America's* activities show] how nineteenth century American engineering helped industrialization. [adult]

[*Engineering America's* activities show] how everything works and give [visitors] a good idea of how things were in the old days and in the modern days. [child]

## TOWPATH TOWN

### GALLERY NAME

Interviewees who visited *Towpath Town* varied in their reactions to its name depending on their familiarity with the term, "towpath." Several said they either did not like the name *Towpath Town* or did not know how well it reflects the gallery's activities because they did not know what a towpath was (see the first and second quotations below). On the other hand, a few participants said they liked the name, *Towpath Town*, because they learned what a towpath was by visiting the gallery (see the third quotation). Several participants familiar with the name's meaning prior to visiting *Towpath Town* said they liked the name because it "makes sense" given the gallery's topic and/or exhibits (see the fourth and fifth quotations). A few others said they had no opinion because they did not see the title.

(How well do you think the name *Towpath Town* reflects what you saw and did while you were there?) I do not know because I do not know what a towpath is—is that the name of something in the town? [child]

*Towpath Town* I do not really like; I did not get the name. [child]

Initially, I was not aware of the meaning of a 'towpath' or familiar with the term. But I came to understand the meaning behind it [in the gallery] and that was good. [adult]

[The gallery's name] works. I know what a towpath is and a *Towpath Town* would be one right along the path. [adult]

[The gallery's name] is good because all of the donkeys would tow things. [child]

### MOST INTERESTING ACTIVITIES

When asked which activity in *Towpath Town* was most interesting, the majority of interviewees described Mule Harnessing, including a few who referred to the mule as a horse. They said they enjoyed learning new information about the use of mules to pull canal boats and the related responsibilities of children

(see the first quotation below). They also said they liked doing the activity and watching the accompanying video (see the second quotation).

[The most interesting activity was] the mule. I had no idea mules pulled boats down the canal. I never thought before about why we had the boats or how they were pulled. [adult]

[The most interesting activity was] harnessing the horse and the horse video that showed how things used to be done. [child]

Many interviewees described dress-up and play areas in general (e.g., washing clothes, collecting eggs) as the most interesting activity. Several others described Big Pulleys (see the first quotation below) and Tiller Steering (see the second quotation) as the most interesting activity. A few participants identified the Captain's Game computer interactive as the most interesting activity (see the third quotation).

[The most interesting activity was] pulling the barrels because it shows how more pulleys make the job easier. [child]

[The most interesting activity was] steering the boat to the left and right. It gave the kids an idea of how difficult it is to operate [a canal boat]. [adult]

[The most interesting activity was] the interactive computer toll collector, figuring out how much it cost to get something from one place to another, and how much money [canal boat captains] actually made. [adult]

#### **UNDERSTANDING OF KEY MESSAGE**

Nearly three-quarters of interviewees said *Towpath Town's* key message related to history. Among these interviewees, many described the history of canals and/or of people who worked the canals (see the first and second quotations below), whereas many others more generally referenced the history of transportation, the history of the local community, or "how people lived back then" (see the third and fourth quotations).

[*Towpath Town's* activities] were a history lesson. People do not realize that the canals were the first mass transportation and the first mass cargo system. [adult]

[*Towpath Town's* activities] generally show the life of people who lived along the canal, the people who worked it. [child]

[*Towpath Town's* activities show] early modes of transportation; how people got around 150 to 200 years ago. [adult]

[*Towpath Town's* activities show] things that were in this [geographic] area a long time ago. [child]

The remaining interviewees said they either could not remember or did not know what *Towpath Town's* activities were trying to show or tell visitors.

#### **WATERWORKS**

##### **GALLERY NAME**

Most interviewees who visited *Waterworks* said the name reflects the gallery's activities because each one involves water (see the first quotation below). Among these interviewees, a few referred to canals (see the second quotation). Some interviewees said they either did not know the gallery had a name until they were told or said the name should explicitly reflect the gallery's focus on how canals work (see the third quotation).

(How well do you think the name *Waterworks* reflects what you saw and did while you were there?) Very well; [the gallery] was all water and it shows you how the land and water work with the boats and everything. [adult]

[The gallery's name] is pretty good because the activities were all about the canals lowering and moving the water up and down. [child]

If [the Museum] put more about canals and locks in the name, then that would explain [the gallery's activities] better. [adult]

### **MOST INTERESTING ACTIVITIES**

When asked which activity in *Waterworks* was most interesting, interviewees overwhelmingly described aspects of the Model Canal System, particularly the locks and the changing water levels (see the first and second quotations below). They explained that moving a model boat through water in this large-scale canal system helped them understand how canals work. A few participants mentioned Boats Move Heavy Loads as most interesting (see the third quotation), while a few others named Boats Displace Water.

[The most interesting activity was] the canals and the locks . . . the fact that the kids could learn how the locks actually work. [adult]

[The most interesting activity was] the canal because if you open all the stuff or close them and open the little slots, the water goes up. Then if you let things out and let all the water out, the boat goes down really fast, down to the river. The canal forces the water so this can happen. [child]

[The most interesting activity was] where you pull the boat and try to move the one that weighs the same amount as the one not in the water. [child]

### **UNDERSTANDING OF KEY MESSAGE**

Interviewees' understanding of what *Waterworks*' activities were trying to show or tell visitors varied. Most discussed specific aspects (e.g., how locks work) and/or functions of a canal (e.g., moving cargo) (see the first and second quotations below). Several interviewees more generally described the key message as showing how a canal system works and/or its purpose (see the third and fourth quotations below).

[*Waterworks*' activities show] how you put a boat into a lock and raise or lower the water, depending on what you are doing. I have seen real live canals before but it is fun to see the model. [child]

[*Waterworks*' activities show] how important the locks were in engineering the water flow, controlling it, and getting stuff from point A to [point] B. [adult]

[*Waterworks*' activities show] how the canal system works and manipulates water. [adult]

[*Waterworks*' activities show] how water was used to move cargo. [child]

A few interviewees described the history of canals as *Waterworks*' key message rather than focusing on the functionality of canals. Their responses ranged from broad references to the canals' role in history to personal reflections on the experiences of people working the canals (see the first and second quotations below).

[*Waterworks*' activities show] how the canals supported our country and how industrialization happened by water. [adult]

[*Waterworks*' activities show] how hard it was to be a boat driver back then. [child]

## OVERALL VISITOR SUGGESTIONS

Interviewees were not asked directly for suggestions to improve the exhibits; however, a few offered suggestions during interviews. Their suggestions included adding instructions to the Building a Lock computer interactive and the Build a Canal exhibits, as well as renaming all three galleries to more explicitly explain their activities and increasing the visibility of the galleries' title signage.

## VISITOR UNDERSTANDING

### IDENTIFYING THE CANAL PEOPLE

Interviewees were asked to identify and reflect upon the stories, exhibits, and/or artifacts about the people who built and operated canals presented throughout the Museum. The majority said they did not recall coming across anything about these “canal people” while in the Museum (see the first quotation below). Most of these interviewees further explained that their children made it difficult for them to pay attention to anything in the Museum (see the second and third quotations below).

We did not [come across any stories/exhibits/artifacts about these ‘canal people’] but we kind of ran through things. [adult]

No. I think we mostly ran from place to place to see what was going on. I did not have a chance to look at anything because I was trying to keep up with the kids. [adult]

The kids did not want to stop and read so it was hard for us to be able to spend time on anything [in the galleries]. [adult]

Among interviewees who recalled coming across these “canal people” while in the Museum, most identified stories or information they had read or learned from doing the activities rather than from the exhibits or artifacts they had used or viewed. Nearly all the stories they recalled related to their daily lives, particularly the work of families and children who operated canals (see the first and second quotations below). A couple interviewees identified the importance of foreign workers in building the canal system (see the third quotation).

Yes, [I recall] the fact that [operating the canal] was a family thing; we read about how it was a hard, hard life. I did not realize it was families [who worked the canals]. They built a house and the whole family was there to work the lock. [adult]

I read about [the canal people] making one dollar a day and how the families and the kids worked on the canals. [child]

Yes, [I recall] the people who built the canal, the engineers, and people who worked the railroad. Workers, engineers were brought here from Europe . . . because we did not have people who did this kind of work. . . . [adult]

A few interviewees identified specific exhibits about the people who operated canals, including the Canal Boat Captain computer interactive, the Mule Harnessing video, and Tiller Steering (see the first and second quotations below). One participant also mentioned viewing artifacts—“old tools”—belonging to people who built the canals.

[I recall] the computer game with the captain had a little section with a description of what they had to do [as captains]. [adult]

Yes, [I recall] one exhibit we did with the interactive video that had us operating the boat. You could actually steer the boat, which was pretty cool. [child]

### UNDERSTANDING THE KEY IDEAS

Interviewees were asked to identify one or more key ideas that they would take away from their museum visit. Most identified science-related ideas, ranging from the specific (e.g., how locks, pulleys, and/or cranes work) to the broad (e.g., engineering concepts, physics concepts, and /or the mechanisms underlying canal systems) (see the first and second quotations below). However, many of these interviewees did not clearly articulate the scientific ideas or concepts they identified (see the third quotation).

[I will take away] the locks, the pulleys, the engineering. [adult]

[I will take away] a better appreciation of canals. The activities do a great job [of] illustrating how things worked so you can at least value the underlying mechanisms [of canals], even if you do not understand it all. [adult]

[I will take away] the science of how the water comes down and the boats go through the different dams and how the water moves; it was pretty cool. [child]

Some interviewees identified key ideas relating to science and history (see the first quotation below) that they would take away from their museum visit, whereas others described ideas only about the history of canals (see the second quotation). A couple interviewees said they were “going too fast” through the galleries to identify any key ideas that they would take away from their museum visit.

[I will take away] the history of the kids and families who worked on the canals. (Anything else?) The pulleys, the incline plane, the locks. [adult]

[I will take away] how the children had to do all that work to set up the mule, and kids really helped with all the work on the canals. [adult]

### RECALLING NEW INFORMATION

When asked to recall any new information they discovered about canals during their museum visit, nearly one-half of interviewees described learning how locks work (see the first quotation below). Several interviewees discussed general information they learned about canal systems (see the second quotation). Several others said they learned about specific aspects of canals, including aqueducts, towpaths, water displacement, and canal construction (see the third, fourth, and fifth quotations).

Mommy did not know how the water raised and lowered [in the canal]. I did not know anything about canals; I learned a lot. I did not know how the locks let the water go through to raise and lower the water levels for boats. [child]

I did not know anything about canals before [my visit]. I learned they have a two-part system and it was very educational since I had no idea before how that worked. [adult]

[I discovered] that aqueducts were actually bridges with water running over them and they are used as roads nowadays. [adult]

I learned about . . . [people]’s use of the mules for towing boats; that surprised me. [child]

Where [the Museum] showed the construction of the canal, that was interesting. I never really knew there were so many components that went into it. [adult]

A few interviewees said they did not discover anything because they already knew the information or their children distracted them. In contrast, a couple of participants said “everything” was new because they did not know anything about canals before their visit (see the quotation below).

I never realized that canals were built. I just thought there were all these bodies of water that were always here. Now I see that they were not. It was land and people built a canal to get across and to transport people and things. [adult]

# PRINCIPAL FINDINGS: STATIONED OBSERVATIONS

## BACKGROUND INFORMATION

NSF-funded interactive exhibits in all three exhibition galleries were designed to appeal to a range of generations and were intended to promote behaviors and conversations associated with learning science in a history setting. To provide a detailed account of how visitors used the activities and to determine whether their usage reflected science-related learning in a history setting, RK&A observed visitors at four exhibits identified by museum staff as among the most frequently used: Build a Masonry Aqueduct (*Engineering America*); Model Canal System (*Waterworks*); and Big Gear Reducer and Tiller Steering (*Townpath Town*).

The evaluator stationed herself at each exhibit and observed visitors as they used the activity. She noted visitors' ages, genders, and familial relationships (if she could determine them) and wrote a detailed description of their actions and conversations. The evaluation goals for the stationed observations were to:

- Record the level of visitor engagement with each exhibit;
- Document group dynamics fostered by each exhibit, and;
- Capture conversational trends and topics inspired by each exhibit.

RK&A observed a total of 570 visitors\* at all four exhibits over a total of 12 hours.

## BUILD A MASONRY AQUEDUCT EXHIBIT

### VISITOR DEMOGRAPHICS

A total of 114 visitors approached and/or used Build a Masonry Aqueduct during four one-hour observations (one hour in the morning and three in the afternoon). More than one-half of observed visitors were children (under 18 years) and less than one-half were adults (54 percent and 46 percent, respectively). Fifty-one percent were male and 49 percent were female.

Slightly less than one-half of the children ranged in age from 5 to 7 years (47 percent), followed by children age 8 to 12 years (23 percent), teenagers aged 13 to 17 years (17 percent), and children age 4 and younger (13 percent). More than three-quarters of adults were between the ages of 25 and 54 years (81 percent), while adults age 55 and older made up the remaining 19 percent.

### OVERALL RESPONSE

Children and adults working together were the primary users of Build a Masonry Aqueduct. Nearly all children immediately began deconstructing the aqueduct (if already built) or building it (if disassembled) without looking at the accompanying panel of instructions. In contrast, most adults watched their children's usage and/or viewed the instructions before helping to build the aqueduct.

Visitors generally worked on constructing the aqueduct in pairs or groups, rarely collaborating with visitors outside their familiar social group. Most adults and children who attempted to build the aqueduct together successfully completed the activity. When parents or other adults helped, children were more likely to successfully complete the task. Adult visitors who approached the exhibit without children did not try the activity.

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\* The evaluator attempted to track repeat users of the exhibits to avoid counting them more than once; however, the total number of visitors observed likely includes some repeat users for each exhibit.

## HOW VISITORS USED THE BUILD A MASONRY AQUEDUCT EXHIBIT

Children and adults were drawn to Build a Masonry Aqueduct, often calling other group members over to help them build or, if pre-constructed, knock down the structure. Constructing the aqueduct was most often a shared or collaborative experience. Nearly all children who began the activity independently enlisted the help of parents, siblings, and/or friends. In contrast, adults who approached the exhibit on their own viewed the exhibit but did not begin the activity. Instead, they either walked away or brought over children in their visitor groups.

Regardless of age, visitors did not intuitively understand how to build the aqueduct. Most adults began by watching their children, then viewed or read the instructions aloud and waited until their children looked like they needed or requested assistance before joining them. While all children immediately began to deconstruct or build the structure upon approaching the exhibit, most children age 8 years or older stopped usage either to read or to listen to the instructions or to watch others do the activity. Most children 7 years old or younger experimented with touching or moving pieces before asking the adults and/or older children accompanying them, “What is this?” After the structure was identified, younger children needed an adult or older child to lead them through the activity, step-by-step. A few groups of children without adults began building their own creations (e.g., a tower) or randomly stacking pieces.

All visitors started building the aqueduct from scratch, knocking down any part of the structure left standing by other visitors. Visitors who did not read the instructions first often started building without pushing in the buttresses and/or without using the orange support pieces. However, many quickly corrected such mistakes, following the step-by-step instructions from then on. All successful visitors referred back to the panel images and/or instructions at least once to review any given building step. As children proceeded through the steps, most experienced some frustration (e.g., partially constructing an arch and knocking it down; attempting to place the same piece in multiple directions and saying, “I can’t do this.”). Visitors of all ages often had difficulty understanding in which direction to place the four dark gray pieces, despite the arrows on them. Visitors also frequently confused the direction in which to place the light gray pieces—despite visible differences in shape—to form the arches. However, most visitors who failed to complete the aqueduct ended the activity owing to lack of time or distractions from non-participating group members, not to frustration or inability.

Upon successfully completing the activity, most visitor groups left their aqueduct standing. Several knocked it down intentionally before walking away, although a few others did so accidentally.

## GROUP DYNAMICS

Most often, adults and children constructed the aqueduct together. Usually one or two children would approach the exhibit, begin deconstructing or building the aqueduct, and then invite adults and/or other children in their visitor group to join them. A few times, a gallery docent approached and offered assistance to visitors using the exhibit. The docent directed adults and children in their completion of steps, often explaining some basic exhibit-related content. For example, one docent introduced a child to the term, “keystone,” and demonstrated what happens when a keystone is removed from an arch.

Nearly all parents and other adults coached children in their visitor groups throughout the building process. Most directed rather than probed children toward the next steps (e.g., “Now you need to start building with the little side in and the big side out.”), although a few encouraged children to take the lead in building (e.g., “Tell me what you think we should do next.”). Many adults physically assisted children only when needed; for example, holding a piece of an arch in place while the child added more pieces. Adults in visitor groups who completed the aqueduct encouraged children to work through problems



(e.g., “We’re almost done; c’mon, you can do it!”), whereas adults in unsuccessful groups often expressed frustration when children did not follow directions (e.g., “You’re wrecking it! Stop!”).

Among visitor groups who completed the aqueduct, nearly all tested the aqueduct’s stability by removing the orange arch supports. Most parents and other adults praised their children’s accomplishments (e.g., “You did it; great job!”). Many also expressed approval in other ways, including photographing children with the aqueduct, exchanging “high fives,” and clapping for them. Children, including teenagers, expressed pride in their success (e.g., “Wow! Let’s leave it standing so everyone can see we did it right.”) and amazement when the aqueduct remained standing without support (e.g., “No way! This is the coolest thing ever; if you pull out the sides it stays up!”). Children often asked to do the activity again but adults did not allow them to do so, citing a lack of time or the need to give other visitors the opportunity to build the aqueduct.

### SCIENCE-RELATED CONVERSATIONAL TRENDS IN A HISTORY SETTING

The evaluator identified a variety of conversational trends among visitors using Build a Masonry Aqueduct, including a few related to learning science in a history setting (see Table 17 on the following page). It was most common for visitors, primarily adults, to use building- and/or engineering-related language to introduce the activity (“Do you want to build a bridge?”) and/or upon completion to explain its significance (“These are called keystones; the middle ones that hold all the weight.”). Similarly, adults typically used canal-related language to explain the exhibit to children (e.g., “It’s an aqueduct. It carries boats and water.”).

Throughout the activity, adults and children used descriptive (e.g., big, gray, strong, etc.), often mathematical (e.g., center, shape, side, etc.) language when referring to or describing a specific part of the aqueduct. They frequently used these descriptive and/or mathematical words when collaborating with other visitors (e.g., “Where are those two orange pieces?”). Nearly all adults and many children also combined such words with instructional language (e.g., first, look, next, etc.) to coach each other through the multi-step process. For example, visitors often talked each other through the steps, describing which panel image to imitate or which part of the aqueduct to use next.

Many visitors used language referring to problem solving as they constructed the aqueduct. For example, visitors often experimented by placing pieces several ways before correctly constructing the aqueduct’s arches. Adults often encouraged children to continue problem solving (e.g., “What’s the problem? You can fix it.”), while children expressed pride when they successfully solved a problem (e.g., “I figured it out! This one’s in the wrong place.”). Visitors also challenged each other to test their problem-solving abilities as builders when they completed the aqueduct (e.g., “Let’s test it to see if we’re good builders.”).

**TABLE 17**

**CONVERSATIONAL TRENDS: BUILD A MASONRY AQUEDUCT STATIONED OBSERVATIONS**

Conversational Trend	Word or Phrase	Example
Building- and/or Engineering-related	Abutment, Arch, Brace, Bridge, Build, Force, Foundation, Keystone, Lift, Line up, Move, Pressure, Pull, Push, Slide, Stand up, Support	<ul style="list-style-type: none"> <li>- The arch needs a brace to hold it up.</li> <li>- Do you want to build a bridge?</li> <li>- You have to build a foundation.</li> <li>- If you pull the side supports out, it stands up.</li> <li>- These are called keystones; the middle ones that hold all the weight.</li> <li>- See how the pressure keeps them all together?</li> </ul>
Canal-related	Aqueduct, Boats, Canal, Mountain, River, Valley, Viaduct, Water	<ul style="list-style-type: none"> <li>- It's an aqueduct. It carries boats and water.</li> <li>- It's a canal on top with a river underneath.</li> <li>- There's a valley so the boat needs to go across from one mountain village to another.</li> </ul>
Descriptive	Big, Fat, Filler, Flat, Gray, Heavy, High, Little, Long, Orange, Pointy, Strong	<ul style="list-style-type: none"> <li>- I'm placing these skinny edges down flat.</li> <li>- The fat side should be facing out.</li> <li>- Where are the little pointy ones?</li> <li>- I want to use this big piece to make it strong.</li> </ul>
Instructional	First, Follow directions, Last, Look, Next, Notice, Now, Second, See, Start, Step, Watch, Wait	<ul style="list-style-type: none"> <li>- First you have to put on the bottom part.</li> <li>- We need to follow the directions.</li> <li>- Look over here; it should look like this.</li> <li>- Wait! What's the next step?</li> <li>- Let's see how much we can take away without breaking it.</li> <li>- Watch what he's doing.</li> </ul>
Mathematical	One, Bottom, Center, Curve, Four, How many, Middle, Shape, Side, Straight, Top, Two, Trapezoid	<ul style="list-style-type: none"> <li>- This one is shaped like a trapezoid.</li> <li>- Put that in the center; there are two of them.</li> <li>- How many do you have? Four of these?</li> <li>- Notice how this one has that side curve?</li> </ul>
Problem-solving	Challenge, Figure it out, Fix it, Problem, Right, Test, Try again, Wrong	<ul style="list-style-type: none"> <li>- I figured it out! This one's in the wrong place.</li> <li>- What's the problem? You can fix it.</li> <li>- Let's test it to see if we're good builders.</li> <li>- Oh, you were right and I was wrong.</li> </ul>

## MODEL CANAL SYSTEM EXHIBIT

### VISITOR DEMOGRAPHICS

A total of 260 visitors approached and/or used the Model Canal System during four one-hour observations (two hours in the morning and two in the afternoon). More than one-half of observed visitors were children (18 and under) and less than one-half were adults (60 percent and 40 percent, respectively). Fifty-six percent were female and 44 percent were male.

About one-third of the children ranged in age between 8 and 12 years (34 percent), which was equal to the number of children age 5 to 7 years (34 percent). Children age 4 and under followed, comprising 24 percent of all children, while teenagers age 13 to 17 years made up the remaining eight percent. More than three-quarters of the adults were between the ages of 25 and 54 years (78 percent). Adults age 55 and older made up the remaining 22 percent.

### OVERALL RESPONSE

Children, playing together with adults, other children, and/or independently, were the primary users of the Model Canal System. Accompanying adults verbally and, if necessary, physically guided children through the activity. Many children used the canal section under observation (i.e., “Farm Town”) multiple times, including some who returned to the area alone or in child-only groups after initially navigating their boats with adult assistance. In contrast, the evaluator observed adults using the exhibit only when accompanied by children—rarely navigating their own boat and typically ending the exhibit experience before children were ready to stop playing.

Most visitors used the Model Canal System in pairs or groups, occasionally collaborating with visitors outside their familiar social group. Some adult-led visitor groups left the gallery when forced to interact with others owing to overcrowding, although a few of these groups returned at a later time. In contrast, a few children individually using the exhibit initiated interaction with unrelated children and/or adults close by.

### HOW VISITORS USED THE MODEL CANAL SYSTEM EXHIBIT

Docents greeted visitors entering the gallery, encouraging hand-washing and providing brief verbal instructions before they used the Model Canal System. Nearly all visitor groups followed these instructions by selecting boats and cargo and navigating the canal from its center toward either end (i.e., Farm Town or Port City). All children began the activity accompanied by adults, although a few adults accompanying children age 8 and older left almost immediately to sit on benches in the gallery and observe from a distance.

Regardless of age, most visitors did not intuitively understand how to navigate the canal’s multiple series of locks. Some learned how to operate the locks through hands-on, one-on-one interactions with docents. These visitors then modeled correct usage, which the majority of visitors, in turn, observed and imitated. Several adults also referred to instructional signage featured throughout the exhibit. Most adults stood beside or behind their children to verbally and, if necessary, physically guide their navigation of the locks and other major interactive components (i.e., the incline plane, aqueduct, etc.).

Upon completion of the canal section under observation, nearly all children continued or asked to continue their exhibit experience. The majority immediately picked up their boats and walked back to the central starting point of the Model Canal System to repeat the journey to Farm Town or to try heading in the opposite direction toward Port City. Some others turned their boats around and retraced their water route back to their initial starting point. However, some children left the gallery or approached other *Waterworks* exhibits, typically after adults in their visitor group denied requests to continue the exhibit experience.

## GROUP DYNAMICS

Group usage without docent assistance in the section of the Model Canal System under observation followed a similar pattern. First, nearly all children immediately placed their boats in the canal without viewing any instructional exhibit signage. Instead, most children and accompanying adults briefly watched other visitors using the canal, while several adults did read signage. Then, most adults verbally guided children step-by-step through their first encounters with the incline plane followed by a series of locks. Additionally, adults accompanying children age 7 years and younger often physically demonstrated and/or assisted with the completion of these activities. Next, children of all ages typically took the lead in navigating their boats through the second round of locks with verbal encouragement from adults and, if necessary, physical assistance. Finally, children age 5 years and older, along with a few age 4 years and younger, independently navigated their boats through the canal and across the aqueduct into Farm Town. After mastering operation of the locks, some children verbally or physically assisted other children in “locking through.”

Among groups assisted by docents, children and adults first observed and/or participated in a hands-on demonstration by the docent (e.g., how to use the incline plane or operate a lock), then exhibited a usage pattern similar to that observed in other visitor groups.

## SCIENCE-RELATED CONVERSATIONAL TRENDS IN A HISTORY SETTING

The evaluator identified a variety of conversational trends among visitors using the Model Canal System, including a few related to learning science in a history setting (see Table 18 on the following page). Overwhelmingly, science-related visitor conversations focused on the canal’s locks. Children and adults similarly coached others through the multi-step process of operating a lock (e.g., “Close the doors, wait until the lock fills up, then let some water out.”), whereas adults usually explained how locks work (“e.g., Close the gate so everything equalizes inside and your boat can pass through to the next lock.”). Although visitors also discussed two other major components of the canal (i.e., the aqueduct and the incline plane), neither of these components compared with the locks in terms of generating science-related conversations.

Throughout the activity, visitor conversations also reflected the canal’s history setting by referencing exhibit elements related to people or places. Children and adults often described the destinations of the canal boats (e.g., “This is the farm town where you unload your stuff.”) and people or roles related to canals (e.g., “Here, let me operate this for you. I’m the lockmaster.”). Several children engaged in imaginary play-related conversations—by themselves or with other children—that connected the canal to people, but not always in a historically accurate way. For example, one child narrated his boat’s journey to Farm Town with imaginary conversations among passengers.

Many adults positively reinforced children’s attempts to independently use the canal, and praised them upon successful navigation of major interactive components, such as through a series of locks (e.g., “Way to go, you did it!”). On the other hand, a less positive trend emerged among conversations between adults and children. When children expressed interest in continuing their exhibit experience, some adults denied their request, often repeatedly (e.g., “Put your boat back and let’s go to the trains.”). A few children refused to obey the adults and continued playing, and a few others cried or argued before leaving the exhibit.

While using the Model Canal System, children of all ages expressed pride in their accomplishments, often inviting adults or other children in their social groups to watch their boat’s passage over the aqueduct, for example. Furthermore, several verbally assisted other children, whether in their social group or not, in navigating the canal without prompting. Several children also reprimanded children in their immediate area who incorrectly used the exhibit (e.g., “You have to wait until my boat is through. You have to follow the rules.”). In contrast, few adults, including docents, enforced exhibit rules when children misused the exhibits—such as opening all the gates to flood a series of locks or navigating their boat in the opposite direction of other visitors.

**TABLE 18**

**CONVERSATIONAL TRENDS: MODEL CANAL SYSTEM STATIONED OBSERVATIONS**

Conversational Trend	Example
Aqueduct-related	<ul style="list-style-type: none"> <li>- See, sometimes the canals went over valleys in a bridge filled with water called an aqueduct.</li> <li>- I'll be darned. I didn't know they had water-filled bridges.</li> <li>- This is an aqueduct; it carries the canal over the stream.</li> </ul>
Lock-related: How to operate a lock	<ul style="list-style-type: none"> <li>- See, you have to put the boat in the lock, close [the gate], then open this one.</li> <li>- Close the doors, wait until the lock fills up, then let some water out.</li> <li>- You have another lock to go through. Lock it up, watch the boat go down, open the door, out it goes.</li> </ul>
Lock-related: Why a lock works	<ul style="list-style-type: none"> <li>- Close the gate so everything equalizes inside and your boat can pass through to the next lock.</li> <li>- What you have to do is go in the lock, raise the water up to the right level, then flow through. That's how locks work.</li> <li>- That's pretty clever. See how the water is up high on this one? Ease up and let your boat go in [the lock]. Now let the water out of this. There goes the water, and once it's level you can move through. Close the door behind you.</li> </ul>
Incline Plane-related	<ul style="list-style-type: none"> <li>- The boat goes down there, then hits the locks.</li> <li>- Now we can go back and go uphill or downhill.</li> <li>- Keep turning: 1,2,3,4,5,6 turns. Three more, there you go!</li> </ul>
Enforcing exhibit rules	<ul style="list-style-type: none"> <li>- You cannot do [the lock] like that. If you don't know how, I can show you.</li> <li>- You have to wait until my boat is through. You have to follow the rules.</li> <li>- No splashing!</li> </ul>
Adults ending children's exhibit experiences	<ul style="list-style-type: none"> <li>- We are done. Let's go see something else.</li> <li>- Put your boat back and let's go to the trains.</li> <li>- We have to go. There's more to see [in the Museum].</li> </ul>
Imaginary play-related	<ul style="list-style-type: none"> <li>- Vroom! Vroom! [boat noises]</li> <li>- Whoa! Here we go—whee!</li> <li>- Oh no! My people fell overboard and want their money back.</li> <li>- What about the mule?</li> </ul>
Positive Responses to Exhibit Use	<ul style="list-style-type: none"> <li>- That is how the canal works; you are so smart.</li> <li>- Good, now do it again for the next lock. Do you understand?</li> <li>- Wow! You are doing a great job.</li> <li>- Way to go, you did it!</li> <li>- That was cool; I want to do it again!</li> <li>- Come see! I'm going back up now!</li> </ul>
People- or place-related	<ul style="list-style-type: none"> <li>- Careful! You're going to lose your cargo.</li> <li>- Here, let me operate this for you. I'm the lockmaster.</li> <li>- This is the farm town where you unload your stuff.</li> <li>- There goes George Washington!</li> </ul>
Reading signage	<ul style="list-style-type: none"> <li>- Did you know one mule could pull a whole load of cargo?</li> <li>- Oh cool, what does [the sign] say? Read the rest of it.</li> <li>- [The sign] says to put your boats in, one at a time, then shut the lock.</li> </ul>

## BIG GEAR REDUCER/ TILLER STEERING EXHIBITS

### VISITOR DEMOGRAPHICS

A total of 196 visitors approached and/or used one or both of the two exhibits—Big Gear Reducer and Tiller Steering—during four one-hour observations (one hour in the morning and three in the afternoon). Owing to their close proximity, the two exhibits were observed simultaneously. Nearly two-thirds of observed visitors were children (under 18 years) and more than one-third were adults (63 percent and 37 percent, respectively). Fifty-one percent were male and 49 percent were female.

More than one-third of the children ranged in age from 5 to 7 years (37 percent), followed by children ages 8 to 12 years (31 percent), children ages 4 and younger (23 percent), and teenagers ages 13 to 17 years (9 percent). More than three-quarters of the adults were between ages 25 and 54 years (78 percent), while adults ages 55 and older made up the remaining 22 percent.

### OVERALL RESPONSE

Children and adults, working together and independently, were the primary users of both the Big Gear Reducer and Tiller Steering. Nearly all visitor groups used first one exhibit, then the other—the order determined by the direction from which they first approached. Visitor groups under observation typically engaged with Big Gear Reducer and/or Tiller Steering for 30 seconds or less per exhibit.

Most often, an adult verbally led the Big Gear Reducer activity and/or explained its significance to other group members, including children and/or other adults. Likewise, an adult typically led visitor groups of all ages in using Tiller Steering. Although children almost always initiated and ended usage of the exhibits, few used either one without adult assistance. While adults most often used the two exhibits accompanied by children, some stayed behind to continue usage after their children moved on to other exhibits. Additionally, several adults without children approached and used the exhibits alone or with other adults.

Most visitors used Big Gear Reducer and Tiller Steering in pairs or groups but none collaborated with visitors outside their familiar social group. Occasionally, visitors stood off to the side, waiting for one of the exhibits to become available and observing others' usage. A few times, children played in the Tiller Steering exhibit area while children from other visitor groups “steered” the boat; however, no one initiated interaction with unrelated children and/or adults close to them.

### GROUP DYNAMICS

#### *BIG GEAR REDUCER*

Visitors of all ages typically expressed curiosity when they first approached the Big Gear Reducer. Most children and adults alike tried turning one wheel, and sometimes the other as well, at which point those alone invited or were joined by others from their visitor group to help turn both wheels simultaneously. Many adults read aloud the exhibit's signage by asking, “Which one is stronger?” before or while their group turned the gears' wheels.

Most users continued working together beyond this initial experiment to answer the question by taking turns using the two gears, watching the gears turn, reading aloud signage, and/or discussing the exhibit's significance. Among visitors who “competed” with others in their visitor group to determine which gear was stronger or to test their strength, nearly all laughed and/or joked during usage, especially groups in which younger children “won” against older children or adults. Most visitors who competed against each other indicated understanding that the smaller gear (i.e., the blue wheel) was “stronger” than the larger gear (i.e., the red wheel), although such competitions did not all result in visitors' further discussion of the exhibit's significance.

### **TILLER STEERING**

Nearly all children demonstrated interest in the boat by immediately jumping onto its deck and attempting to use the tiller without asking for assistance or reading instructions. However, most visitors, regardless of age, immediately demonstrated understanding that the exhibit represented a boat, often referring to the exhibit as such. Adults in family groups provided accompanying children with verbal instruction and, for those ages 4 years and younger, often physically guided their exhibit use. Children engaged in little, if any, conversation with adults or other children during their exhibit experience. Instead, they focused on operating the boat's tiller.

### **SCIENCE-RELATED CONVERSATIONAL TRENDS IN A HISTORY SETTING**

#### **BIG GEAR REDUCER**

Although visitors spent more time doing the activity than they did talking about it, most engaged in conversations at some point while using the Big Gear Reducer. Despite visitors' typically brief encounters with the exhibit, the evaluator identified several conversational trends among visitors doing the activity. Nearly all these trends related to learning science, but not with regard to a history setting. Specifically, visitors identified, compared and experimented with the exhibit's two gears to determine which one was stronger (see Table 19 on the following pages).

Younger children often started their exhibit experience by asking adults or older children to identify the gears (e.g., "What are those?"). In contrast, most adults and older children immediately began talking through the process of determining which gear was stronger. They did so by reading aloud the question (i.e., "Which gear is stronger?") displayed on accompanying signage, comparing the gears' sizes (e.g., "See the big gear and the little gear?") and/or comparing the gears' rotational speeds (e.g., "This one's slow and that one's fast."). Children and adults alike encouraged each other to experiment with the gears by redirecting their rotational spin, taking turns using both gears, and challenging each other's strength.

During such brief, focused conversations, the majority of visitors correctly identified the smaller gear as the stronger of the two. They directed each other's usage and pointed out the outcomes (e.g., "Try the other one, Mom! . . . See, the little one is stronger.") Most visitors did not continue the conversation after completing the activity; however, some indicated they read signage next to determine why the smaller gear was stronger by either closely viewing labels or paraphrasing the written explanations (e.g., "[The sign] says that one person turning slow here can overpower the others because..."). A few adults responded to children's questions about why the smaller gear was stronger without referencing signage.

Visitors did not indicate they identified the exhibit with any aspect of canal history, except for one adult couple. This couple engaged in conversation with a docent at length about how using gears made it possible for women and children to operate canals by easily opening and closing gates via a "doghouse."

### **TILLER STEERING**

Despite visitors' typically brief encounters with the exhibit, the evaluator identified several conversational trends among visitors doing the activity. Most of these trends related to learning science in a history setting, primarily regarding identification and/or operation of the canal boat (see Table 20 on the following page).

Children of all ages focused on using Tiller Steering rather than talking about it, whereas adults did the opposite. Adults initiated most conversations relating to the boat and/or how to operate it. For example, adults used boat terminology to direct children's attention (e.g., "You are standing starboard."), although a few children identified specific boat areas or parts by name after reading labels (e.g., "Hey Mom! This is called the bow."). Adults and some older children directed children's use of the tiller, explaining how to steer the boat (e.g., "When you push one way, the bow goes the other way, get it?"), and yet no one referred to the tiller by name.

Many adults also explained to children how to move the tiller more easily; however, their explanations were limited to describing how to operate it and to identifying the best method for doing so. For example, when children experienced difficulty moving the tiller while holding it at the red line, adults instructed them to move their hands to the blue line (e.g., “If you try pushing it on the blue line it’s easier.”). Several encouraged their children to try both ways for comparison, which resulted in children correctly saying that using the blue line was easier. However, no one said the blue line was further out on the tiller handle than the red line or explained that its location provided more leverage. As a result, most conversations ended once children understood how to steer the boat and what was the best method for doing so.

Several younger children engaged in pretend play relating to the boat and/or water while using the exhibit, and their verbal engagement reflected this (e.g., making boat noises). Additionally, a few adults referred to the canal specifically in conversations rather than generally referencing a boat and/or water (e.g., “Can you steer the canal boat?”).



**TABLE 19**

**CONVERSATIONAL TRENDS: BIG GEAR REDUCER STATIONED OBSERVATIONS**

Conversational Trend	Example
Basic Identification of Gears	<ul style="list-style-type: none"> <li>- *What are those? **Oh, these are gears, just like the gears you have at home.</li> <li>- *What's this? **Gears. *Can I play with them?</li> <li>- Look at this: 'Which gear is stronger?' I want to try it.</li> </ul>
Size Comparison of Gears	<ul style="list-style-type: none"> <li>- Which gear do you think is stronger: the bigger one or the smaller one?</li> <li>- Watch the gears spin; they're different sizes.</li> <li>- See the big gear and the little gear?</li> </ul>
Speed Comparison of Gears	<ul style="list-style-type: none"> <li>- Okay, get that [gear] spinning as fast as this one and watch!</li> <li>- Watch the gears. See how I'm turning this one, how fast it's going? Now turn yours.</li> <li>- Ooh, I can't do it! This one's slow and that one's fast.</li> </ul>
Experimenting With the Direction of Gears	<ul style="list-style-type: none"> <li>- Come here! Turn that wheel. There you go! Now try counterclockwise.</li> <li>- Turn it the opposite direction; I'm going left, you go right.</li> <li>- *[Grunting.] I can't do it. I was really trying! **Try turning it to the right instead.</li> </ul>
Taking Turns Spinning Gears	<ul style="list-style-type: none"> <li>- That's not fair! It's time to switch sides!</li> <li>- *Here, do you want to switch [gears]? **Now I can't do this side! [Laughter.]</li> <li>- *Dad, come here! Try to turn this [gear]. **That one's easy. Now both of you come and try turning the blue one while I hold the red one. [Laughter.]</li> </ul>
Testing Personal Strength	<ul style="list-style-type: none"> <li>- *I bet I can move yours! **Alright, alright, stop! [Laughter.]</li> <li>- She's stronger than Daddy! [Laughter.]</li> <li>- *I bet I'm stronger! **Oh yeah? Go ahead and try the red one. You can't turn it!</li> </ul>
Identifying the Stronger Gear	<ul style="list-style-type: none"> <li>- *Try the other one, Mom! **Help! Am I going the wrong way? Stop! *Which gear is stronger? **Yours. *Let's switch. **Ok. *See, the little one is stronger. [Laughter.]</li> <li>- *What am I supposed to do? **You spin that way and I go this way. See, this is stronger [points to smaller gear]. Look how much power is in that little one. *Let's switch [gears]. You're right! I can't do it! [Laughter.]</li> <li>- *Which gear is stronger? **I don't know. *Well, try both! [Each tries both sides.] **That one [points to smaller gear]!</li> <li>- *One of you try the other wheel. Which is harder? **The red one! *Let me try turning it with you. Okay, now let me try this other one by myself. See, that's easier!</li> </ul>
Reading signage	<ul style="list-style-type: none"> <li>- This is easy! See [the sign] says, 'Spinning the smaller gear can overpower the larger gear, which is an example of mechanical advantage. It takes less force to move it. This made it possible for women and children to open the lock gates.'</li> <li>- [The sign] says that one person turning slow here can overpower the others because this gear has a smaller rotation.</li> </ul>
Understanding Why the Smaller Gear is Stronger	<ul style="list-style-type: none"> <li>- *What's it mean? **Well, it means this gear is smaller but it has more force. *So this little gear is actually stronger?</li> <li>- *Look how easy turning that one is for him. **Why is it like that? [Taking turns, laughing.] *I don't know but it's amazing, isn't it?</li> <li>- Do you know why turning the smaller one is easier? It takes less force so you don't have to turn it as often.</li> </ul>
Connecting Gears to the Operation of Canals	<ul style="list-style-type: none"> <li>- *I get it but how does this tie together with everything here? **[Docent] Come over here, this is called a doghouse. They used these gears to open and close the gates on the canal. One revolution and it was turning. So they could work the locks easier. *Oh, so the gears made it easier. That's fantastic! ***I never learned about that. So back then without this, [people] could not operate the canals.</li> </ul>

**TABLE 20****CONVERSATIONAL TRENDS: TILLER STEERING STATIONED OBSERVATIONS**

Conversational Trend	Example
Using boat terminology	<ul style="list-style-type: none"> <li>- You are standing starboard!</li> <li>- Pull the tiller this way.</li> <li>- Hey Mom, this is called the bow!</li> </ul>
Identifying the activity as steering a boat	<ul style="list-style-type: none"> <li>- Oh, look! This is how you steer a boat.</li> <li>- You can steer the boat, see?</li> <li>- Let's go steer the boat!</li> </ul>
Explaining how to steer the boat	<ul style="list-style-type: none"> <li>- You need to look where you're going! Turn around; that's the front end of the boat.</li> <li>- When you push one way, the bow goes the other way, get it?</li> <li>- When you push [the tiller] one way, it goes the other way. See?</li> <li>- See, the boat's going the opposite way from where you're steering it.</li> <li>- *Mommy, come see! **Wow! You just changed direction!</li> </ul>
Explaining how to move the tiller	<ul style="list-style-type: none"> <li>- If you try pushing it on the blue line it's easier. If you try pushing it on the red line, then it's harder.</li> <li>- *It doesn't work, Dad! **Try it here [points to blue line]. Now we're moving!</li> <li>- Try holding it here [on the blue line] instead [of the red line]. See, it's easier that way.</li> <li>- *Try doing it at the red line now. Is it harder? **Yes!</li> </ul>
Engaging in related pretend play	<ul style="list-style-type: none"> <li>- Pretend you're on the boat!</li> <li>- Look, here's our boat. You've got to steer us down the river.</li> <li>- Hurry! Hop on! The boat's leaving!</li> <li>- Child making noises imitating water hitting the side of the boat.</li> <li>- Children making boat whistle noises while moving tiller back and forth.</li> </ul>
Referencing the canal	<ul style="list-style-type: none"> <li>- Look at the video, see? They're steering the boat on the canal.</li> <li>- Can you steer the canal boat?</li> <li>- See the mule on the picture? You need to turn around and face the front.</li> </ul>

# APPENDICES

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REMOVED FOR PROPRIETARY PURPOSES