Impact Planning, Evaluation & Audience Research

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Summative Evaluation:
Q?rius

Prepared for the
National Museum of Natural History
Washington, DC

INTRODUCTION

The Smithsonian's National Museum of Natural History (NMNH) contracted Randi Korn & Associates, Inc. (RK&A) to conduct a multi-method summative evaluation of *Q?rius*, an interactive and experimental learning space that brings the unique assets of NMNH—the science, researchers, and collections—out from behind the scenes. The study was conducted between May and July 2014, soon after *Q?rius* had opened to the public. It sought to measure the impact of *Q?rius* on casual, walk-in visitors—specifically youth (10 – 18 years) and adults (19 years and older). Intentionally, this study does not examine the affects of *Q?rius* on students visiting as part of a school group experience or those who participated in a program. The report is structured for easy use and access as follows:

1. **Executive Summary**
   This section is intentionally brief and intended to be shared with high-level executives with NMNH and the board.

2. **Detailed Summary of Findings by Methodology**
   This section provides a highlight of findings by methodology. It is intended for executive staff or staff outside *Q?rius* who may have additional questions about the results of the study than those presented in the executive summary but do not require the detail provided in the later findings sections (sections 5-8).

3. **Discussion of Findings and Recommendations**
   This section discusses to what extent *Q?rius* is achieving its intended outcomes and provides explicit recommendations based on the evaluation to help *Q?rius* better achieve its outcomes. It should be read by all *Q?rius* staff.

4. **Evaluation Background**
   This section provides context for how the evaluation process unfolded and is intended for those outside of the process who may have questions, such as non-*Q?rius* staff or new *Q?rius* staff.

5. **Timing and Tracking Observations**
   This section is the first of four methodology sections, all describe the methodological protocol and findings. This section is intended for staff who have questions about how visitors spend their time in *Q?rius*. The data are quantitative.

6. **Ethnographies**
   This section is the second methodology section. It is intended for staff who seek a detailed understanding of how the spaces in *Q?rius* are being used. Data are qualitative.

7. **Interviews**
   This section is the third methodology section and is intended for staff who are interested in how visitors make meaning from their *Q?rius* experience and the measured impact of *Q?rius* on visitors. Data are qualitative and quantitative.

8. **STEM Semantics Survey**
   This section is the final methodology sections and is intended for staff who are interested in the measured impact of *Q?rius* on youth's perceptions of STEM disciplines and careers. Data are quantitative.

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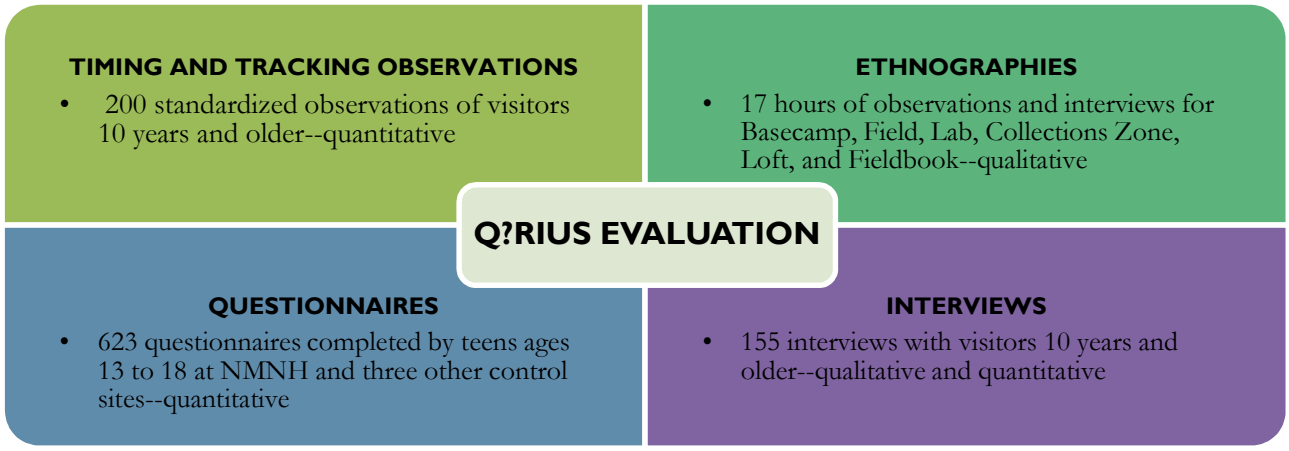
I. EXECUTIVE SUMMARY

The Smithsonian's National Museum of Natural History (NMNH) contracted Randi Korn & Associates, Inc. (RK&A) to conduct a multi-method summative evaluation of *Q?rius*, an interactive and experimental learning space that brings the unique assets of NMNH—the science, researchers, and collections—out from behind the scenes. The evaluation was conducted from May to August 2014, soon after *Q?rius* opened to public. Please keep in mind that this study captures a moment in time, and that *Q?rius* has changed some since the study began. Also note that the focus of the evaluation is on the casual walk-in visitor and does not include the experience of *Q?rius* school groups or visitors attending programming.

METHODOLOGY

Four methodologies were employed in the study: timing and tracking observations, ethnographies, interviews, and questionnaires (see Figure 1). The four methodologies complement each other, and together, they provide a comprehensive understanding of *Q?rius*. For instance, the methodologies in the top half of the figure, timing and tracking observations and ethnographies, describe how visitors are using *Q?rius*; while the methodologies in the bottom half of the figure, questionnaires and interviews, describe the effect of *Q?rius* on visitors. Additionally, the methodologies in the right two quadrants provide rich, detailed qualitative information, while the methodologies in the left two quadrants provide highly standardized numerical information that has statistical value.

FIGURE 1



DASHBOARD

The following page presents a dashboard that summarizes the evaluation results. Findings are not reported by methodology. Findings are presented within four boxes to describe:

1. Who is visiting *Q?rius?*
2. How are visitors using *Q?rius?*
3. What is the effect of *Q?rius* on visitors?—presented by the intended outcomes
4. What do the findings suggest?

WHO IS VISITING *Q?RIUS*?

64% are visiting in intergenerational groups

67% are youth 10 – 18 years

89% are US Residents

51 % are first-time visitors to NMNH

HOW ARE VISITORS USING *Q?RIUS*?

Median time spent:
15 minutes 35 seconds
(Max time: 2+ hours)

Spaces used from most to least (% visitors):

Basecamp (96%)

Collections Zone (63%)

Field (49%)

Loft (14%)

Studio (2%)

Theater (2%)

79% interacted with volunteers/staff/scientists (often in Basecamp and Collections Zone)

<u>Almost all</u> engaged in natural history skills (often observation, collaboration, & using scientific instruments)

WHAT IS THE EFFECT OF *Q?RIUS* ON VISITORS? (PRESENTED BY INTENDED OUTCOMES)

<u>Intended Outcome 1:</u>
Youth & adults value the opportunity to engage with authentic processes & tools, and use objects of natural history research.

★★★★☆

93% enjoyed engaging with natural history objects, tools, & processes

61% recognize the advantages of natural history research

<u>Intended Outcome 2:</u>
Youth & adults explore questions & curiosities by practicing the skills of natural history research.

★★★☆☆

Most engaged in skills of natural history research.

39% identified questions or curiosities they explored in *Q?rius*

<u>Intended Outcome 3:</u>
Youth & adults increase interest in connections between natural history research & current environmental / social issues.

★★☆☆☆

30% are familiar with current natural history topics but no difference by control and treatment

58% expressed interest in natural history research (but no difference by control and treatment)

<u>Intended Outcome 4:</u>
Youth & adults strengthen personal connections to natural history research & the natural world through experiences with experts, researchers, & facilitators.

★★☆☆☆

17% found relevance in interactions with staff, volunteers, & scientists

49% recognize how natural history is relevant to their lives (more repeat than non-repeat visitors)

WHAT DO THE FINDINGS SUGGEST?

Q?rius is awe inspiring; visitors' contact with specimens, scientific tools & processes is memorable and enjoyable and should be maintained.

Since scientists are not at the forefront of visitors' experiences in *Q?rius*, NMNH should consider new ways to emphasize the importance of scientists who study & learn about natural history

NMNH should consider how to push visitors beyond enjoyment of seeing specimens / using scientific tools to self-awareness and relevance of natural history.

Repeat exposure to *Q?rius* is important because it is a very unique space that visitors have to become used to.

2. DETAILED SUMMARY OF FINDINGS BY METHODOLOGY

The following summary of the summative evaluation of *Q?rius* conducted by Randi Korn & Associates, Inc. (RK&A) for the Smithsonian's National Museum of Natural History (NMNH) provides a more detailed presentation than that presented in the Executive Summary. Findings are presented by methodology. Please see the body of the report for the most comprehensive presentation of data by methodology and the discussion that describes the results as they relate to the intended outcomes of *Q?rius*. Keep in mind that results speak to those of casual, walk-in visitor—not program attendees.

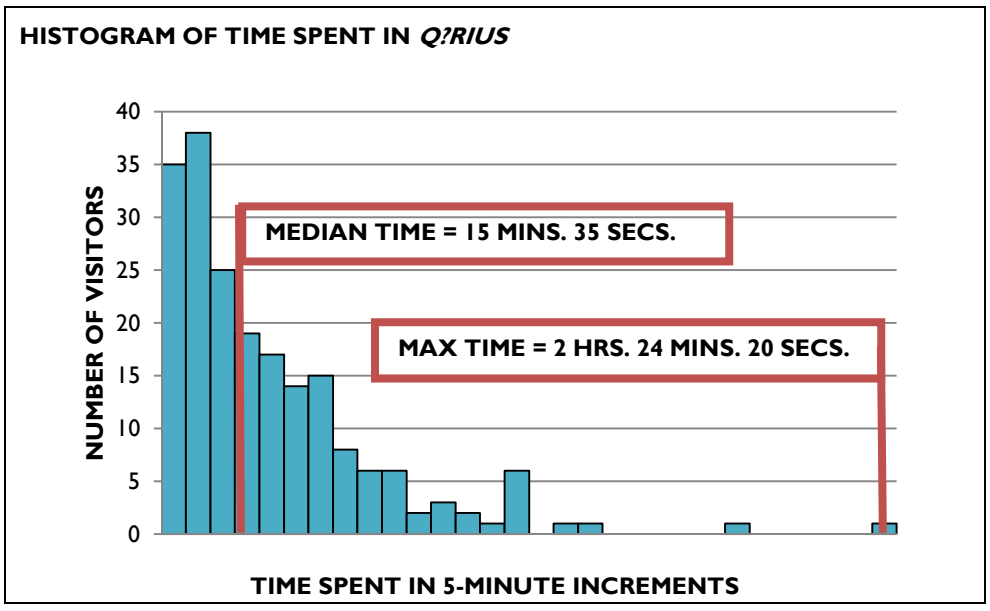
TIMING AND TRACKING OBSERVATIONS

Timing and tracking observations were collected to provide an objective and quantitative account of how visitors use *Q?rius*, including what they do while in *Q?rius*, which components they use, and for how long they use them. RK&A collected a total of 203 timing and tracking observations of visitors 10 years and older who were visiting in family or social groups. Findings were tested by various demographic variables to determine any statistically significant relationships, such as gender, age, and group composition.

OVERALL VISITATION

- **Group Composition**: 64 percent are visiting in intergenerational groups. Another 9 percent were in children/youth-only groups, so they were likely visiting NMNH within an intergenerational group but were not visiting *Q?rius* as such.
- **Time spent**: The median time spent in *Q?rius* is 15 minutes 35 seconds, meaning one-half of visitors spent less time than the median amount, and one-half spent more time than the median, with the maximum time being 2 hours, 24 minutes, and 20 seconds (see Figure 2). **Notably, youth (10 – 18 years) spent statistically more time in *Q?rius* than adults 19 years and older.**

FIGURE 2



- **Sections used**: Out of all visitors, 96 percent stopped at a component in Basecamp, making it the most used section in *Q?rius* (the largest word in Figure 3). Collections Zone was the second most stopped at section (63 percent), followed by Field (49 percent). The Loft was used by 14 percent and the Lab, Studio, and Theater were used by 2 percent each, making them invisible in Figure 3.

FIGURE 3

WORDLE DEPICTION OF SECTIONS VISITED

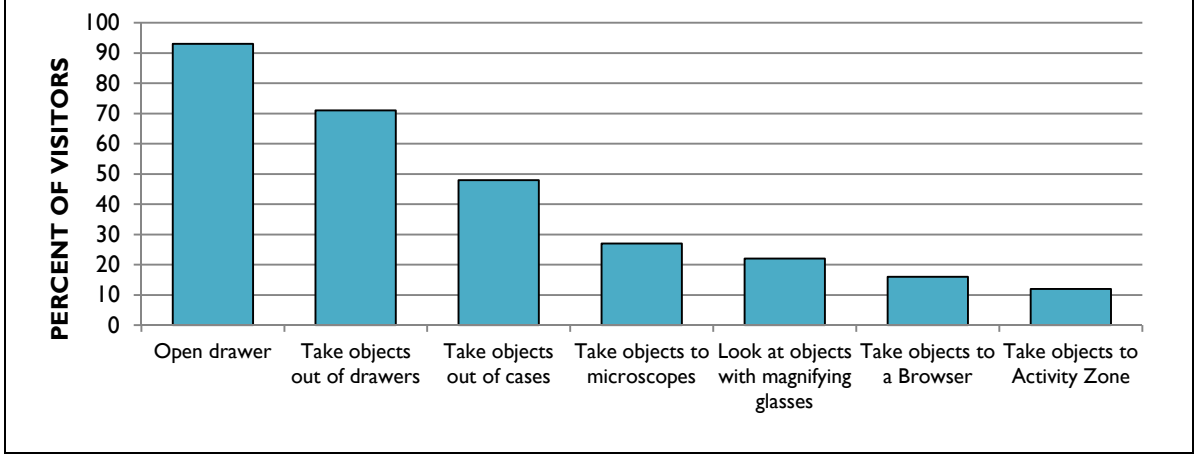
- **Time spent in sections**: Visitors spent the greatest amount of time in the Theater (median time = 34 minutes, 42 seconds), followed by the Collections Zone (median time = 9 minutes, 46 seconds). Median times for the other sections are less than 5 minutes each.
- **Interactions**: 93 percent of all *Q?rius* visitors had at least one interaction with another visitor while in the space. Additionally, 79 percent interacted with a *Q?rius* staff member at least once during their visit, and 4 percent interacted with scientists.
- **Photos**: 25 percent took a photo at least once.

COLLECTIONS ZONE VISITATION

- **Introduction**: 63 percent of visitors who stopped in the Collections Zone received a staff introduction as they entered the space, and of these, 98 percent were told about the object markings used in the Collections Zone (e.g., red, yellow and green tags).
- **Collection activity**: Visitors were active in Collections Zone; they frequently opened drawers (93 percent) and took objects out of the drawers (71 percent) (see Figure 4). The least frequent activities were taking objects to a Browser (16 percent) or Activity Zone (12 percent).

FIGURE 4

COLLECTIONS ZONE BEHAVIORS

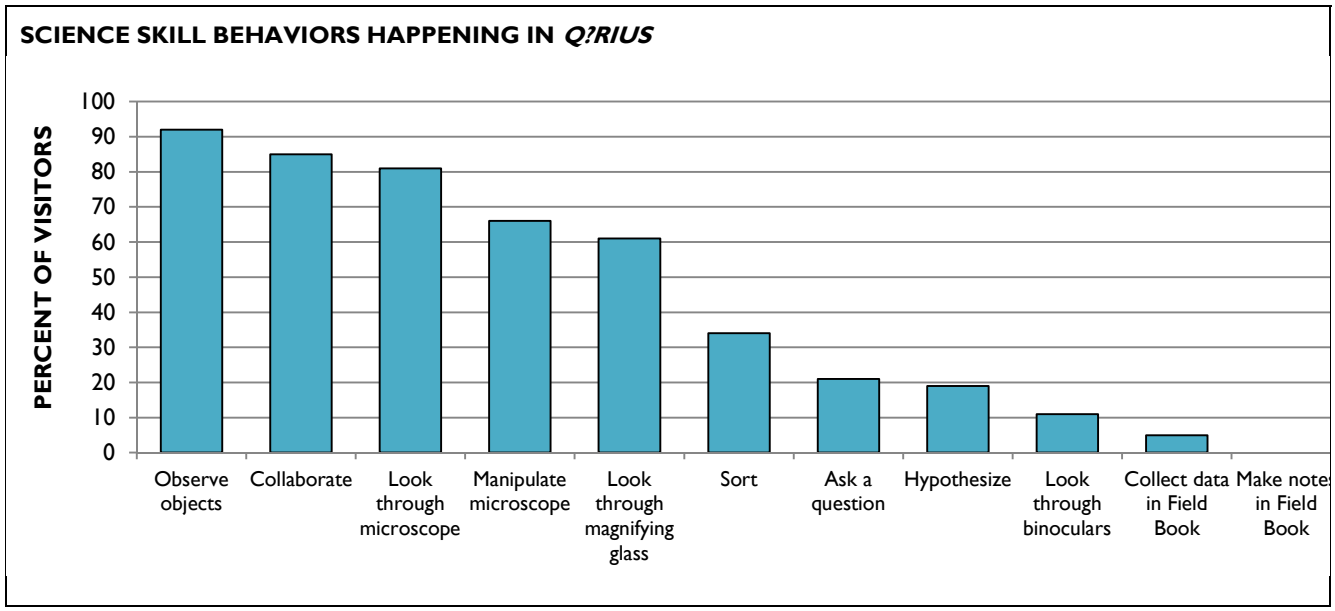


- **Misuse**: There was very little misuse of objects or materials in the Collections Zone; 9 percent opened two or more drawers at once and there were no observed instances of visitors violating the colored tag system or not returning objects to their original drawers.
- **Collections Browser and Activity Zone**: Use of the Collections Zone and Activity Zone Browser was moderate; 32 percent used the Collections Browser and 23 percent used the Activity Zone stations. Of visitors who used each, the median time spent was around 2 minutes each.

SCIENCE SKILLS

- **Visitors to *Q?rius* were often observed engaging in the 11 science skill behaviors.** The three most frequently occurring behaviors are: observing objects (92 percent), collaborating (85 percent), and looking through a microscope (81 percent) (see Figure 5). By contrast, the three least frequently occurring behaviors are: making notes in Field Book (0 percent), collecting data in Field Book(5 percent), and looking through binoculars (11 percent).

FIGURE 5



STATISTICAL DIFFERENCES BY VISITOR CHARACTERISTICS

Visitors' time spent and behaviors were compared by gender, age (youth versus adult), and group composition (intergeneration group, adults-only, versus youth/children-only). Differences include:

- Regarding **gender**, females (versus males) are more likely to stop at Registration.
- Visitors in **intergenerational groups** (versus visitors in adult-only and youth/children-only groups):
  - Spent more time in Basecamp and Collections Zone.
  - Are more likely to stop at components: Hear Insect Karaoke in Basecamp and Reefs Unleashed Field Station in Field.
  - Are more likely to engage with scientific tools including microscopes and binoculars.
- Visitors in **groups that include adults** (versus youth /children-only groups) are more likely to observe objects at least once in *Q?rius*.

- Visitors in **groups that include children** (versus adult-only groups) are more likely to:
  - Hypothesize at least once in *Q?rius*.
  - Take objects out of their cases in the Collections Zone.
  - Take objects to microscopes in Collections Zone.

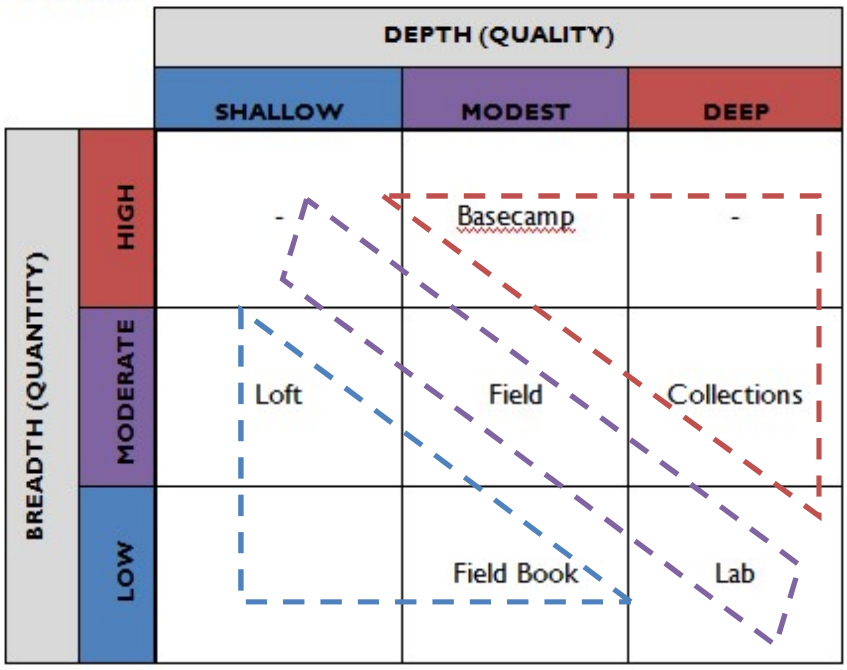
ETHNOGRAPHIES

Ethnographies are a naturalistic data collection method often used in cultural settings to describe cultural phenomena. For this study, we used them to provide an in-depth understanding of how the parts of *Q?rius* provide unique experiences and opportunities for visitors to NMNH. RK&A conducted 17 hours of observations and short-answer interviews to examine the following spaces in-depth: Basecamp, Field, the Collections Zone, Lab, Loft, and Field Book.

SUMMARY

The opportunities in *Q?rius* are intentionally varied and offer various breadths and depths of experience. Broad experiences reach many visitors, whereas deep experiences provide a rich, high-quality experience to fewer visitors (e.g., practice science skills). In Figure 6, we have mapped how the sections of *Q?rius* and the Field Book vary in depth (top of the chart) and breadth (left side of the chart) based on ethnographic observations and timing and tracking results. Basecamp and Collections Zone fared best in terms of either having the highest breadth (Basecamp) or depth (Collections)—indicated in the red, triangle-shaped outline in the upper right corner. By contrast, the Loft and Field Book fared relatively low, being either shallow in depth (Loft) or low in breadth (Field Book)—indicated in the blue, triangle-shaped outline in the lower left corner. Field and Lab are in the middle—indicated by the purple rhombus-shaped outline. Field placed here because the experiences were moderately broad and modestly deep, whereas the Lab offered very deep experiences that reached few visitors, which metered its placement; the Lab also has limited hours, so the low breadth was to be expected.

FIGURE 6



BASECAMP

Basecamp is the first space encountered in *Q?rius*, and as such, is the space where visitors become acclimated to a very distinct type of space within NMNH. Basecamp was highly visited and engagement with its components was generally in-depth. Visitors often interacted within intergenerational groups at the activities and generally did not have trouble using the components. Several interviewees interacted with staff, either short encounters with the greeter or more in-depth ones at components, such as Rocks and Minerals. Use of science skills in this area was particularly high with most visitors practicing observation and using microscopes.

FIELD

Field, located immediately behind Basecamp, is the second space visitors encounter in *Q?rius*. While visitation to the Field was moderate to high, visitors were not using the components to the depth that they were designed to support. For instance, many groups left before completing one entire activity (versus completing all steps at Reefs Unleashed or Decoding Mars). Unlike in Basecamp, there were few interactions with staff or within visitor groups. Positively, the majority of visitors in this section engaged in science skills that require depth of engagement, such as hypothesizing and collaboration.

COLLECTIONS ZONE

The Collections Zone runs along the left side of the first floor of *Q?rius*, separated from the Basecamp and Field activities by a series of drawer units. The Collections Zone was used by a large number of visitors who engaged in many of its offerings. Visitors typically started their visit by looking at the drawers along the right wall upon entering. The majority of visitors started opening whatever drawer was closest or available, while others identified areas that they were interested in to explore or were guided to a certain area by the staff. Visitors' interactions with staff and within visitor groups were high, and there was a mixture of engagement. For instance, some visitors were audibly and visibly excited by the experience ("Wow!"; "Look at this!"; "Cool"), while others were more staid but deep into looking and engaged in quiet conversations with others. Given the number of specimens and tools available to visitors in the Collections Zone, most groups who spent time in the space engaged in observation through examination of the specimens and some used scientific instruments, such as microscopes and magnifying glasses. Moreover, several visitors made hypotheses as they examined specimens. Visitors who looked at specimens under the microscope were most likely to hypothesize; however visitors who were observed looking at specimens in the drawers were also overheard hypothesizing.

LAB

The Lab is a space at the back of the first floor of *Q?rius*. It is enclosed in glass and open to the public at select times for special drop-in activities. The Lab was used by few visitors (almost all intergenerational groups); albeit fairly extensively. Groups spent between 2 to 7 minutes with each of the two activities available at the time of observation, which is a healthy dwell time. All engaged with staff and the conversations at the activities were consistently in-depth. Significantly, all of the groups that used the activity were observed engaging in observation and hypothesizing as they matched species or rocks to their environment.

LOFT

The Loft is the primary space on the second floor of *Q?rius* that features couches, chairs, and tables for visitors to use, as well as books and a Collections Browser that allows visitors to gather information about the items seen in the Collections Zone display cases. The Loft was used by a moderate number of visitors to differing degrees. Groups who used the origami activity available, tended to work in groups and interact with the staff. However, despite the high engagement at origami, science skills were

primarily practiced when groups looked at the Collections Zone display cases, and were observed engaging in observation and some hypothesizing.

FIELD BOOK

The evaluator observed use of Field Book across all of the spaces observed. Field Book use was observed only a few times in Collections Zone where several visitors added items to their Field Books and many added the specimens they searched for using the interface. Several other visitors added specimens to their Field Book while working at the Activity Zone. There were occasions when the Q-card was scanned in Basecamp and Field but these visitors did not save anything to their Field Book. For instance, a few visitors scanned Q-cards at Reefs Unleashed activities but simply clicked through the activities in order to earn credit. Some visitors said they were unaware of the Q-card or the ability to save specimens to it, while others said they were unsure of how to save things. Of those who saved specimens, visitors generally understood that saved items could be accessed online from home.

INTERVIEWS

RK&A conducted 155 in-depth interviews with visitors 10 years of age and older; 78 visitors were interviewed before their visit to *Q?rius*, and a separate sample of 77 visitors were interviewed after completing their visit. Two-thirds of interviewees are youth (10-17 years), and one-third are adults (18 years and older).[1] Questions were open-ended to allow visitors to express their experiences and understandings in their own words. The interviews informed the contents of a scoring rubric that was used to analyze the interviews. Scoring rubrics are useful because they provide a quantitative score to the qualitative data, allowing descriptive results to be measured. In this evaluation, we used a 4-level scoring rubric, where level 1 is "below beginning," and level 4 is "accomplished." **These levels comprise a continuum of achievement; the top half of the continuum includes individuals who scored a 3 and a 4.** In this summary we have only presented the quantitative data but please see the report body for the descriptive narrative and quotations for further context.

Q?RIUS EXPERIENCES

Overall, visitors' experiences are somewhat aligned with what NMNH staff would consider ideal; on three of the six measures related to their *Q?rius* experiences, more than 50 percent of visitors scored at the top half of the continuum (see Figure 7, next page). The three measures of highest achievement are:

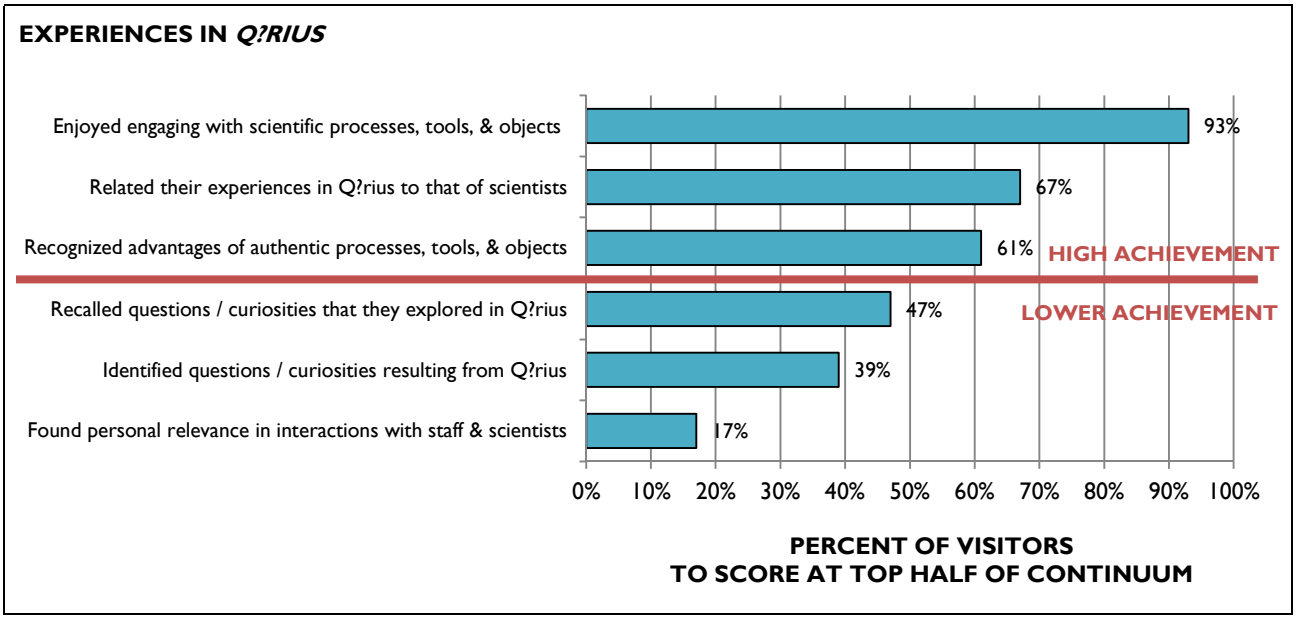
- 93 percent enjoyed engaging with scientific processes, tools, and objects in *Q?rius*.
- 67 percent related their experiences in *Q?rius* to that of scientists.
- 61 percent recognized the advantages of engaging with authentic processes, tools, and objects in *Q?rius*.

The three measures of lowest achievement are:

- 17 percent found personal relevance in their interactions with staff and scientists in *Q?rius*.
- 39 percent identified questions or curiosities that they would like to explore as a result of their experience in *Q?rius*.
- 47 percent recalled questions or curiosities that they explored in *Q?rius*.

[1] The proportion of youth to adults was purposeful; that is, the sampling was done to reach specific quotas of youth and adults.

FIGURE 7



STATISTICAL DIFFERENCES BY VISITOR CHARACTERISTICS

All scores were tested by gender, age (youth versus adult), and NMNH visitation (first-time versus repeat), and three statistically significant relationships emerged:

- Youth (versus adults) are more likely to relate their experiences in *Q?rius* to that of scientists.
- Youth (versus adults) are more likely to identify questions they would like to explore as a result of their experience in *Q?rius*.
- Repeat visitors to NMNH (versus first-time) are more likely to recall questions or curiosities that they explored in *Q?rius*.

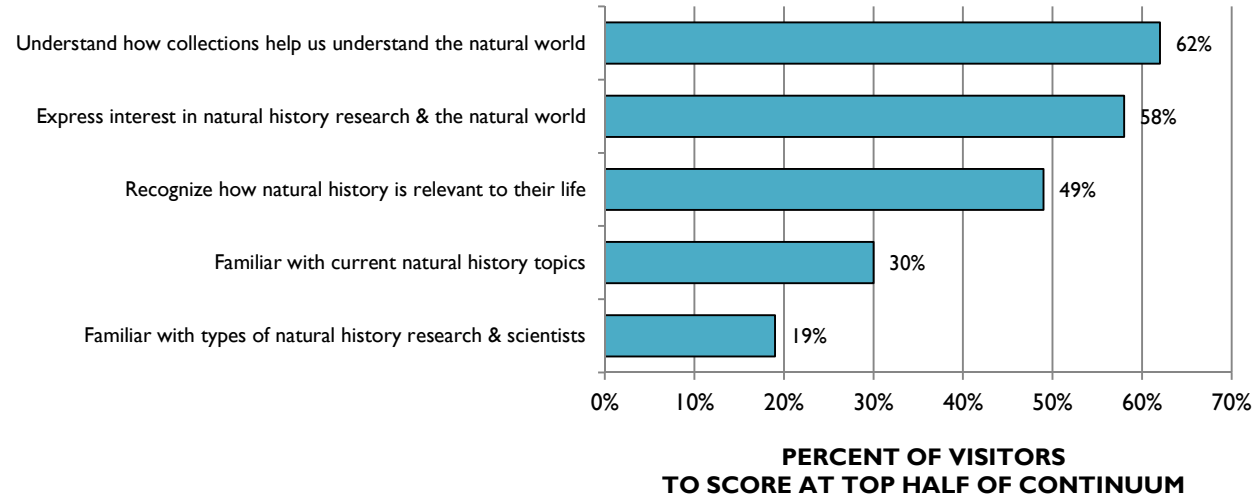
CONTROL AND TREATMENT COMPARISON

Control and treatment groups were asked identical questions, the control group before their visit to *Q?rius* and the treatment group after. Results in the following sections are reported by control and treatment group, but there are no statistical differences in any of the five measures. Therefore, control and treatment results are presented together in Figure 8 (next page). Overall, visitors' familiarity, understanding, and interest in natural history are moderate:

- 62 percent understand how collections are used to understand the natural world.
- 58 percent express interest in natural history research and the natural world.
- 49 percent recognize how natural history is relevant to their life.
- 30 percent are familiar with current natural history topics.
- 19 percent are familiar with types of natural history research and scientists.

FIGURE 8

FAMILIARITY, UNDERSTANDING, AND INTEREST IN NATURAL HISTORY



STATISTICAL DIFFERENCES BY VISITOR CHARACTERISTICS

All scores were tested by gender, age (youth versus adult), and NMNH visitation (first-time versus repeat), and two statistically significant relationships emerged:

- Adults (versus youth) are more likely to understand how collections are used to understand the natural world.
- Repeat visitors to NMNH (versus first-time) are more likely to recognize how natural history is relevant to their life.

STEM SEMANTICS SURVEY

The development of the STEM Semantics Survey was funded by NSF and designed and tested by Knezek and Christensen[2] specifically to assess students' interest in STEM content and careers. RK&A administered the survey to teenagers age 13 to 18 years who were part of a control group (had not visited *Q?rius*) and a treatment group (had visited *Q?rius*). The control group comprises teens recruited at the National Museum of Natural History (NMNH), and the treatment group comprises teens recruited at three Smithsonian Affiliate Museums to obtain a national sample: the Denver Museum of Nature and Science, the Perot Museum of Nature and Science, and the San Diego Museum of Natural History. In all, 623 teenagers completed the survey for an overall participation rate of 71 percent. The sample of 623 respondents is fairly evenly divided between NMNH (53 percent) and Affiliate Museums (47 percent).

RESPONDENTS' BACKGROUND INFORMATION

- **Control and treatment groups are similar demographically**:
  - Two-thirds of respondents are 13 to 15 years of age, and one-third is 16 to 18 years of age. The median age is 14.5 years.
- **Control and treatment groups are mostly similar in background**:

[2] Tyler-Wood, Tandra; Knezek, G; and Christensen, R. (2010). Instruments for assessing interest in STEM content and careers in *Journal of Technology and Teacher Education* 18(2), 341-363.

- Control and treatment groups had taken similar science classes overall.
- More control group respondents (versus treatment group respondents) had taken an Advanced Placement (AP) Science class (25 percent versus 16 percent).

PERCEPTIONS OF SCIENCE

- **Control and treatment groups have some similar perceptions**:
  - Control and treatment groups' perceptions of "science" are relatively favorable.
  - Control and treatment groups' perception of "math" and "engineering" are least favorable among the scientific disciplines asked about.
- **Treatment group respondents have better perceptions of two items**:
  - Treatment group respondents have a more favorable overall perception of "technology" as well as more favorable ratings on three of five specific scales about "technology."
  - Treatment group respondents have a more favorable perception of "a career in science, technology, engineering, or math" on one of five specific scales.

3. DISCUSSION OF FINDINGS

Randi Korn & Associates, Inc. (RK&A) began their work with the Smithsonian's National Museum of Natural History (NMNH) by co-creating an Engagement Framework that describes the intended outcomes for *Q?rius*. The four outcomes identified by RK&A and NMNH for youth and adult visitors to *Q?rius*, as the ideal result of the *Q?rius* experience, serve as the focus of the discussion that follows:

- **Outcome 1**: Youth and adults value the opportunity to engage with the authentic processes and tools and use objects of natural history research.
- **Outcome 2**: Youth and adults explore questions and curiosities by practicing the skills of natural history research.
- **Outcome 3**: Youth and adults increase their interest in the connections between natural history research and current environmental & social issues.
- **Outcome 4**: Youth and adults strengthen their personal connection to natural history research and the natural world through experiences with experts, researchers, and facilitators.

OUTCOME 1 ★★★★☆

The outcome of greatest achievement is: **"Youth and adults value the opportunity to engage with the authentic processes and tools, and use objects of natural history research."** For visitors, engagement with natural history specimens and tools is the hallmark of their visit to *Q?rius*. At a basic level, visitors generally appreciate that *Q?rius* offers hands-on opportunities and activities. And moreover, some visitors noted that *Q?rius* offers unique and distinct opportunities that are beyond simple hands-on interactive experiences.

The presence of real specimens is one key component to what makes the *Q?rius* experience unique for visitors. Many visitors said they know that the specimens in *Q?rius* are real, and the majority of visitors expressed that it is important that these are real or authentic specimens—even though most of visitor's responses are not particularly eloquent or quotable. The lack of eloquence is not surprising though. From countless studies, we have heard visitors describe the importance of being in contact with "real" things because they are "real"; this type of circular logic is not indicative of thoughtlessness though or lack of conviction, but rather an inability to articulate the thrill or feeling of encountering something real.[3]

But, what really makes *Q?rius* unique is that there are real specimens that visitors can *examine and explore*. That is, visitors felt like they can come in greater contact with these real specimens than they could in a traditional museum exhibition. Again, visitors' responses are not particularly eloquent in this regard but "examining" and "exploring" is an underlying thread in responses (see the quotation to the right). Visitors viewed *Q?rius* as offering them access to specimens that they had not expected, particularly for walk-in visitors and teens and youth. Something we found notable and a testament to their appreciation of access is that

> ***I like that you could examine the rocks and this stuff because, at most museums, they don't have this kind of stuff.***
>
> ***[female 10, first-time visitor]***

[3] Stephanie Downey (2014). Reflection 14: Is it real? Retrieved at: http://intentionalmuseum.com/2014/08/14/reflection-14/; Roy Rosenzweig and David Thelen (1998). The Presence of the Past: Popular Uses of History in American Life.

interviewees who said they were not able to spend much time in the space due to time limitations: (a) expressed genuine remorse at not being able to spend more time in *Q?rius*; and (b) took the extra time away from their NMNH visit to participate in an interview about their experiences in *Q?rius* despite having limited time—a sign of their enthusiasm.

OUTCOME 2 ★★★☆☆

Q?rius' achievement on the following outcome is quiet commendable: **"Youth and adults explore questions and curiosities by practicing the skills of natural history research."** Most visitors engaged with the specimens, tools, and processes of natural history research in *Q?rius* and quite often. However, despite being observed engaging with the objects, tools, and processes of natural history research, visitors' self-reflection and acknowledgement that they were doing natural history research by exploring questions and curiosities was low (see the quotation on the right). For instance, as noted above, visitors talked about examining or exploring objects but did not describe these experiences in more explicit scientific terms (e.g., they did not connect their actions to scientists or scientific processes). Forty-seven percent of visitors identified questions or particular curiosities they explored through their actions in *Q?rius*, which also suggests that visitors are going through the motions of "doing science" but they are not approaching the activities with the mindfulness to connect their actions to larger scientific questions or curiosities. Another 39 percent identified questions and curiosities they wanted to explore as a result of *Q?rius*, and these responses often centered around a topic in general and not a specific question or curiosity (see the quotation on the right).

> ***It just made me curious about a lot of these fossils and other things like these rocks and . . . . I always thought they were interesting but it was cool to actually see them and look into the stuff differently than just online or in pictures and videos.***
>
> ***[male 13, repeat visitor]***

For more visitors to grasp the questions and curiosities aspect of this outcome, *Q?rius*—over time and with other support—may be able to deepen visitors' understanding of their actions. That is, visitors to *Q?rius* are expecting a traditional Smithsonian space, which *Q?rius* is not. Visitors to the Smithsonian (like many national museums) are generally there to hit the highlights—Hope Diamond, rotunda, etc.—in a fixed amount of time. But to achieve Outcome 2 (as well as some of the other outcomes), visitors cannot not approach a visit to *Q?rius* like they do other exhibitions. *Q?rius* requires that visitors take their time and think about what they are doing. Museums have trained visitors to behave in a certain way in museum spaces; thus, NMNH may need to temper its expectations until *Q?rius* retrains visitors' notions of what is possible to do and experience in a museum.

Retraining visitors is not hopeless by any means, but staff may need to be patient and reassess their expectations. For instance, in 2008, RK&A evaluated the Dallas Museum of Art's Center for Creative Connections (CCC), an interactive space for all ages in the art museum.[4] The first evaluation of the space identified many barriers to achieving its desired outcomes because visitors needed to become acclimated to the space; now, over five years later, the space is the beloved space that the Museum had envisioned. We see a similar situation facing *Q?rius*. It is new and different, which is fantastic, but visitors' expectations need time to shift and adapt. There is already some evidence that visitors are starting to realize what may be required to fully experience *Q?rius*, such as those visitors who said they wished they had better planned their visit to spend more time in *Q?rius*. It will take time for visitors' expectations to match those of *Q?rius* staff, and as a national museum with a higher proportion of first-

[4] Randi Korn & Associates, Inc. (2008). Summative Evaluation: Center for Creative Connections and *Materials and Meanings* Exhibition. Dallas, TX: Dallas Museum of Art.

time visitors than museums in other cities, it may require greater support from the entire institution (for example, perhaps visitor services staff can help set expectations before visitors walk into the space).

While visitors' expectations may be the most significant barrier to achieving this outcome, there are some other small adjustments NMNH may make to the space to further support this outcome. For instance, signage in Basecamp highlights the behaviors "touch" or "zoom in"—which we understand as intentional since this is a skill-building area—but potentially consider also emphasizing *to what end* these behaviors are being done; some such ideas are embedded into the activities already, but there may be ways to bring them to forefront without overshadowing the emphasis on skill. Alternatively, the Field makes sense as a place to highlight exploring questions and curiosities, but some thought may need to be given to how to increase attraction and dwell time in this area in order to enhance achievement on this outcome.

OUTCOME 3 ★★☆☆☆

One area where *Q?rius* has opportunity to improve is related to the outcome: **"Youth and adults increase their interest in the connections between natural history research and current environmental & social issues."** Visitors are coming in with low familiarity of current natural history topics and moderate interest in natural history research. When visitors were asked to describe natural history in general as well current natural history research, responses were often vague and abstract, and as the conversation ensued, their responses remained vague. For instance, a visitor could explain research in natural history was being conducted in relation to climate change but was not able to identify a specific study or even a type of study (e.g., monitoring ocean levels). Comparisons between control and treatment groups show no difference in familiarity and interest, meaning an experience in *Q?rius* did not move the needle.

We are not surprised by this result; it is one of the most difficult outcomes to achieve, particularly through experiences that we know are lasting about 15 minutes on average and are most characterized by the wonder of experiencing real things—clearly *Q?rius'* greatest asset. Offerings like the Field Book present opportunities to increase interest offsite by saving things to the Field Book, but it is undetermined whether its minimal use is a result of lack of awareness, lack of understanding the purpose of the Field Book, or a general lack of interest, although it seems to be a bit of all three. Because visitors are entering *Q?rius* with such a low baseline in terms of familiarity and interest, there is a terrific opportunity to affect visitors but it will likely have to build on greater achievement of Outcome 4 (discussed below).

OUTCOME 4 ★★☆☆☆

Q?rius has the greatest opportunity for growth as related to the outcome: **"Youth and adults strengthen their personal connection to natural history research and the natural world through experiences with experts, researchers, and facilitators."** While most visitors interacted with volunteers, staff, or scientists in the space to some extent, the percent of visitors who found personal relevance in these interactions is low. Visitors greatly appreciate the assistance and support that volunteers and staff provides, but their exposure to and encounters with these experts, researchers, and facilitators did not affect the *relevance* visitors felt between natural history and their lives (however, repeat visitation was a factor, with repeat visitors to NMNH being more able to describe the relevance of natural history).

The implications for NMNH are to consider how they might further emphasize experiences with experts, researchers, and facilitators in the space. Visitors most remembered interacting with volunteers, staff, and scientists in the space mainly through assistance, such as adjusting microscopes or providing instructions at components (see the quotation on the right) versus remembering scientists featured in the components (at signage or on digital components). Assistance is important in a new and different-looking space like *Q?rius*, (and was greatly appreciated by visitors). It is certainly a stepping stone to helping visitors find relevance, but potentially there are additional strategies that could be used to complement existing ways that volunteers and staff interact with visitors to bring relevance to the forefront. For instance, NMNH might identify comments and questions that volunteers, staff, and scientists could integrate into their interactions (e.g., "Studying specimens like these can be a lot of fun, but why do you think it is important to study them? Can you think of any ways it may be important to you and your life?"). Volunteers, staff, and scientists could also identify strategies to emphasize the scientist's story (e.g., "This scientist (point to scientist in the component signage) studies rocks including these. You can explore these rocks by using the microscope to try to identify minerals in the rocks like the scientist does. While you are doing that, I'd like to challenge you to think about why this scientist studies these things. Why is it important to him or you?') The examples above are rough and may not represent NMNH's implementation preferences, but they suggest that there are many tactics NMNH could take.

> ***I really like how the people at Q?rius ask you questions and they give you examples like, 'Hey, if you do this, then it'll sound a little similar, or if you do this, then it'll look really cool,' or, 'Hey, how about you put this here, and then you can look at it, see little part right there." . . . . And it's really cool because they are experts and they know what happens if you do certain things.***
>
> ***[female 13, first-time visitor]***

Alternatively, NMNH might consider if there is a better vehicle than the "people" of natural history to help visitors make personal connections to natural history research. For instance, we know most visitors valued interacting with authentic specimens. The "real thing" can be quite powerful, as noted previously, and is of greater access to visitors in *Q?rius* than scientists in that there are far more specimens than people. We understand that highlighting scientist's stories is an important part of the *Q?rius* initiative, so perhaps scientists could be presented through the specimens, tools, and processes. For instance, as indicated above, maybe there is a strategy that could connect how this *one specific specimen* that visitors are experiencing is important to this *one particular scientist's research* and how that research in turn is important to that specific visitor in a very concrete and specific way.

CONCLUSION

In its first year of operation, *Q?rius* is doing well. It is a drastically different type of space than other museum spaces, and as such, visitors need to become acclimated to it; from an evaluation perspective (and having knowledge of how many innovative projects have fared), high achievement on all outcomes was neither expected nor realistic. Even so, these evaluation results, like all evaluation results, indicate places where *Q?rius* has the opportunity to strengthen its impact on visitors, such as by reconsidering strategies for helping visitors find relevance in natural history. Changing visitors' expectations for the space is a challenge—one that comes with any innovative endeavor. Allowing for time and exercising patience is vital. Likewise, staff may wish to periodically monitor visitor' changing expectations, behaviors, and experiences and revise activities, staff interactions, and messaging accordingly to bring them into closer alignment with the outcomes. NMNH may also wish to continue to clarify what *Q?rius* is and how it can be best utilized.

RECOMMENDATIONS

The NMNH has already begun modifying *Q?rius* based on staff's experiences in the space and this report. In the coming year, we recommend that Q?rius staff continue to use evaluation to improve what is already a rich experience for visitors. Recommendations include both assessments that NMNH can do internally as well as evaluation they might contract:

- School and Program Experiences—this evaluation did not include visitors in school groups or those who experienced scheduled programs. As such, we recommend that NMNH use resources to understand the experiences of visitors who are exposed to programs, which are carefully coordinated—more so than what is possible to coordinate with casual visitors who are more or less surprised to find all there is to do in *Q?rius*. Observations paired with interviews of program participants may provide the richest data about program experiences; however surveys completed by students or teachers are another option if staff wish to collect baseline information as a precursor to a more in-depth study.
- New or Modified *Q?rius* Components—staff observations can provide valuable assessments of new components or modified components about which NMNH may have questions. We recommend staff or volunteers spend an hour observing visitors using new or modified components. Prior to conducting observations, however, staff should convene to clarify the outcomes of the components so outcomes can serve as a gauge against which one would measure component success. As staff develop new components, we also recommend that they review the Engagement Framework, which represents the larger—higher-order thinking outcomes of *Q?rius*.
- Casual, walk-in Visitor Experiences—this current study focuses on the walk-in visitor experience. If NMNH staff is interested in understanding how *Q?rius* better serves walk-in visitors a year since opening and after modifying the space, we recommend conducting timing and tracking observations and interviews again and comparing the data sets from the two years. RK&A might make minor adjustments to the instruments based on any new thoughts staff have about the intended outcomes identified in this study or their assessment needs for the space.

REFLECTION

One year after the delivery of this report, RK&A facilitated a reflection during one of the *Q?rius* staff meetings. The reflection provided an opportunity for staff to think about the findings again and reflect on the learning that has happened as a result of this study and through living with the *Q?rius* space for almost two years. The outcomes identified in this report are still at the core of staff's work in *Q?rius*, and they have taken several steps to further achievement of these outcomes, through training staff and volunteers to use inquiry when conversing with visitors, remediating components, and increasing collaborations with scientists across NMNH.

4. EVALUATION BACKGROUND

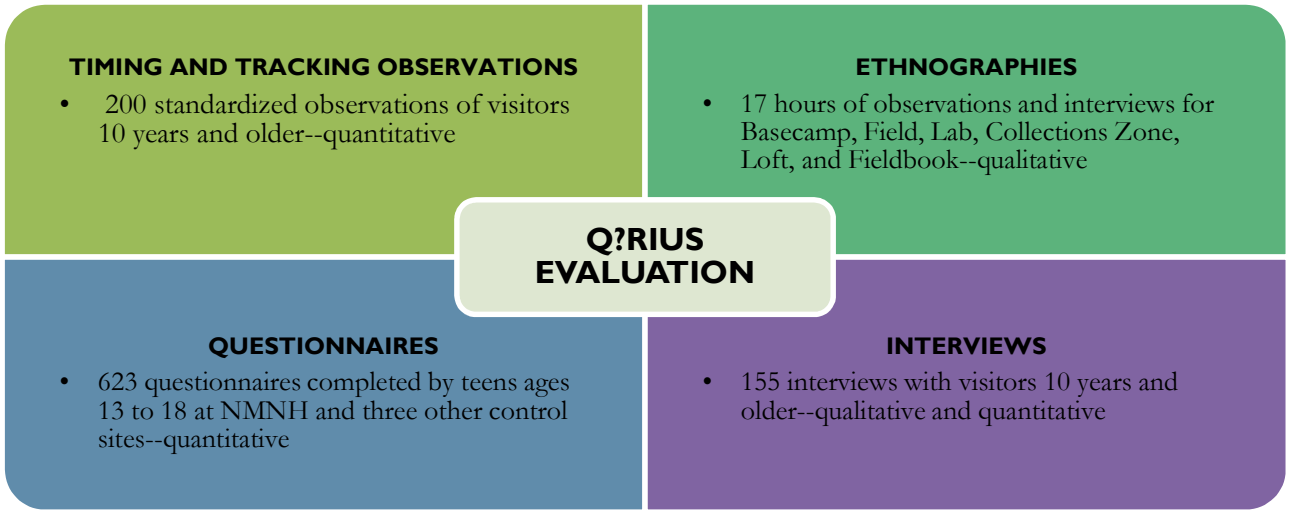
The Smithsonian's National Museum of Natural History (NMNH) contracted Randi Korn & Associates, Inc. (RK&A) to conduct a multi-method summative evaluation of *Q?rius*, an interactive and experimental learning space that brings the unique assets of NMNH—the science, researchers, and collections—out from behind the scenes. The study was conducted between May and July 2014 and sought to measure the impact of *Q?rius* on the following four outcomes for youth (10 – 18 years) and adult (19 years and older) visitors:

1. Youth and adults value the opportunity to engage with the authentic processes and tools, and use objects of natural history research.
2. Youth and adults explore questions and curiosities by practicing the skills of natural history research.
3. Youth and adults increase their interest in the connections between natural history research and current environmental & social issues.
4. Youth and adults strengthen their personal connection to natural history research and the natural world through experiences with experts, researchers, and facilitators.

METHODOLOGY

RK&A conducted a multi-method summative evaluation. See Figure 9 for an overview of the study. The methodologies were selected because they complement each other and provide a comprehensive understanding of *Q?rius*. For instance, the methodologies in the top half of the figure, timing and tracking observations and ethnographies, describe how visitors are using *Q?rius*; while the methodologies in the bottom half of the figure, questionnaires and interviews, describe the effect of *Q?rius* on visitors. Additionally, the methodologies in the right two quadrants provide rich, detailed information, while the methodologies on the left two quadrants provide highly standardized information that has statistical value.

FIGURE 9



EVALUATION DESIGN

Designing a comprehensive evaluation is often a multi-step process that requires much back and forth between the evaluators and their client. RK&A worked closely with NMNH staff prior to the evaluation to ensure that the evaluation was responsive to NMNH's needs. Figure 10 shows the process leading up to collecting data for the evaluation as well as through to the dissemination of results. The items in shades of green indicate initial planning stages for the evaluation. The transition to actual evaluation is indicated in shades of blue and reflection in purple.

FIGURE 10

PREPARE INITIAL SCOPE OF WORK - AUGUST 2013

- RK&A drafted an initial scope of work based on the desires articulated by NMNH in the RFP.

REVISE SCOPE OF WORK - NOVEMBER TO DECEMBER 2013

- After being awarded the project, RK&A met with NMNH and revised the scope of work based on our enhanced understanding of the evaluation needs.

IDENTIFY OUTCOMES - JANUARY TO FEBRUARY 2014

- RK&A facilitated a workshop with NMNH staff to identify the outcomes for *Q?rius*. The outcomes state the intended result of *Q?rius* on visitors.
- RK&A developed an Engagement Framework that includes outcomes and indicators. It was vetted by NMNH but remains a living document.

DESIGN INSTRUMENTS - MARCH TO APRIL 2014

- RK&A designed the instruments based on the Engagement Framework.
- NMNH staff vetted the instruments, and they were reviewed by the Smithsonian's Institutional Review Board (IRB).

CONDUCT EVALUATION - MAY TO JULY 2014

- Data were collected over three months.

SHARE EVALUATION RESULTS - AUGUST TO OCTOBER 2014

- RK&A analyzed all data.
- RK&A prepared a prelimary summary of results for the October board meeting.

REFLECT - NOVEMBER 2014

- RK&A prepared the final report.
- Reflection is an important step in making the evaluation results actionable. RK&A will facilitate a reflection workshop.

LIMITATIONS

Every study has limitations due to constraints such as time and resources. The primary limitation of this study is that it focuses on the casual walk-in visitor—no data were collected from school or program participants. Furthermore, this study took place relatively soon after *Q?rius'* opening so results represent a very specific moment in time, especially when considering that the space is intentionally dynamic versus static and has changed much since this study was conducted.

5. TIMING AND TRACKING OBSERVATIONS

INTRODUCTION

Timing and tracking observations were collected to provide an objective and quantitative account of how visitors use *Q?rius*, including what components visitors use, for how long, and how they behave. Timing and tracking observations are particularly useful because they document visitor behaviors in a standardized manner, which can be analyzed statistically. RK&A collected 203 timing and tracking observations of visitors 10 years and older who were visiting in family or social groups.

METHODOLOGY

RK&A conducted timing and tracking observations in *Q?rius* over approximately two months bridging spring and summer. Timing and tracking observations are unobtrusive, so visitors were not asked to participate but selected randomly upon entering *Q?rius*. To select visitors, the observer imagined a line just inside the entrance to *Q?rius* and selected the first visitor age 10 years and older to cross this imaginary line. Once the visitor crossed the imaginary line, the observer started a stopwatch and unobtrusively followed the selected visitor through the space, recording the components used, time spent, and behaviors (see the Appendix for the timing and tracking form, daily checklist, and a description of the behaviors tracked). When the visitor exited *Q?rius*, the observer returned to the entrance to await the next eligible visitor to cross the imaginary line.

DATA ANALYSIS

Timing and tracking observation data are quantitative and were analyzed using IBM SPSS Statistics Version 20, a statistical package for personal computers. The objectives of the study, as well as our professional experience, were used to inform the analyses, which include descriptive and inferential methods. The Appendix contains a list of all statistical analyses run and reports the raw data.

DESCRIPTIVE STATISTICS

Frequency distributions were calculated for all variables, including visitor characteristics and behaviors. Summary statistics were also calculated for some variables, including total time spent in the exhibition; summary statistics include the range, median (50th percentile, the data point at which half the responses fall above and half fall below) [5], mean (average), and standard deviation (spread of scores: "±").

INFERENTIAL STATISTICS

Inferential statistics were used to examine the relationship among variables. A 0.05 level of significance was employed to preclude findings of little practical significance.[6]

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[5] Medians rather than means are reported in the timing and tracking section of this document because, as is typical, the number of exhibits used and the time spent by visitors were distributed unevenly across the range. For example, whereas most visitors spent a short to moderate time in the exhibition, a few spent an unusually long time. When the distribution of scores is extremely asymmetrical (i.e., "lopsided"), the mean is affected by the extreme scores and, consequently, falls further away from the distribution's central area. In such cases, the median is a better indicator of the distribution's central area because it is not sensitive to the values of scores above and below it—only to the number of such scores.

[6] When the level of significance is set to $p = 0.05$, any finding that exists at a probability (p-value) ≤ 0.05 is "significant." When a finding (such as a relationship between two variables) has a p-value of 0.05, there is a 95 percent probability that the finding exists; that is, in 95 out of 100 cases, the finding is correct. Conversely, there is a 5 percent probability that the finding would not exist; in other words, in 5 out of 100 cases, the finding appears by chance.

To examine the relationship between two categorical variables, cross-tabulation tables were computed to show the joint frequency distribution of the variables, and the chi-square statistic (X^2) was used to test the significance of the relationship. For example, "stop" (yes or no) was tested against "gender" to determine whether components were attractive to a particular gender.

To test for differences in the medians of two or more groups, the nonparametric Kruskal-Wallis (K-W) test was performed.[7] For example, "total time in the exhibition" was compared by "gender" to determine whether time spent in the exhibition differed by gender.

REPORTING

Findings are presented in tables with narrative. Only statistically significant differences by demographics are presented.

DATA COLLECTION CONDITIONS

TIMING AND CROWDING

Observations were collected in May, June, and July 2014. The greatest percent were collected in June (40 percent), and more than one-half of observations were conducted on weekdays (59 percent) (see Table 1). More than one-half of observations were conducted while *Q?rius* was moderately crowded (57 percent).

TABLE 1

MONTH	% OF T&T (*n* = 203)
May	36
June	40
July	25
DAY OF THE WEEK	**% OF T&T (*n* = 203)**
Weekdays	59
Weekend days	41
LEVEL OF CROWDING	**% OF T&T (*n* = 203)**
Few	21
Moderate	57
Crowded	22

[7] The Kruskal-Wallis (K-W) test is a nonparametric statistical method for testing the equality of population medians of two or more groups. Nonparametric statistical methods do not assume that the underlying distribution of a variable is "normal" with a symmetric bell-shape, so they are appropriate for testing variables with asymmetric distributions such as "total time in the exhibition." The K-W test is analogous to a One-way Analysis of Variance, with the scores replaced by their ranks. The K-W test statistic *H* has approximately a chi-square distribution.

ALTERATIONS TO *Q?RIUS*

Q?rius was intentionally designed to be a flexible space in which components could be moved around or swapped in and out. Each day of data collection, the observer recorded any alterations to the space to provide context for the findings. Overall, the alterations were not major. The majority of the time at least one component had a broken or missing part (83 percent) (see Table 2). The majority of the time, the component missing was paper and pencils needed to make observations at I Spy in Basecamp. For explanations of the alterations, see the Appendix.

TABLE 2

ALTERATIONS TO *Q?RIUS*	% OF DAYS (*n* = 35)
Broken or missing parts to a component	83
Components missing	11
Components moved	3

DESCRIPTION OF VISITORS

DEMOGRAPHICS

More than one-half of visitors are female (58 percent) (see Table 3). Additionally, more than one-half of observed visitors are adults (55 percent are 19 years of age or older), while almost one-half are youth age, 10 to 18 years (45 percent).

TABLE 3

GENDER	% OF T&T (*n* = 196)
Female	58
Male	42
AGE[1] (IN YEARS)	**% OF T&T (*n* = 203)**
10 – 12	12
13 – 15	16
16 – 18	17
19 – 24	14
25 – 34	11
35 – 44	10
45 – 54	13
55 – 64	3
65 and older	4

GROUP COMPOSITION

Almost two-thirds were visiting in intergenerational groups (a group with at least one adult 19 years and older and at least one youth or child 18 years and younger) (64 percent) (see Table 4). More than one-quarter were visiting in adult-only groups (a group of two or more adults 19 years and older). A few

were in groups of youth and children only (a youth age 10 to 18 years visiting with at least one other youth or child).

TABLE 4

GROUP COMPOSITION	% OF T&T (*n* = 203)
Intergenerational group (adults and youth or children)	64
Adults only	28
Youth and children only	9

OVERALL VISITATION

This section describes visitors' overall experience in *Q?rius* including time spent and sections visited.

TIME SPENT IN *Q?RIUS* OVERALL

The median time spent is 15 minutes 35 seconds (see Table 5). Nearly one-third of visitors spent more than 30 minutes in *Q?rius* (27 percent), while 7 percent spent more than 60 minutes in the space.

TABLE 5

TIME INCREMENTS	% OF T&T (*n* = 201)
Less than 5 minutes	17
5 – 10 minutes	19
10 – 20 minutes	22
20 – 30 minutes	15
30 – 40 minutes	11
40 – 50 minutes	6
50 – 60 minutes	3
More than 60 minutes	7
TIME SPENT SUMMARY STATISTICS (*n* = 201)	**TIME SPENT (MIN: SEC)**
Range	:57 to 2:24:20
Median time	15:35
Mean time	22:05
Standard deviation	21:26

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- Youth (10 – 18 years) spent more time in *Q?rius* (versus adults 19 years and older).
- Visitors in intergenerational groups (versus visitors in adult-only and youth/children-only groups) are more likely to spend 30 or more minutes in *Q?rius*.

STOPS BY SECTION

Almost all *Q?rius* visitors stopped in the Basecamp section (96 percent) (see Table 6). Additionally, almost two-thirds stopped in the Collections Zone (63 percent), and almost one-half stopped in Field (49 percent). Fewer visitors stopped in the Lab (3 percent), Theater (2 percent), and Studio (2 percent); keep in mind that these spaces are not always open to the public.

TABLE 6

SECTIONS	% OF T&T WHO STOPPED (*n* = 203)
Basecamp	96
Collections Zone	63
Field	49
Loft	14
Lab[1]	3
Studio[2]	2
Theater[3]	2

[1]The Lab was open to the public on 9 of the 37 days of data collection.
[2]The Theater was open to the public on 8 of the 37 days of data collection.
[3]The Studio was open to the public on 1 of 37 days of data collection.

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- Visitors in groups that include adults (versus visitors in youth/children-only groups) are more likely to stop in the Basecamp section.

TIME SPENT BY SECTION

The median time spent at each section was calculated for the visitors who stopped at each. Visitors spent the greatest amount of time in the Theater (median time = 34 minutes 42 seconds), followed by the Collections Zone (median time = 9 minutes 46 seconds) (see Table 7). The median times for all other sections are less than 5 minutes.

TABLE 7

SECTIONS	# OF VISITORS WHO STOPPED	MEDIAN TIME (MIN:SEC)
Theater	3	34:42
Collections Zone	128	9:46
Basecamp	149	4:38
Lab	5	4:38
Loft	28	3:29
Field	99	1:49
Studio	3	1:19

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- Visitors in intergenerational groups (versus visitors in adult-only and youth/children-only groups) spent more time in:
  - Collections Zone.
  - Basecamp.
- Youth/children-only groups (versus visitors in adult-only and intergenerational groups) spent more time in Field.

BASECAMP AND FIELD VISITATION

Basecamp and Field, the first and second sections encountered in *Q?rius*, are made up of various self-contained components. Visitation to these individual components is described below.

STOPS

Of visitors to *Q?rius*, 59 percent stopped at Touch Mystery Skull in the Basecamp section, making it the most stopped at component (see Table 8, next page). The second and third most stopped at components were also in Basecamp: Feel Ancient Pottery (57 percent) and Examine Your Hand (54 percent). By comparison, the least stopped at component is I Spy in Basecamp (1 percent). The Decoding Mars components in the Field (5 to 11 percent stopped at each) and Registration in Basecamp (7 percent) were also among the least stopped at components. Overall, Basecamp components, which are the first components encountered, were stopped at more than Field components.

TABLE 8

BASECAMP AND FIELD COMPONENTS	SECTION	% OF T&T WHO STOPPED (*n* =203)
Touch Mystery Skull	Basecamp	59
Feel Ancient Pottery	Basecamp	57
Examine Your Hand	Basecamp	54
Zoom In Rocks and Minerals	Basecamp	43
Zoom In Bees	Basecamp	41
Smell the Scents of Science	Basecamp	40
See Hidden Worlds of Sand	Basecamp	38
Zoom In Inside Rocks	Basecamp	36
Hear Insect Karaoke	Basecamp	22
Reefs Unleashed Introduction	Field	21
Reefs Unleashed Field Station	Field	21
Zoom In X-Ray and SEM	Basecamp	20
Reefs Unleashed DNA Lab	Field	20
Mega Field Book	Basecamp	12
Decoding Mars Level 1	Field	11
Decoding Mars Level 2	Field	8
Registration	Basecamp	7
Decoding Mars Level 4	Field	7
Decoding Mars What Did You Discover?	Field	6
Decoding Mars Level 3	Field	5
I Spy	Basecamp	1

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- Males (versus females) are more likely to stop at Decoding Mars Level 1 in Field.
- Females (versus males) are more likely to stop at Registration in Basecamp.
- Youth (versus adults) are more likely to stop at Registration in Basecamp.
- Visitors in intergenerational groups (versus visitors in adult-only and youth/children-only groups) are more likely to stop at:
  - Hear Insect Karaoke in Basecamp.
  - Reefs Unleashed Field Station in Field.
  - Mega Field Book in Basecamp.
  - Registration in Basecamp.

TIME SPENT

The median time spent at individual components in Basecamp and Field was calculated for visitors who stopped at them. Visitors spent the greatest amount of time at Mega Field Book in Basecamp (median time = 2 minutes 33 seconds) (see Table 9); however, time spent is slightly inflated since some visitors sat and used their phone at this component.[8] By comparison, visitors spent the least amount of time at the Reefs Unleashed Introduction, a component that is not interactive (median time = 22 seconds).

TABLE 9

BASECAMP AND FIELD COMPONENTS	SECTION	# OF VISITORS WHO STOPPED	MEDIAN TIME (MIN:SEC)
Mega Field Book	Basecamp	25	2:33
Registration	Basecamp	15	1:57
Examine Your Hand	Basecamp	109	1:40
Decoding Mars Level 4	Field	14	1:31
Reefs Unleashed Field Station	Field	43	1:31
Zoom In Rocks and Minerals	Basecamp	87	1:28
Zoom In X-Ray and SEM	Basecamp	41	1:27
Smell the Scents of Science	Basecamp	81	1:25
Reefs Unleashed DNA Lab	Field	40	1:17
I Spy	Basecamp	2	1:14
See Hidden Worlds of Sand	Basecamp	78	1:12
Hear Insect Karaoke	Basecamp	44	1:09
Zoom In Bees	Basecamp	84	:58
Decoding Mars Level 2	Field	17	:55
Decoding Mars What Did You Discover?	Field	12	:55
Decoding Mars Level 3	Field	11	:48
Touch Mystery Skill	Basecamp	119	:43
Feel Ancient Pottery	Basecamp	115	:38
Decoding Mars Level 1	Field	22	:35
Zoom In Inside Rocks	Basecamp	72	:34
Reefs Unleashed Introduction	Field	43	:22

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- Males (versus females) spent more time at Zoom In Bees.
- Females (versus males) spent more time at Decoding Mars Level 1.
- Youth (versus adults) spent more time at Reefs Unleashed DNA Lab.

[8] In some cases, it was not possible to distinguish engaged time from unengaged time within a stop. For instance, visitors sometimes sat at or used their phones at components along the windows interspersed with "active" engagement. Therefore, time spent at these components may include unengaged time.

COLLECTIONS ZONE

LINE

Of visitors who stopped in the Collections Zone, almost all stopped without having to wait in line (97 percent) (see Table 10). For those who waited in line, the median time spent was 4 minutes 16 seconds.

TABLE 10

WAITING	% OF THOSE WHO VISITED COLLECTIONS (*n* = 128)
Visitors who did not have to wait in line	97
Visitors who waited in line	3
TIME SPENT IN LINE SUMMARY STATISTICS (*n* = 4)	**TIME SPENT (MIN: SEC)**
Range	1:10 to 3:00
Median time	2:16
Mean time	2:11
Standard deviation	:47

INTRODUCTION

Almost two-thirds of visitors who stopped in the Collections Zone received an introduction as they entered the space (63 percent) (see Table 11, next page). Of those who received an introduction, almost all were told about the object markings used in the Collections Zone (e.g., red, yellow and green tags) (98 percent), and almost three-quarters were told about the QR codes on the object tags (74 percent).

TABLE 11

INTRODUCTION	% OF THOSE WHO VISITED COLLECTIONS (*n* = 128)
Received an introduction	63
Did not receive an introduction	38
INTRODUCTION CHARACTERISTICS	**% OF THOSE WHO RECEIVED INTRO (*n* = 80)**
Staff described object markings (i.e., red, yellow, green)	98
Staff explained the QR codes on the object tags	74
Staff instructed visitors to return objects when done	65
Staff told visitors they can use the tools in the area (e.g., microscope)	59
TIME SPENT AT INTRO SUMMARY STATISTICS (*n* = 80)	**TIME SPENT (MIN: SEC)**
Range	:03 to 1:45
Median time	:31
Mean time	:33
Standard deviation	:19

COLLECTIONS ZONE ACTIVITY

Of the visitors who stopped at the Collections Zone section, the most frequent activity was opening drawers (93 percent), followed by taking objects out of drawers (71 percent) (see Table 12). The least frequent activities were taking objects to a Browser (16 percent) or Activity Zone (12 percent).

TABLE 12

ACTIVITY	% OF THOSE WHO VISITED COLLECTIONS (*n* = 128)
Open drawer	93
Take objects out of drawers	71
Take objects out of cases	48
Take objects to microscopes	27
Look at objects with magnifying glasses	22
Take objects to a Browser	16
Take objects to Activity Zone	12

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- Youth (versus adults) are more likely to take objects to Activity Zone.
- Visitors in groups that include youth or children (versus adult-only groups) are more likely to:
  - Take objects out of their cases.
  - Take objects to microscopes.

COLLECTIONS USED

Collections Zone visitors used many of the types of collections available to them. Of the seven collections, the most used was Vertebrate Zoology (83 percent), while the least used collection was Botany (20 percent) (see Table 13). All of the other collections were used by about one-half of Collections Zone visitors: Paleobiology (59 percent), Invertebrate Zoology (57 percent), Entomology (55 percent), Anthropology (50 percent), and Mineral Science (45 percent).

TABLE 13

COLLECTION	% OF THOSE WHO VISITED COLLECTIONS (*n* = 128)
Vertebrate Zoology	83
Paleobiology	59
Invertebrate Zoology	57
Entomology	55
Anthropology	50
Mineral Science	45
Botany	20

MISUSE IN COLLECTIONS

There was very little misuse of objects or materials in the Collections Zone area. Only 9 percent of visitors opened two or more drawers at once (see Table 14). There were no observed instances of visitors violating the colored tag system or not returning objects to their drawers.

TABLE 14

MISUSE BEHAVIOR	% OF THOSE WHO VISITED COLLECTIONS (*n* = 128)
Two or more drawers open at once	9
Violation of colored object markings (e.g., removed red marked object from case)	0
Do not return object to drawer	0

COLLECTIONS BROWSER

Of the visitors who stopped in the Collections Zone, less than one-third used a Collections Browser (32 percent) (see Table 15). Of those who used a Collections Browser, almost all used the touchscreen (93 percent), and less than one-fifth saved data to their Field Book (15 percent). The median time spent at the Collections Browser is 1 minute 40 seconds.

TABLE 15

USE OF COLLECTIONS BROWSER	% OF THOSE WHO VISITED COLLECTIONS (*n* = 128)
Did not use Collections Browser	68
Used Collections Browser	32
BEHAVIORS AT COLLECTIONS BROWSER	**% OF THOSE WHO USED A BROWSER (*n* = 41)**
Used touchscreen	93
Saved data to their Field Book	15
Made notes in their Field Book	0
TIME SPENT AT COLLECTIONS BROWSER (*n* = 41)	**TIME SPENT (MIN: SEC)**
Range	:06 to 22:58
Median time	1:40
Mean time	3:59
Standard deviation	5:23

ACTIVITY ZONE

Almost one-quarter of Collections Zone visitors used the Activity Zone stations (23 percent) (see Table 16). When using the Activity Zone stations, more than one-half of visitors used the touchscreen (57 percent), and more than one-third watched a video (37 percent). The median time spent at Activity Zone is 1 minute 46 seconds.

TABLE 16

USE	% OF THOSE WHO VISITED COLLECTIONS (*n* = 128)
Did not use Activity Zone	77
Used Activity Zone	23
BEHAVIOR	**% OF THOSE WHO USED ACTIVITY ZONE (*n* = 30)**
Used touchscreen	57
Watched a video	37
Used build collection	13
Saved data to their Field Book	13
Made notes in their Field Book	0
TIME SPENT AT ACTIVITY ZONE (*n* = 30)	**TIME SPENT (MIN: SEC)**
Range	:05 to 10:41
Median time	1:46
Mean time	2:13
Standard deviation	2:22

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- Youth visitors (versus adults) spent more time at the Activity Zone.
- Intergenerational groups (versus adult-only and youth/children-only groups) were more likely to stop at the Activity Zone.

LOFT

Of those visitors who visited the Loft, most looked at the Collections while they were in the Loft (89 percent), and more than two-thirds looked over the Loft to *Q?rius* (68 percent) (see Table 17). Almost two-thirds used the seating in the Loft (61 percent).

TABLE 17

BEHAVIOR	% OF THOSE WHO VISITED THE LOFT (*n* = 28)
Look at collections	89
Look over loft	68
Use seating	61
Use the touchscreen	18
Look at books	11

VISITOR BEHAVIORS

The following section describes visitors' behaviors in *Q?rius* overall.

GENERAL BEHAVIORS

More than three-quarters of visitors read text at least once while in *Q?rius* (79 percent) (see Table 18). One-quarter took at least one photo (25 percent), and 1 percent scanned an object QR code.

TABLE 18

GENERAL BEHAVIORS	% OF T&T (*n* = 203)
Read text	79
Take photo	25
Scan Object QR code	1

INTERACTION WITH VISITORS, STAFF, AND SCIENTISTS

Q?rius components were designed to encourage group members, staff members, and scientists to work together to answer the questions presented. Almost all *Q?rius* visitors had at least one interaction with another visitor while in the space (93 percent) (see Table 19). More than three-quarters interacted with a *Q?rius* staff member at least once during their visit (79 percent). A few interacted with scientists (4 percent).

TABLE 19

INTERACTION WITH	% OF T&T (*n* = 203)
Visitor	93
Staff	79
Scientist	4

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- Youth (versus adults) are more likely to have at least one interaction with:
  - Another visitor in *Q?rius*.
  - A scientist in *Q?rius*.

SCIENCE SKILLS

There are many opportunities for visitors to engage in a science skill behavior. Of the behaviors, observing objects, which included looking at the raw materials at Feel Ancient Pottery, was most frequent (92 percent of visitors observed an object at least once while in *Q?rius*) (see Table 20). Additionally, many collaborated at least one time while in the space (85 percent) by working with other members of their group or *Q?rius* staff members, and many also looked through a microscope (81 percent). The least frequent behaviors were related to the Field Book: 5 percent collected data and none took notes.

TABLE 20

SCIENCE SKILL[1]	# OF OPPORTUNITIES TO DO EACH SKILL	% OF T&T (*n* = 203)
Observe objects	16	92
Collaborate	28	85
Look through microscope	5	81
Manipulate microscope	4	66
Look through magnifying glass	5	61
Sort	6	34
Ask a question	28	21
Hypothesize	3	19
Look through binoculars	1	11
Collect data in Field Book	8	5
Make notes in Field Book	8	0

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- Females (versus males) are more likely to:
  - Ask a question at least once in *Q?rius*.
  - Hypothesize at least once in *Q?rius*.
- Youth (versus adults) are more likely to:
  - Hypothesize at least once in *Q?rius*.
  - Collect data in their Field Book at least once in *Q?rius*.
- Adults (versus youth) are more likely to observe objects at least once in *Q?rius*.
- Visitors in intergenerational groups (versus adult-only and youth / children-only groups) are more likely to:
  - Look through a microscope at least once in *Q?rius*.
  - Manipulate a microscope at least once in *Q?rius* .
  - Look through binoculars at least once in *Q?rius*.
  - Collect data in their Field Book
- Visitors in groups that include adults (versus youth /children-only groups) are more likely to observe objects at least once in *Q?rius*.
- Visitors in groups that include children (versus adult-only groups) are more likely to hypothesize at least once in *Q?rius*.

6. ETHNOGRAPHIES

INTRODUCTION

Ethnography is a naturalistic data collection method that results in rich description of cultural phenomena. The innovative and diverse qualities of *Q?rius* suggested that ethnographies of the smaller, discreet learning environments within *Q?rius* are necessary to capture the character of the environments. The ethnographies allow us to triangulate the quality of experiences articulated in the in-depth interviews to people's overall experiences (as garnered through in-depth interviews and timing and tracking) to environmental specifics. The ethnographies will also aid in linking the environment to outcomes.

METHODOLOGY

RK&A allotted 17 hours of ethnographic data collection to five areas in *Q?rius*: Basecamp, Field, Collections Zone, Lab, Loft, and Field Book. RK&A spent the greatest amount of time in Collections Zone and the least amount of time in Lab. During the ethnographies, RK&A took descriptive field notes on how visitors used the components, particularly the field books and touchscreens, whether and to what extent they engaged in science skill behaviors, and who they interacted with and how. Additionally, RK&A conducted short-answer interviews with some of the visitors who had been observed to understand the meaning they made from each area. See the instrument in the Appendix.

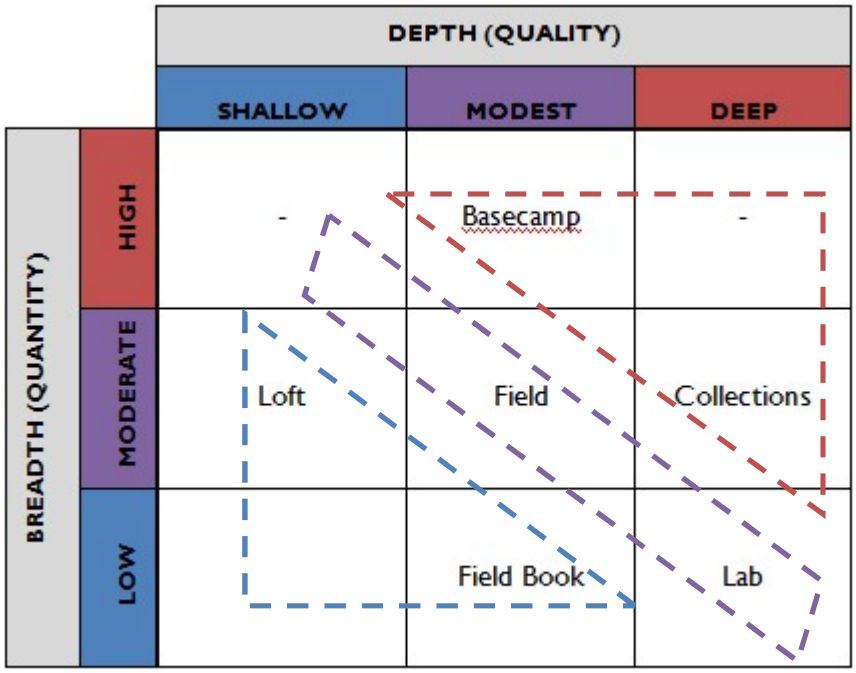
DATA ANALYSIS AND REPORTING

The observation and interview data are qualitative whereby the evaluator studies the notes for patterns and trends, and as they emerge groups similar findings. Data are presented in narrative with specific examples to clarify the observations. Observation and interview findings are presented together to create a holistic picture of how the spaces work.

SUMMARY OF ETHNOGRAPHIES

The opportunities in *Q?rius* are intentionally varied and offer various breadths and depths of experience. Broad experiences reach many visitors, whereas deep experiences provide a rich high-quality experience to fewer visitors (e.g., practice science skills). In Figure 11, we have mapped how the sections of *Q?rius* and the Field Book vary in depth (top of the chart) and breadth (left side of the chart) based on ethnographic observations and timing and tracking results. Basecamp and Collections Zone fared best in terms of either having the highest breadth (Basecamp) or depth (Collections)—indicated in the red, triangle-shaped outline in the upper right corner. By contrast, the Loft and Field Book fared relatively low, being either shallow in depth (Loft) or low in breadth (Field Book)—indicated in the blue, triangle-shaped outline in the lower left corner. Field and Lab are in the middle—indicated by the purple rhombus-shaped outline. Field placed here because the experiences were moderately broad and modestly deep, whereas the Lab offered very deep experiences that reached few visitors, which metered its placement; of course, the Lab also has limited hours so the low breadth was to be expected.

FIGURE 11



BASECAMP ETHNOGRAPHY

Basecamp is the first space visitors encounter when they enter *Q?rius*. The components in this section, which are on moveable carts and tables, invite visitors to use their senses to explore specimens as scientists do, such as at Touch the Mystery Skull, Hear Insect Karaoke, and Examine Your Hand.

OVERALL USE AND ENGAGEMENT

Basecamp was highly visited and engagement with its components was generally in-depth, particularly in terms of science skills (described in the science skills section). There was not a common path or sequence for visiting the Basecamp activities, but rather visitors stopped at activities that were available and attracted their interest. Examine Your Hand was the most popular component with frequent visitation and high dwell times; visitors at this station, especially children younger than 15 years, used the microscope to get a close-up look at their hands, sometimes compared fingerprints, and a few discussed the fact that fingerprint patterns vary. By contrast, I Spy, the Registration Kiosk, and Mega Field Book—all of which are located along the windows were the least popular components. Often visitors would sit on the ledges at I Spy or Mega Field Book in particular or even at the seats at the Registration Kiosk while checking their phone or watching their children engage with the activities.

Overall, visitors did not have trouble using any of the components on their own or in groups. One of the few difficulties that visitors encountered was using the microscopes; most of these visitors were young children who struggled to focus the microscope lenses without adult help. Additionally, a few visitors engaged with components but did not use the activities as fully as they could, such as a young boy and girl who played with the instruments at the Insect Karaoke station without using the touch screen and a 10-year-old girl who smelled a few items at the Smell station and then walked away. A few others became frustrated trying to complete activities, such as those who were unable to determine which minerals were contained in the rocks at Zoom in Rocks and Minerals.

Several adults and children were observed taking pictures of group members with various objects in Basecamp, including the skulls, rocks and minerals, pottery, and bees. These visitors typically

photographed one or more group members holding specimens such as the skulls or rocks and tended to be females in groups of two to three people. For instance, one visitor was observed taking a picture of her children engaging with the Feel Ancient Pottery station, while a young girl was observed photographing a close-up image of a bee on the screen.

INTERACTIONS

STAFF INTERACTIONS

There were approximately two to three staff members in Basecamp during observations. One staff served as a designated "greeter" who introduced visitors to *Q?rius* as they entered the space. Several visitors interacted with greeters although these interactions were typically very short; staff asked if visitors had visited the space before and, if they had not, provided an introduction to each section of *Q?rius* and explained that visitors were allowed to touch the specimens at the stations. While "greeter" staff primarily remained near the entrance to *Q?rius*, they were sometimes observed helping visitors at stations close to the entrance, such as at Examine Your Hand and Touch the Mystery Skull.

Visitors primarily interacted with *Q?rius* staff when staff were facilitating one of the components. In addition to the greeter, who sometimes facilitated components, one staff member often remained at Rocks and Minerals to help with a sorting activity, while another staff member floated between components to offer assistance as necessary. Overall, staff often approached visitors and asked questions to engage visitors with the components (e.g., "Do you know the difference between rocks and minerals?"), and sometimes presented tools (e.g., magnifying glass) to young children in particular to help them examine the rock and mineral specimens.

Staff had unique approaches to facilitating components and engaging with visitors but were generally comfortable and flexible. Staff tended to interact more with children and youth versus adults in the same group—asking questions, offering explanations, providing assistance in focusing microscopes, and pointing out characteristics directly to children and youth. While flexible, individual staff had regular points of discussion or analogies for various components; for instance, one staff member frequently compared chocolate chip cookies to sugar cookies to describe the relationship between rocks and minerals. Staff also responded readily to clarifying questions, such as "Why are there two types of quartz?"

VISITOR INTERACTIONS

Interaction within visit groups was frequent. In intergenerational groups, many adults actively helped children under 10 years of age use the components and guided them through the activities. Adults often read directions, asked questions, and directed children to observe the specimens. For example, a few adults asked their children to look closely and compare their fingerprints to those of other group members. Others talked to their children about the rocks and minerals and rephrased questions posed by staff members. Adults and children were also frequently observed talking about their observations with one another. For example, one adult was observed telling his group that the sand in Hidden Worlds in Sand looks very coarse. A few others had more in-depth conversations about their observations, such as a family that talked about the colors of bees and a woman and her granddaughters

who compared their fingerprints with one another. One family with a 9-year old girl said that their favorite thing about Basecamp was the potential to learn and explore together: "I think as a family you can interact—it doesn't have to be an individualized activity. That was nice."

By comparison, a few adults were observed asking their children general questions about the activities but did not engage with them at the activity, and rather, watched them from afar. For example, one mother stood away from her teenage daughters as they examined their fingers under the microscope and asked, "What are you seeing?"

SCIENCE SKILLS

Most visitors engaged in a wide range of skills while in Basecamp. All visitors engaged in observation and did so at nearly every station in Basecamp, though their observations varied in terms of depth. Several visitors were observed looking closely, using the microscopes and the magnifying glasses, at their fingers at the Examine Your Hand station and at the rocks at the Rocks and Minerals station. A few looked closely at the pottery pieces and the bees; visitors at these stations tended to be young children accompanied by at least one adult. In addition to observing at the components, adults and children often talked about their observations within visitor groups; for instance, one 6-year-old boy said about the rocks, "There's a little gold too [in the rock]… Well, this one is kind of blackish."

Going hand-in-hand with observation, most visitors used objects or tools and, overall, used the tools correctly without the help of a staff member. Most intergenerational groups used the microscopes, particularly at Examine Your Hand to look at their fingerprints and Hidden Worlds in Sand and Zoom in Bees to examine the specimens. Interviewees who used the microscopes describe it as fun, helping them learn new information, and feel like a scientist. Generally, however, young children struggled to adjust the microscopes without adult help. One young girl, for example, was observed twirling the eyepiece unsuccessfully to try and focus the image on the screen. However, one adult interviewee said that the directions at the microscopes were simple and easy to follow: "The simpler the better. One says zoom, one says focus. That's all you need."

Many visitors were observed collaborating with others to observe, compare specimens, and complete activities in Basecamp. Collaborations took place at a variety of stations and were typically between a parent and at least one child under the age of 13. For example, visitors at Examine Your Hand compared their fingerprints to others and talked about the different fingerprint shapes, although sometimes adults tended to play a facilitator/collaborator role. Additionally, at Hidden Worlds in Sand and Zoom in Bees, a few were observed working together to examine the sand and bee specimens—taking turns using the microscopes to examine the specimens.

Several visitors were observed sorting and comparing specimens with members of their group. For instance, at Examine Your Hand, nearly all visitors compared their fingerprints to their group members' and talked about their fingerprints' shapes, and a few young children were observed sorting pottery independently at the Ancient Pottery station; these visitors, however, tended to move the pottery pieces around without intentionally sorting the pieces as part of the activity. Additionally, a few parents were observed helping children under the age of 10 compare and classify the skulls at Touch the Mystery Skull as well as compare the various bee specimens at Zoom in Bees.

Some visitors hypothesized, primarily at Rocks and Minerals, Examine Your Hand, and Ancient Pottery. Visitors at these stations used their observations to hypothesize and complete a challenge, such as guessing which minerals are present in granite and schist. A group of sisters, for example, noticed that granite contains something shiny. They then picked up the various minerals, looked at them closely, noticed that quartz is shiny, and hypothesized that the shiny material in the rock they were examining was quartz.

Some visitors were observed solving problems. Most often, visitors were observed solving problems at Rocks and Minerals; these visitors made observations and compared their findings to determine the minerals present in granite and schist. For example, they often looked closely at the colors and textures of the rocks, and used this information to compare them to the various mineral specimens. These visitors tended to be part of groups of one to two young children with at least one adult. Additionally, a few visitors in Basecamp asked staff members' questions. Adults' tended to ask focused questions about specific specimens ("Why are there two types of quartz? Biotite, is that in quartz?"), while children tended to ask broader questions about the specimens or the activities ("What should I look at?").

FIELD ETHNOGRAPHY

Field, located immediately behind Basecamp, is the second space visitors encounter in *Q?rius*. There is not a physical barrier between Basecamp and Field, although there is a banner hanging from the ceiling that identifies the space. Field components address two science topics: Reefs Unleashed, which focuses on the biodiversity of coral reefs, and Decoding Mars, which focuses on discovering the geology of Mars. Each exploration has several stations that allow visitors to dive deeper into the topic (as compared to Basecamp components). These components are on tables that can be moved as necessary, and a few stations include monitors with video and the opportunity to add items to a Field Book.

During the observation, there was a particularly high number of youth-only groups (three-quarters of groups) because a large organized group was visiting *Q?rius* during about 60 minutes of the observation. The timing and tracking findings do not indicate age to be a factor in Field visitation (e.g., youth are not more inclined to use these components), so visitation during the ethnography may not be representative of normal use. In presenting the data below, we note when group composition may have affected the results.

OVERALL USE AND ENGAGEMENT

The field was used by a moderate number of visitors, and many groups left before completing one entire activity (e.g., Reefs Unleashed Field Station, Reefs Unleashed DNA Lab, individual level of Decoding Mars). For example, some visitors completed several steps at Reefs Unleashed but walked away before watching the final video or fast forwarded through it. Some others at Decoding Mars left before checking their answers. Additionally, only a few groups were observed engaging with all of the activities about a single science topic; all of these groups completed Reefs Unleashed activity (versus Decoding

Mars). Youth, in particular, tended to move through activities quickly, and it was also common for intergenerational groups too.

In the Field, components often went missing. For instance, for approximately 45 minutes, the species card associated with step one of the Reefs Unleashed DNA Lab was tucked between the monitor and the white board at one of the stations, making it easy to overlook. Additionally, about halfway through the observation period, the dry-erase marker visitors could use to write a potential species name in step three of the DNA Lab activity went missing, prohibiting visitors from recording hypotheses.

INTERACTIONS

STAFF INTERACTIONS

There were very few interactions with staff, since the Field section did not have a dedicated staff member; rather, one staff member floated between Basecamp and Field activities toward the back of *Q?rius*. The two groups who were observed interacting with staff were both youth-only groups who used the Reefs Unleashed Field Station. In both cases, staff members initiated the interaction and provided information about the work being done in the reefs. There was a short back-and-forth exchange between visitors and staff, but it was too quick and quiet to overhear.

VISITOR INTERACTIONS

Few visitors interacted with others in their groups; the majority of those who did were visiting in intergenerational groups versus youth-only groups. For intergenerational group interactions, most observed adults acted primarily as facilitators and to some extent collaborators. For instance, adults helped youth or children sort images at Mars Decoded or hypothesize at Reefs Unleashed. A few adults were overheard asking children and youth questions, such as one man who said to his child, "Does this look like sand or flowing water?" while sorting images at Mars Decoded Level 2. Interaction within intergenerational groups happened often and across components. By contrast, interaction within youth-only groups was most likely to take place when several youth were using a single monitor or station. For example, when two boys were observed working together at the Reefs Unleashed Field Station, a 12-year old boy looked at the anthropoid information on the monitor while an 8-year old boy read aloud the different items that needed identification. The older boy helped the younger boy place the flags, saying, "Based on what you have learned, where do you think the anthropoids would live?"

SCIENCE SKILLS

Hypothesizing was the most frequent behavior in Field, with about one-half doing so. These visitors were observed labeling the plate at the Reefs Unleashed Field Station, identifying and / or naming species based on DNA at the Reefs Unleashed DNA Lab, or sorting images into categories at the Decoding Mars activities. Since so many visitors worked on the activities alone, very few visitors were heard saying hypotheses aloud, but rather, doing so through choices prompted by the components.

Slightly less than one-half engaged in observation behaviors. These groups were seen looking closely at the metal plates or the images of species at the Reefs Unleashed stations, or looking closely at the images and the training booklet at Decoding Mars.

A few groups collaborated while completing a Field activity. Almost all of these groups were intergenerational groups, with the adults guiding the collaboration. For instance, at Decoding Mars Level 2, a man and his 12-year old child were observed reading the training materials and sorting images together.

Additionally, all interviewees provided an example of something they learned while in the Field, with visitors in two different groups talked about the Autonomous Reef Monitoring Structure. One girl said, "[Scientists] don't go and take creatures out of their environment, but they put something down [in the ocean] for [creatures] to attach to, then take that out."

COLLECTIONS ZONE ETHNOGRAPHY

The Collections Zone is a space near the back of the first floor of *Q?rius*. It is separated from the Basecamp and Field activities by a series of drawer units and is available to the public during regular hours. In the Collections Zone space, visitors have access to 6,000 biological, geological, and anthropological objects, many of which can be removed from their boxes and handled. The space also features several microscopes, magnifying glasses, Collections Browsers, and Activity Zone stations for closer examination of specimen.

OVERALL USE AND ENGAGEMENT

The Collections Zone was used by a large number of visitors who engaged in many offerings. Visitors typically started their visit by looking at the drawers along the right wall. The majority of visitors started opening whatever drawer was close or available, while others identified areas that they were interested in to explore or were guided by staff to a certain area. Collections in the moveable divider designating the Collections Zone were used infrequently, generally because visitors did not notice them.

All groups opened at least one drawer while they were in the Collections Zone, more than one-half took at least one object out of a drawer, and almost one-half opened at least one object box. Visitors tended to use their eyes versus tools to observe the objects and specimens; for example, just one-third used a microscope and two used a magnifying glass. Additionally, visitors tended to spend their time observing the specimens versus seeking out supplemental information of available devices; for example, just one-fifth of groups scanned object QR codes at Collections Browsers and a few used the Activity Zone activities. A few used the Activity Zone activities, and a few also took pictures either of themselves or of the specimens. All of these behavioral results align with what was found in timing and tracking observations.

As will be described below, interactions with staff and within groups of visitors was high in the Collections Zone, and there was a mixture of engagement. For instance, some visitors were audibly and visibly excited by the experience ("Wow!"; "Look at this!"; "Cool"), while others were more staid but deep into looking and engaged in quiet conversations with others.

The one main challenge visitors seemed to face in Collections Zone was scanning QR codes. A few visitors had trouble doing so due to worn object tags. Occasionally staff members would point out that visitors could search for items using the touchscreen interface, but often, visitors who were unable to scan the QR codes returned the object to the drawer without seeking out additional information. These visitors were not noticeably frustrated but rather moved on to another object. As in other sections, some visitors had trouble manipulating the microscopes but adults or staff were generally able to assist them.

INTERACTIONS

STAFF INTERACTIONS

There were usually four or five staff members in the Collections Zone, and many groups interacted with staff members. Often staff members helped visitors use the microscopes; these staff members generally showed visitors how to work the microscopes and then encouraged them to try it on their own. For example, staff members said things such as: "Always zoom down and then focus" and "Have you figured out how to see things in 3-D yet?" Staff members also encouraged close looking through microscopes by pointing out things visitors might be able to see on a specimen.

Additionally, staff members helped visitors find specimens in the drawers. Often staff members would ask visitors what they were interested in seeing when they entered the space, after explaining the Collections Zone rules. Some staff members also suggested items to visitors; for example, one staff member asked an intergenerational group, "Do you want to see a tarantula?" In some cases, visitors approached staff members with questions about specific things, such as the 8-year old boy who asked, "Do you have any octopus fossils?"

Staff also assisted some visitors with scanning or searching for specimens using the Collections Browser to gather more information. Often staff members approached visitors who appeared to be having trouble scanning the QR codes. These staff members provided general support by redirecting them to another scanner or showing them how to use the search function to access information.

Several staff members used the specimens visitors were looking at as a starting point for interaction, either to provide more information or to encourage close looking. For instance, staff members said things such as, "Guess what these yellow things are?" to a group looking at a porcupine. These interactions often led to sustained engagement and a few visitors (both adults and children) asked the staff member questions, including some broad questions such as ("Is this real?") to specimen-specific questions related to visitors' observations and content presented to them.

SCIENTIST INTERACTIONS

While RK&A was in the space, one scientist spent time in the Collections Zone for approximately 30 minutes. The scientist talked with two groups and encouraged deeper exploration around his specific subject area. The first interaction was about 5 minutes in length and the second was about 20 minutes—both significant amounts of time when we consider the median time spent in the Collections Zone was under 10 minutes. Both interactions involved back-and-forth questions and discussion between the scientist and visitors, but the second interaction was considerably more in-depth. For example, the scientist showed a starfish to one girl and said "Some starfish have five arms, but look at this one; it looks like the sun." The girl replied, "It does not have a backbone." The scientist confirmed

that this was true and encouraged the girl to pick up other starfish and look at them, while talking with the girl about predators of starfish.

VISITOR INTERACTIONS

Most visitors interacted with others in their group. In intergenerational groups, most adults let children direct the experience but provided support, such as helping their children use the microscopes and magnifying glasses, reading aloud content available to them ("That is a Madagascar hissing cockroach"), and searching for additional information about specimens using the Collections Browsers. Additionally, many of these adults encouraged youth to select additional specimens to examine. Many groups engaged in two-way interaction while in the Collections Zone, although these interactions were often superficial expressions of excitement (e.g., "Look at this!") or oral observations of the specimens (e.g., "The wings are hairy.").

Of youth-only and youth-initiated interactions, many revolved around the color-coding system of specimens in the Collections Zone. For example, one girl was observed telling her sister, "If it's a green tag, you can take it out." A few minutes later, the same girl said, "Oh, you can't take that one [out]; it has a red tag." A few youth talked about the science skills they were using, or referring to themselves as scientists. For instance, two teenage girls were using a microscope to look closely at a mollusk, and one girl said "We are scientists!" Although several youth-only groups looked at specimens together, conversations about the specimens were superficial (e.g., "Look at this.") or were too quiet to overhear.

SCIENCE SKILLS

Given the number of specimens and tools available to visitors in the Collections Zone, most groups who spent time in the space engaged in observation through examination of the specimens. More than one-third of visitors used microscopes while they were in the Collections Zone, and two used magnifying glasses. Visitors who took specimens out of boxes and those who used microscopes often observed specimens for more time than those who did not.

Moreover, several visitors made hypotheses as they examined specimens. Visitors who looked at specimens under the microscope were most likely to hypothesize; however visitors who were observed looking at specimens in the drawers were also overheard hypothesizing. One girl who looked at coral under the microscope said: "I think these two pieces used to be connected; look at these ridges." One man who looked at objects in the Anthropology drawers pulled out a tool and hypothesized that it was used for writing.

In addition to engaging in science skills, many seemed to take away some content knowledge. Most interviewees provided an example of something they learned while in the Collections Zone, although some provided more detail than others. For instance, one girl said, "I learned that moth wings also have a little fuzz around them for silent flight like owls. Another girl simply said: "A hummingbird's nest is pretty small." Also, some observed visitors reflected aloud what they learned while they examined specimens in the space. For instance, one girl was looking at a butterfly under the microscope and said: "I didn't know butterfly wings were hairy."

LAB ETHNOGRAPHY

The Lab is a space at the back of the first floor of *Q?rius*. It is enclosed in glass and open to the public for special drop-in activities. When RK&A collected data in the space, there were two activities available, both related to matching. In the Dig Deep activity, visitors match rocks and environments, while in the Wing It activity, visitors match butterflies by observable characteristics and DNA.

OVERALL USE AND ENGAGEMENT

The Lab was used by few visitors (almost all intergenerational groups); albeit fairly extensively. The majority of groups completed just one of the two activities. Groups spent between 2 to 7 minutes with each activity, which is a healthy dwell time, and as will be discussed below, all engaged with staff and the conversations at the activities were consistently in-depth.

INTERACTIONS

STAFF INTERACTIONS

There was one staff member present, and all groups interacted with him. In almost all interactions, the staff provided the visitor group basic instructional information for the activity as well as placed the activity within a scientific context (the few exceptions were when staff was with one group when another entered). In most interactions, staff specifically connected the activity to what scientists do. For instance, staff said things such as: "That's what scientists do—match them by traits" and "You just did what scientists do." Additionally, the scientist complimented a few children specifically about their scientific abilities.

In more than one-half of the interactions between staff and groups, the interaction was two-way. That is, there was back and forth between the staff and group members, and sometimes staff asked questions to initiate the back-and-forth exchange. A few times, group members (both adults and children) asked staff questions; for instance, one girl asked staff, "What does that mean, 'in the same species?'"

Staff was flexible in their interactions with visitors but still maintained key points of discussion. At the Wing It activity, staff always talked to the groups about visual similarities between species and DNA. Often, staff also described technology's role in species identification by DNA versus visual characteristics. At the Dig Deep activity, staff typically focused on one type of rock and its environment, such as sedimentary rocks. Overall, interactions at Dig Deep were shorter than those at Wing It.

VISITOR INTERACTIONS

Most adults interacted with the children in their group. The majority of these adults acted as collaborators / facilitators, working with their children at the activity and providing support as requested or needed. A few acted solely as facilitators. Two, who were with children about 10 years old, asked the scientists questions about the activity and content, and another, who was with children younger than 8 years, coached his children at doing the activity.

SCIENCE SKILLS

All of the groups that used the activity were observed engaging in observation and hypothesizing as they matched species or rocks to their environment. Several groups had an "a-ha moment" when they realized that butterflies with the same DNA may not look the same.

In addition to science skills, most seemed to take away some content knowledge. All interviewees provided a specific and accurate example of something they learned from the activity. Also, some visitors articulated or reflected aloud on what they learned; for instance, when the scientist asked one girl if two butterflies look alike, she responded, "Sort of but they have different DNA patterns."

LOFT ETHNOGRAPHY

The Loft is the primary space on the second floor of *Q?rius*. The space is open to Basecamp and Field on one side and the display cases in the Collections Zone on the other. Visitors can access the Loft using stairs from Basecamp or the Collections Zone. The Loft features couches, chairs, and tables for visitors to use as well as books and a Collections Browser that allows visitors to gather information about the items seen in the Collections Zone display cases. When RK&A was collecting data in the space, there was a passenger pigeon origami activity facilitated by one or two staff members.

OVERALL USE AND ENGAGEMENT

The Loft was used by a moderate number of visitors by differing degrees. Almost two-thirds of groups were intergenerational, while the remaining groups were youth-only groups. During the three hours of observation, 20 groups engaged in at least one activity in the Loft. These activities included the facilitated origami activity, use of the Collections Browser, and looking at the Collections Zone display cases. Most groups participated in the origami activity, several looked at the items in the Collections Zone display cases, and two groups used the Collections Browser. Groups spent between 4 and 15 minutes at the origami activity and 2 and 10 minutes at the Collections Browser. Most groups only used one activity, so the time they spent at that activity was about the same as the time they spent in the space.

INTERACTIONS

STAFF INTERACTIONS

Many groups interacted with a staff member. In almost all interactions, the staff member provided verbal instructions or hands-on help with the origami activity. One staff member helped a group identify an item in the Collections Zone display cases, directing this group to the Collections Browser. Almost all interactions between staff members and groups were two-way, and these interactions always revolved around proper folding of the origami bird.

VISITOR INTERACTIONS

There was a lot of interaction within groups. The majority of adults were collaborators and/or facilitators, working with their children at the origami activity and providing support as requested or needed. Adults and youth who did not participate in the origami activity were overheard talking about

items in the Collections Zone display cases. For example, one boy who was in a youth-only group pointed to a giant millipede and said, "Look at the millipede. Imagine if that thing was crawling on you while you slept." Overall, these conversations were short, often involving quick observations of specific specimens.

SCIENCE SKILLS

Groups primarily engaged in observation and some hypothesizing while looking at the Collections Zone display cases. For instance, one intergenerational group was trying to identify specimens; ultimately this group used the Collections Browser to search for the specimen, correctly identifying the Coco de Mer in display case C. Additionally, a few intergenerational groups collaborated on the origami activity with adults facilitating a little by helping children fold the paper correctly.

FIELD BOOK ETHNOGRAPHY

The evaluator observed for Field Book use across all of the spaces observed. Field Book use was observed only a few times in Collections Zone where several visitors added items to their Field Books and many added specimens they searched for using the interface. Several other visitors added specimens to their Field Book while working at the Activity Zone. There were occasions when the Q-card was scanned in Basecamp and Field but these visitors did not save anything to their Field Book. For instance, a few visitors scanned Q-cards at Reefs Unleashed activities but simply clicked through the activities in order to earn credit.

All interviewees were asked about the Field Book. Some said they were unaware of the Q-card or the ability to save specimens to it, while others said they were unsure of how to save things. Of those who saved specimens, visitors generally understood that saved items could be accessed online from home. Visitors did not talk about specific items they saved, but talked generally about saving items that interested them. For example, one adult said of her 10-year-old daughter, "You saved 36 things to look at later, things you wanted to know more about." In another group, a 10-year old boy said, "I used [the Field Book] to flag interesting things that I liked. I can go online and look at them and show them to my friends."

7. INTERVIEWS

INTRODUCTION

Interviews are open-ended and encourage interviewees to express their opinions, understandings, and the meaning they construct using language and words that they would naturally use to express themselves (as opposed to the language of the evaluator or researcher). RK&A conducted in-depth interviews with a control group, visitors at NMNM who had not visited *Q?rius*, and a treatment group, visitors who had just finished their visit to *Q?rius*. Interviews were scored on a rubric to demonstrate the spectrum of responses and measure differences between the treatment and control group.

METHODOLOGY

RK&A conducted 155 in-depth interviews with visitors 10 years of age and older; 78 visitors were interviewed before their visit to *Q?rius*, and a separate sample of 77 visitors were interviewed after completing their visit. The response rate is 58 percent. The interviews were audio-recorded and transcribed to facilitate analysis.

DATA ANALYSIS

RK&A developed scoring rubrics—a set of criteria linked to objectives that is used to assess performance of knowledge, skills, etc. on a continuum—to visitors' experiences. Scoring rubrics are useful because they allow qualitative data to be measured in a quantitative way, thus allowing outcomes to be measured. For each item, interviews were scored on a four-level continuum from Level 1, "Below Beginning," to Level 4, "Accomplished." The scoring rubrics were developed based on the engagement framework and trends that emerged from the interview data.

Data are quantitative and were analyzed statistically, using SPSS 2.0 for Windows, a statistical package for personal computers. A standard 0.05 level of significance was used to preclude relationships bearing little or no practical significance.[9] The Appendix includes a list of all statistical analyses that were run.

DESCRIPTIVE STATISTICS

Frequencies were calculated for most data, including demographics and rubric scores. Means were calculated to show a summary of students' achievement by rubric.

INFERENTIAL STATISTICS

To examine the relationship between two categorical variables, cross-tabulation tables were computed to show the joint frequency distribution of the variables, and the chi-square statistic (X^2) was used to test the significance of the relationship. For example, scores for familiarity with natural history and scientists were compared by study group to determine differences by Control and Treatment groups.

REPORTING

Data are presented both quantitatively and qualitatively—matching the methodology and analysis. That is, for each rubric measure, the frequency of visitors to score at each level of the 4-point continuum is presented in a graph. Level 1, the "Below Beginning" level, describes visitors at the very bottom of the continuum of achievement; scores at this level are completely off-the-mark or counter to what *Q?rius* is

[9] When the level of significance is set to $p = 0.05$, any finding that exists at a probability (p-value) ≤ 0.05 is "significant."

trying to accomplish. By contrast, Level 4, the "Accomplished" level, describes the ideal response through the lens of *Q?rius*' intentions.
In describing the results on rubrics, we have looked at the scores through three lenses:

- Percent of students to score across the continuum – This will show us how interviewees score against *Q?rius*' ideal, which is the accomplished level. Seeing scores across all levels of the continuum is expected as visitors are unique and have various experiences and understandings that inform their achievement. Quotations from interviewees who scored across each level are provided to demonstrate each level.
- Differences in scoring by demographics – We have looked at scores by gender, age (youth versus adult), and NMNH visit history to investigate factors that may affect achievement.
- Differences in scoring by study group – For applicable measures, a statistical comparison of control versus treatment group measures the effect of *Q?rius* on achievement. We have reported only those differences that have statistical significance (i.e., percents by group may *appear* very different, but they may not be statistically different).

DESCRIPTION OF INTERVIEWEES

GENERAL DEMOGRAPHICS

Interviewees are about one-half female (54 percent) and one-half male (46 percent) (see Table 21). Two-thirds are youth age 10 to 18 years (67 percent), and their median age is 13 years. The other one-third are adults age 19 years and older, and their median age skews low at 35.5 years. The majority are Caucasian / White (66 percent). There are no differences by control and treatment group.

TABLE 21

	CONTROL	TREATMENT	TOTAL
GENDER (*n* = 153)	**%**	**%**	**%**
Female	61	48	54
Male	40	52	46
AGE (*n* = 154)	**%**	**%**	**%**
Teen (10 – 18 years)[1]	66	68	67
Adult (19 years and older)[2]	34	33	33
ETHNICITY (*n* = 154)	**%**	**%**	**%**
Caucasian / White	69	63	66
Asian / Pacific Islander	11	13	12
African American / Black	10	9	9
Hispanic / Latino	9	9	9
Other[2]	4	6	5
Multi-ethnic	3	4	4
American Indian	0	2	1

[1]Teen age summary statistics (based on total): Range 10 – 18 years; median age 13; mean age 12.9 (± 2.32)
[2]Adult age summary statistics (based on total): Range 19 – 74; median age 35.5; mean age 38.1 (± 14.61)

RESIDENCE

Most interviewees are United States residents (89 percent) (see Table 22). Of United States residents, the greatest percent live in Virginia (15 percent) and Maryland (14 percent). Foreign visitors are from a variety of countries including the United Kingdom, Canada, and Indonesia.

TABLE 22

	CONTROL	TREATMENT	TOTAL
RESIDENCE (*n* = 151)	**%**	**%**	**%**
United States	92	86	89
Foreign country[1]	8	14	11
TOP 10 STATES OF RESIDENCE FOR US RESIDENTS (*n* = 128)	**%**	**%**	**%**
Virginia	15	14	15
Maryland	15	13	14
Pennsylvania	5	10	7
Florida	6	5	6
Texas	3	6	5
California	3	6	5
North Carolina	3	6	5
New York	5	5	5
New Jersey	3	5	4
Georgia	3	3	3

[1]Foreign countries, reported from greatest *n* to smallest: United Kingdom = 3, Canada = 2, Indonesia = 2, Brazil = 1, Denmark = 1, Egypt = 1, Germany = 1, Ghana = 1, Mexico = 1, Slovenia = 1, South Africa = 1.

NMNH VISIT HISTORY

About one-half of interviewees are visiting NMNH for the first time on the day they were interviewed (51 percent), and about one-half had visited NMNH previously (49 percent) (see Table 23).

TABLE 23

	CONTROL	TREATMENT	TOTAL
NMNH VISIT HISTORY (*n* = 150)	**%**	**%**	**%**
First-time visitor	57	45	51
Repeat visitor	43	55	49

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- First-time visitors are more likely to be:
  - Youth (versus adults).
  - Foreign visitors (versus United States residents).

GROUP COMPOSITION

The majority of interviewees are visiting in groups of family and/or friends: family-only (77 percent), friends-only (7 percent), and family and friends (7 percents) (see Table 24). A few are visiting alone (6 percent).

TABLE 24

GROUP COMPOSITION (*n* = 151)	CONTROL %	TREATMENT %	TOTAL %
Family	77	76	77
Friends	7	7	7
Family & friends	5	9	7
Alone	8	4	6
Tour group	1	4	3
Other	1	0	1

STATISTICALLY SIGNIFICANT DEMOGRAPHIC FINDINGS

- Youth (versus adults) are more likely to be visiting with family.
- Adults (versus youth) are more likely to be visiting alone.

Q?RIUS EXPERIENCES

Overall, visitors' experiences are somewhat aligned with what NMNH staff would consider ideal; on three of the six measures related to their *Q?rius* experiences, more than 50 percent of visitors scoring at the top half of the continuum:

HIGHEST ACHIEVEMENT

- 93 percent enjoyed engaging with scientific processes, tools, and objects in *Q?rius*.
- 67 percent related their experiences in *Q?rius* to that of scientists.
- 61 percent recognized the advantages of engaging with authentic processes, tools, and objects in *Q?rius*.

LOWEST ACHIEVEMENT

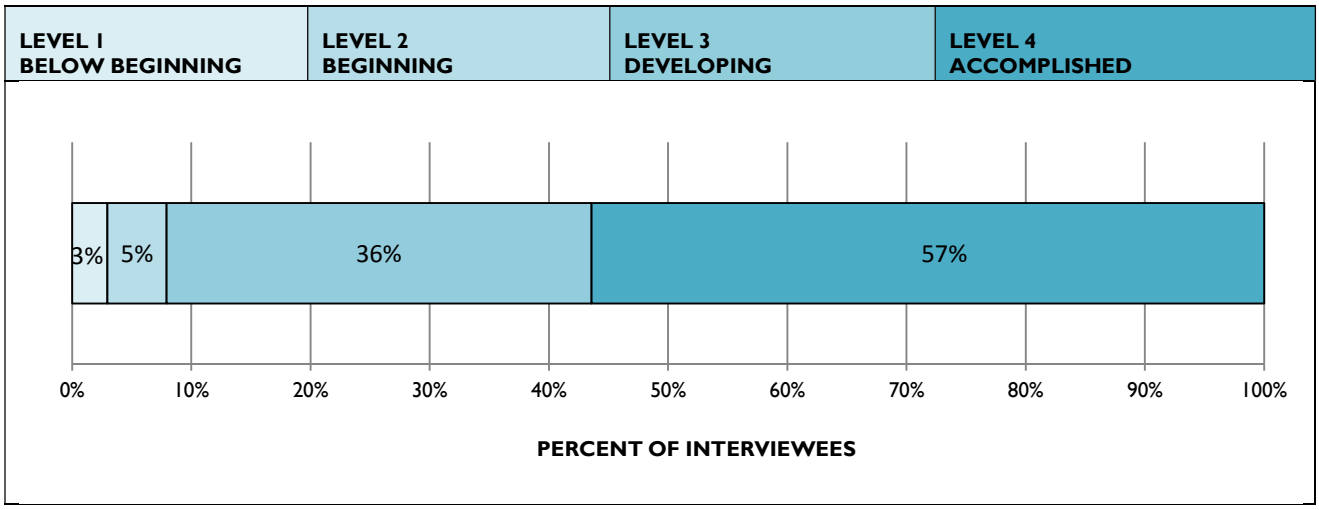
- 47 percent recalled questions or curiosities that they explored in *Q?rius*.
- 39 percent identified questions or curiosities that they would like to explore as a result of their experience in *Q?rius*.
- 17 percent found personal relevance in their interactions with staff and scientists in *Q?rius*.

The following pages contain an in-depth description of how interviewees scored for each of the six measures described above. Findings are presented in order from highest to lowest achievement.

ENJOYED ENGAGING WITH SCIENTIFIC PROCESSES, TOOLS, AND OBJECTS

The vast majority of interviewees scored at the top half of the continuum for enjoyment of scientific processes, tools, and objects (see Figure 12); this means that when interviewees described their *Q?rius* experiences in general, they specifically found enjoyment in engaging with scientific processes, tools, and objects. Most often these interviewees described engaging with collections, followed by tools and then scientific processes. There are no statistical differences in scores by gender, age (youth versus adult), and NMNH visitation (first-time versus repeat).

FIGURE 12



LEVEL 4 – ACCOMPLISHED

The 57 percent of interviewees that scored at the accomplished level described *Q?rius* as engaging and enjoyable *specifically because of* the scientific processes, tools, and objects that visitors engaged with in the space. These interviewees clearly describe interacting with scientific processes, tools, and objects (see the quotations below).

> [I like] that it's open and that there are tools to use to examine what you're looking at. When you're looking at something, it's nice to read about it, but you want to be able to feel something and touch something and make your own decisions about it. Sure, like the Zoom In with the bees—that's kind of cool to look at because you don't normally think about the hair sticking from it or what their wings look like, that kind of stuff. [female 31, repeat visitor]

> I liked the Mystery Skull—how you get to figure out what part it is, and if you're right, you're right, and if you're wrong, you get to try it right next time. But, it's really cool because you get to touch it, and it feels like you're an archeologist. You're a scientist, and you feel like you're looking at. [male 12, repeat visitor]

> (What did you like most about the space?) Microscopes. I actually didn't put any items [under the microscope], but we put our hands in. You can see the pores and everything. That was cool. [male 23, first-time visitor]

> (What did you like most about this space?) I like that you could examine the rocks and this stuff because, at most museums, they don't have this kind of stuff. (And can you give me an example?) Because you can get a little card, and you can examine it, like scan it, and see what that animal looked like on the little computer. [female 10, first-time visitor]

LEVEL 3 – DEVELOPING

The 36 percent that scored at the developing level described *Q?rius* as engaging and enjoyable, but responses only suggested that it was because of the scientific processes, tools, and objects. Some of these interviewees described the space as "hands-on" or "interactive" in general, while some others described processes, tools, and objects as "cool," but they don't give a specific example of an engagement in *Q?rius* that was enjoyable (see the quotations below).

> I think just the hands-on experimentation. It breaks down the walls of a typical museum or gallery setting where everything's behind a barricade, and it's a bit more distant. This way encourages people to touch and feel, which I think is good. It helps people feel more connected with what they see. [male 33, repeat visitor]

> (What did you like most about this space?) All the hands-on activities, and everybody was really helpful. It seemed like you were kind of just playing with something . . . and just poking stuff, then people would come to you [and say], 'Do you know how it is?' You're like, 'No, I don't.' Then they would help you. [female 19, first-time visitor]

LEVEL 2 – BEGINNING

The 5 percent who scored at the beginning level said that *Q?rius* was enjoyable or engaging, but they did not link the enjoyment to their experiences with the scientific processes, tools, or objects encountered in the space. The majority of these interviewees provided short responses, saying the space is "cool," "fun," "educational" or "kid-friendly" without elaborating (see the first quotation below). Another just described the space as being a nice exhibition space in terms of design and resources (see the second quotation).

> This is basically a very educational place, and this is really nice. [female 40, repeat visitor]

> I like that it's very open, and it doesn't feel very crowded at all or anything like that. It feels like there's a lot of resources. [female 22, first-time visitor]

LEVEL 1 – BELOW BEGINNING

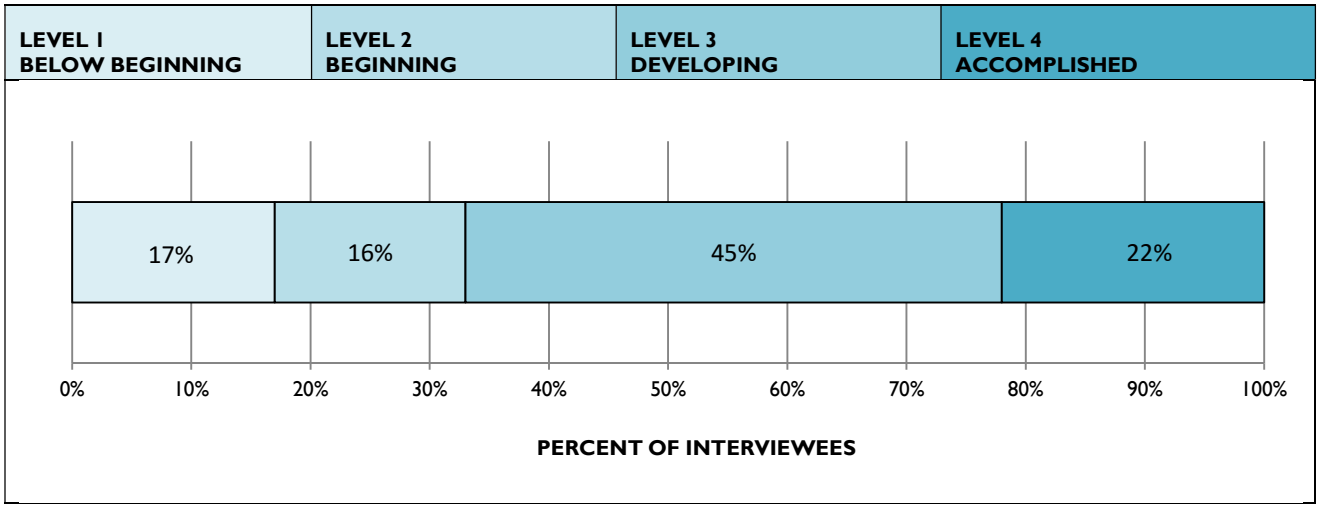
The 3 percent of interviewees that scored at the below beginning level did not describe anything about their *Q?rius* experience as enjoyable or engaging. These interviewees often said they did not spend enough time in the space to determine what they enjoyed about it (see the quotation below).

> (What did you like most about the space?) See, that's the thing, we really just walked in and didn't really look at very much. We were actually looking for an exit to the other side because we're starving. [female 24, repeat visitor]

RELATED THEIR EXPERIENCES IN *Q?RIUS* TO THAT OF SCIENTISTS

When interviewees described their experiences in *Q?rius*, the majority scored at the top half of the continuum for relating their experiences in *Q?rius* to that of scientists (see Figure 13). There are no statistical differences in scores by gender and NMNH visitation (first-time versus repeat). However, youth score statistically higher than adults.

FIGURE 13



LEVEL 4 – ACCOMPLISHED

The 22 percent of interviewees that scored at the accomplished level related what they did in *Q?rius* to what scientists and researchers do by providing a concrete and specific example of what skills, process, or tools s/he used in *Q?rius* that were like that of a scientist. Interviewees often described feeling like a scientist in Basecamp and Collections when engaging in scientific tools or processes to explore an object (see the quotations below).

> I was enthusiastic about being [a scientist or researcher]. Comparing the minerals and rocks and even trying to know what each skeleton represents. It's like knowing a new species or the evolution of an older one. [male 13, first-time visitor]

> I felt like a scientist because you got to do things that they would do. (What in particular did you do that made you feel like a scientist?) The zooming in on the insects. (And how is that like what a scientist does?) They can examine it closer. [female 14, first-time visitor]

> I mostly felt [like a scientist] at Reefs Unleashed because they were trying to find out what kind of reef it was, what kind of specimen. [female 11, repeat visitor]

> Coming in[to *Q?rius*] and getting the opportunity to learn about things that you know less about—that's what a scientist or researcher does. They go in with an open mind, and come out with more information. Especially the exhibit where it shows you the rock, and you have to identify which minerals are in it. That's like something a scientist would do. Getting to use the tools and looking at the minerals, and exploring that made me feel like a scientist. [male 34, repeat visitor]

LEVEL 3 – DEVELOPING

The 45 percent that scored at the developing level related what they did in *Q?rius* to what scientists and researchers do by providing a broad or general example of what s/he did in *Q?rius* that made him/her

feel that way. Sometimes the interviewee mentioned specific skills but did not provide a concrete example of how those skills are applied in the space (see the quotations below).

> Yes. The tools that you have, and you do the scientific process, like—well they observe everything to understand it. They touch it, they analyze it, and they classify it. [female 16, first-time visitor]

> Everything with the microscope feels science-y. *(*And how is that like what a scientist does?) Because they usually look at microscopes to see what stuff looks like really tiny. [female 13, first-time visitor]

LEVEL 2 – BEGINNING

The 16 percent that scored at the beginning level somewhat related what they did in *Q?rius* to what a scientist or researcher does. Some of these interviewees abstractly connected what they did in *Q?rius* to scientists, but they did not provide examples or focused on many differences between what they did and what scientists do (see the quotations below). Some others described engaging in scientific skills, processes, or tools but did not connect it to what scientists do.

> I guess [what I did in *Q?rius*] is much more simplified [than what a scientist does] because this should be for a general and younger audience. [female 25, repeat visitor]

> I don't think that it [what we did in *Q?rius*] is any different [than what scientist do]. It's just done on a smaller scale. [female 45, repeat visitor]

LEVEL 1 – BELOW BEGINNING

The 17 percent that scored at the below beginning level did not relate what they did in *Q?rius* to what a scientist or researcher does. A few simply said they did not feel like a scientist or researcher at all (see the first quotation below). A few others said they could see how others might relate *Q?rius* experiences to what a scientist does but that they did not (see the second quotation).

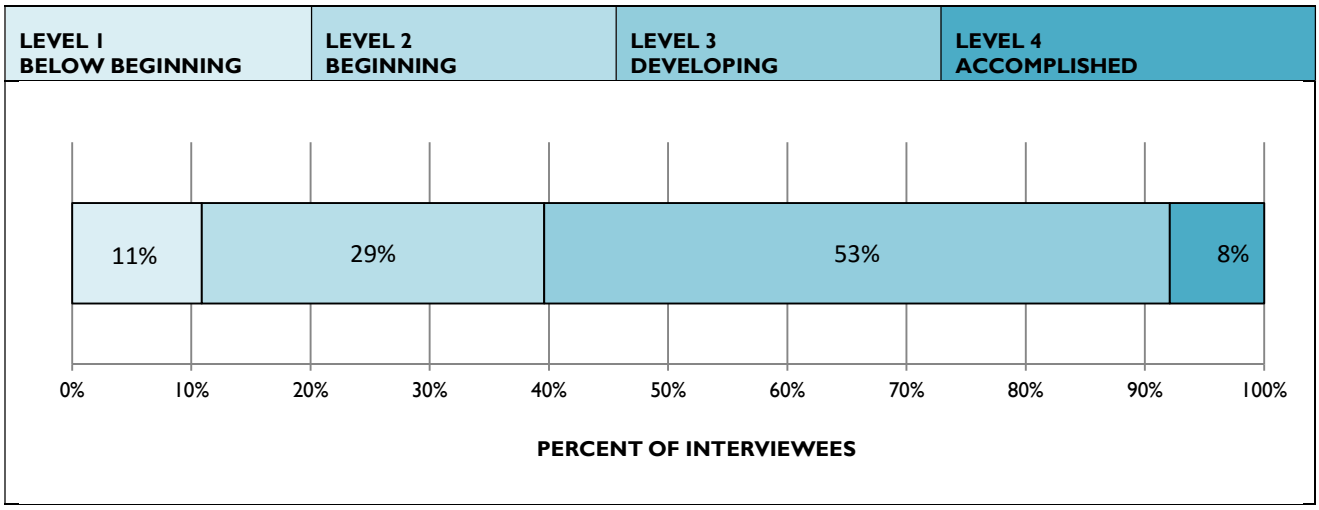
> No, I [did not feel like a scientist or researcher]; I felt more like I'm just looking at stuff. A scientist or researcher they don't know anything about it basically. They have no background knowledge like that was on the signs here. So they have to find out everything and not just read about it. [female 15, repeat visitor]

> I could see how other people who might have spent more time than we did would because there are microscopes and it looks like an atmosphere for learning things. [female 24, repeat visitor]

RECOGNIZED THE ADVANTAGES OF AUTHENTIC PROCESSES, TOOLS, AND OBJECTS

When interviewees described their experiences in *Q?rius*, the majority scored at the top half of the continuum for recognizing the advantages of engaging with authentic processes, tools, and objects (see Figure 14). There are no statistical differences in scores by gender, age (teen versus adult), and NMNH visitation (first-time versus repeat). However, note that when asked, 67 percent said they know that the processes, tools, and objects in *Q?rius* are authentic, and these visitors scored statistically higher than those who had not realized that processes, tools, and objects are authentic.

FIGURE 14



LEVEL 4 – ACCOMPLISHED

The 8 percent of interviewees who scored at the accomplished level clearly described how engaging with authentic objects, tools, or processes in *Q?rius* enhanced their ability to understand and engage with the natural world. These interviewees provided a concrete and specific example of an experience they had in *Q?rius*. Some of these interviewees described the awe they felt when engaging with authentic objects, tools, and processes (see the first quotation below). Some others described said the authentic objects, tools, and processes provided richer experiences since they could explore details of an object genuinely (see the second quotation). Note that all of these interviewees are youth.

> (You kind of touched upon this, but in the spaced objects like the specimens in the collections and the tools like microscopes are authentic. Did you realize that when you first came in?) That's part of the reason that I was amazed, because usually when you think of an exhibit like this, that's somewhat colorful and oriented toward the tweens stage, I was kind of amazed that they were such real artifacts. For instance the Neanderthal skulls, which are real, I really enjoyed that. My eyes got really big and I was like that's really cool. [male 16, repeat visitor]

> I sort of knew [they were authentic] because the microscopes here are a lot different than the kinds I've used at school; they're more like a video camera sort of, but you can zoom in more and stuff like that. And ours at school, it's just light; the objects have to be transparent to see through it. It was a lot more interesting to see it as you could zoom in as far as you wanted without it having to be transparent, which is sort of sounds vague, but it looks really cool to me. I thought it was much more interesting because I could look at whatever I was looking at if it was my fingerprint or a twenty dollar bill, or like a piece of sand. I could look at it in detail, truly examine it, and just completely get in depth with it. [female 13, first-time visitor]

LEVEL 3 – DEVELOPING

The 53 percent that scored at the developing level provided a response that suggested how engaging with authentic objects, tools, or processes in *Q?rius* enhanced their ability to understand and engage with the natural world. Some of these interviewees said authenticity is important in general but did not provide an example from their experience in *Q?rius* (see the first and second quotations below). Some others may demonstrate respect for objects, tools, and processes, such as by saying s/he needed to be careful when handling authentic objects (see the third quotation).

> I wouldn't really get to [engage with authentic objects, tools, or processes] anywhere else, so I thought that was cool. [female 22, first-time visitor]

> Yes, absolutely [I realized that they were authentic]. (And how, if at all, did that affect your experience?) I thought it was great. I mean, you can't really evaluate that stuff otherwise, right? So, yeah. I thought it was awesome. [male 21, first-time visitor]

> Knowing that it's real, it made me want to be more careful because you can't get it another time. [female 11, repeat visitor]

LEVEL 2 – BEGINNING

The 29 percent that scored at the beginning level remained relatively neutral about using authentic objects, tools, and processes to understand and engage with the natural world. Some interviewees used non-committal language, such as "I guess it was useful," or made other ambivalent comments (see the first quotation below). A few were generally ambivalent since they did not know the objects, tools, and processes were authentic and were not sure how knowing that might have changed their experience.

> Well I was using the same objects they were, and it's kind of strange. [female 10, repeat visitor]

> (Did you realize that the objects, tools, and processes were authentic?) I did not. (Does knowing this change your perception of your experience?) Probably. (How so?) Because, I don't know. [female 12, first-time visitor]

LEVEL 1 – BELOW BEGINNING

The 11 percent that scored at the below beginning level did not describe the benefits of using authentic objects, tools, and processes in *Q?rius* to understand and engage with the natural world. Some of the interviewees said it did not matter whether the objects, tools, and processes were real or replicas (see the first quotation below). Some named advantages to using replicas over the real thing (see the second quotation).

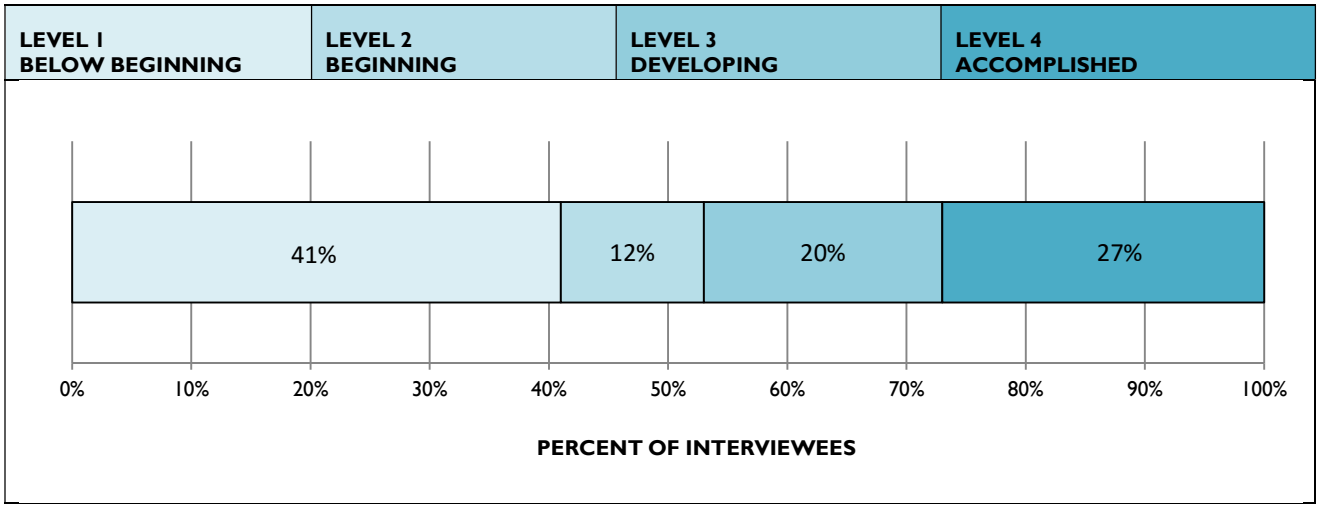
> Well, it's because I'm still going to use them. Because they're authentic, it doesn't change anything. That just means that they're the real deal. [female 10, repeat visitor]

> The truth is, it did not [matter that the objects, tools, and processes are authentic], because if you give me an even fancier microscope, I don't think I would be able to use it, or whether I look at it at a particle level or just based on 100 zoom lens, I don't think it makes too much of a difference to the casual visitor. You also don't want to make it too complicated because then that scares people away as well. [male 33, repeat visitor]

IDENTIFIED QUESTIONS AND CURIOSITIES THAT THEY EXPLORED IN *Q?RIUS*

When interviewees were asked to identify questions or curiosities that they explored in *Q?rius*, the majority scored at the bottom half of the continuum, meaning they could not clearly name any questions or curiosities (see Figure 15). There are no statistical differences in scores by gender and age (teen versus adult). However, repeat visitors to NMNH scored statistically higher than first-time visitors.

FIGURE 15



LEVEL 4 – ACCOMPLISHED

The 27 percent that scored at the accomplished level clearly recalled a question or activity they explored in *Q?rius* and what they did to explore the question or activity. These interviewees provided a concrete and specific example of what they explored and how they explored it. The explanation goes beyond just "reading" or learning." The questions and curiosities may be those articulated in an activity (see the first quotation below) or one generated by the interviewee (see the second quotation).

> (You could explore many questions in *Q?rius*, either your own questions or those posed specifically in the activities; do you recall any questions that you explored?) Well I guess back to the smell. It was interesting to try to recall to your own memory and through the experience situations where those smells were familiar and trying to find out exactly where it comes from. (How did you explore those questions?) I guess we just smelled the specimens and just thought and chatted about it and tried to figure them out. [male 12, repeat visitor]

> I [explored] the secret tiny insects through technology because they are so small that you can't see them with the naked eye. (How did you explore that?) There weren't any questions at that station, but I was wondering how animals could be so tiny that you can't even seem them through your own eyes. They didn't really look real. They just looked like toys or something. I was wondering how something could look that amazing. [female 14, first-time visitor]

LEVEL 3 – DEVELOPING

The 20 percent of interviewees that scored at the developing level recalled a question or activity they explored in *Q?rius* and what they did to explore the question or activity, but responses were vague overall. Alternatively, some interviewees provided a vague question but explained in detail what they did to explore it (see the first quotation below). Others provided a specific question but gave a vague description of what they did to explore it (see the second quotation).

> I think I remember looking at how you could imitate or what the insect was. That one was fun. By using the tools like the rhythm sticks and stuff to find out what insect it was and how I could imitate it. [male 12, repeat visitor]

> Yeah, [I explored] how do they find the genes or how do they extract the DNA of mammals and other animals. It was mentioned in a couple of places and what they do is they use specific machines that extracts enzymes and all that stuff. [male 10, first-time visitor]

LEVEL 2 – BEGINNING

The 12 percent of interviewees that scored at the beginning level provided a broad or general question explored in *Q?rius* but did not describe what they did to explore that question or activity (see the quotation below). A few of these interviewees spoke generally about how scientists explore questions.

> I saw the dinosaur tooth, and they asked why I thought it would face backwards. I said because it would catch onto something if it were facing forward. [female 11, repeat visitor]

LEVEL 1 – BELOW BEGINNING

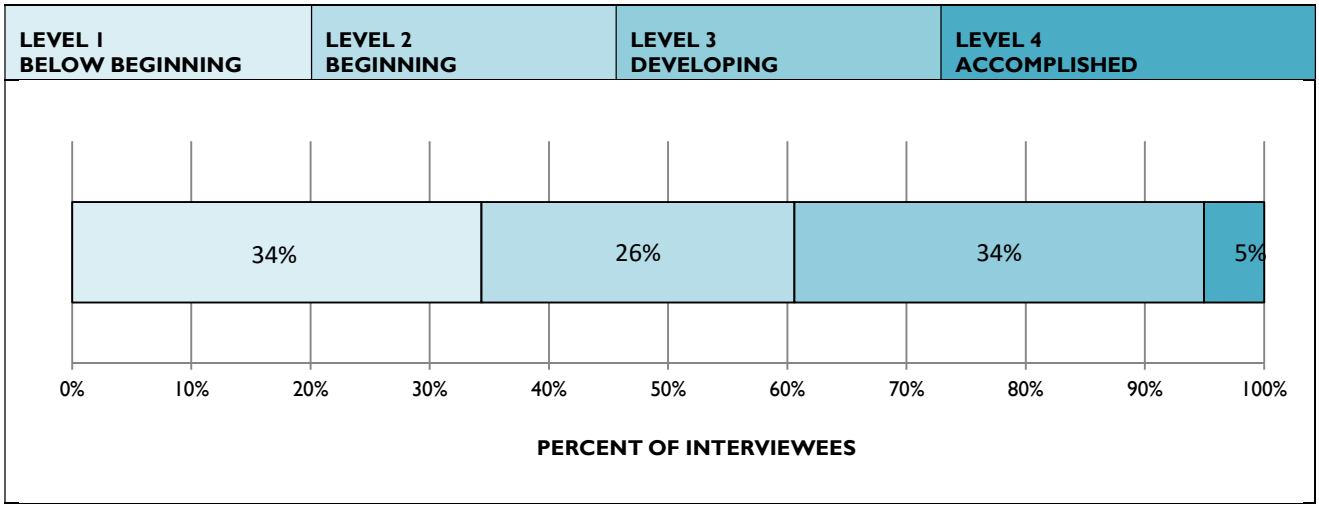
The 41 percent of interviewees that scored at the below beginning level did not recall any questions they explored in *Q?rius*. The majority of these interviewees said they just looked around *Q?rius* and did not explore any questions (see the first quotation below). A few others provided responses that were off-base and unrelated to exploring questions.

> Like I said, I just kind of went through it kind of quickly and just looked at the stuff; stood in the background. So, there's not one thing that stood out that I'm like, 'Oh, it was a eureka moment!' Sorry. [male 25, first-time visitor]

IDENTIFIED QUESTIONS AND CURIOSITIES THAT THEY WOULD LIKE TO EXPLORE AS A RESULT OF *Q?RIUS*

When interviewees were asked to describe other questions or curiosities they would like to explore as a result of their experiences in *Q?rius*, the majority scored at the bottom half of the continuum (see Figure 16). There are no statistical differences in scores by gender and NMNH visitation (first-time versus repeat). However, youth scored statistically higher than adults.

FIGURE 16



LEVEL 4 – ACCOMPLISHED

The 5 percent of interviewees that scored at the accomplished level clearly described additional research topics or questions inspired by *Q?rius* that they would like to explore further. These interviewees provided a specific and concrete example of the question or topic they would like to explore. Often, these interviewees described a specific specimen they would like to learn about, providing details regarding what about the specimen interested them and what else they want to know (see the first quotation below). Some of these interviewees described an interest that had personal relevance to them and their life (see the second quotation).

> I want to learn more about the animals that I liked, where they find them and where they lived. (Why is that?) It is actually pretty cool [seeing] an animal close and I want to learn more about the shark's teeth. I also want to learn more about the Megalodon because his teeth are so huge, and I want to know more about that. [male 16, first time-visitor]

> One of my questions was over at the smelling station, where you smell insects. So, we were smelling stinkbugs. And it's kind of funny, because if you step on one, it smells really bad [even from far away]. But if you smell it up close, it doesn't actually smell as bad as it does from far away. (And why is that something you want to explore?) I guess it's because I live in an area where there are a lot of stinkbugs. So, people are always afraid of stinkbugs. And so, I think that the reason why everyone's afraid of them is because they smell really bad, and they're just afraid of the smell getting to them, so they don't want to be near them. [female 14, first-time visitor]

LEVEL 3 – DEVELOPING

The 34 percent of interviewees that scored at the developing level described additional research topics or questions that they would like to explore, but their response was broad or vague overall. Some of these interviewees just named a broad topic of interest, such as fossils or rocks and minerals (see the first quotation below). Others identified a topic and began to describe what about that topic they would

like to explore, but their responses were broad and did not include clear linkages to *Q?rius* experiences (see the second quotation).

> It just made me curious about a lot of these fossils and other things like these rocks and . . . . I always thought they were interesting but it was cool to actually see them and look into the stuff differently than just online or in pictures and videos. [male 13, repeat visitor]

> Well everything about life, and for example in the mummies, like I wanted to know more about the meanings and why they did that and how they did it. And about the animals. Everything. [female 16, first-time visitor]

LEVEL 2 – BEGINNING

The 26 percent of interviewees that scored at the beginning level recalled new learning or "ah-ha" moments in *Q?rius* but they do not express any new questions or curiosities beyond what they explored in *Q?rius* (see the first quotation below). A few of these interviewees expressed an interest in exploring more of *Q?rius* or the Museum in general (see the second quotation).

> There are a lot more animals than you really know. You know a lot of popular animals but don't know the ones that are very rare in the area that you live in. [male 11, first-time visitor]

> [We were wondering] what else is there that we didn't get to look at in the seven minutes we spent here—it was very short—because it was fascinating, and we wanted to see more of it. [male 24, repeat visitor]

LEVEL 1 – BELOW BEGINNING

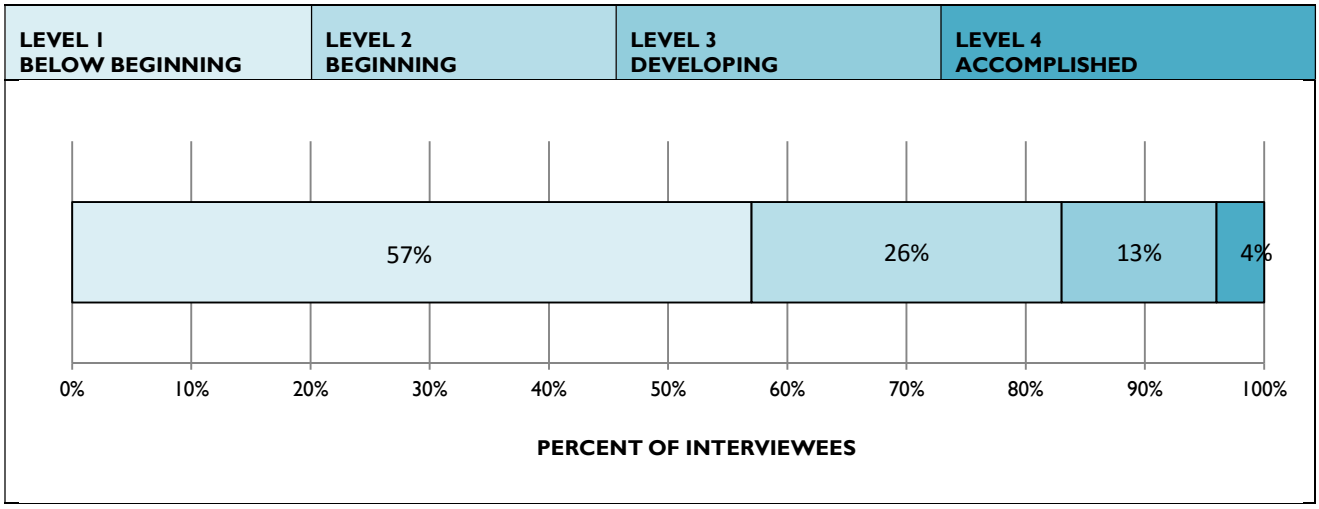
The 5 percent of interviewees that scored at the below beginning level did not suggest additional research topics or questions. A few of these interviewees provided tangential response about *Q?rius* being "interesting" or "fun" in general.

> (What, if any, other questions did your visit to *Q?rius* spark?) Nothing really. I mean it's very interesting. I think that there's a lot of opportunity here. [male 25, first-time visitor]

FOUND RELEVANCE IN ENCOUNTERS WITH EXPERTS, RESEARCHERS, OR FACILITATORS

The majority of interviewees scored at the bottom half of the continuum for finding relevance in encounters with experts, researchers, or facilitators encountered in *Q?rius* (see Figure 17). There are no statistical differences in scores by gender, age (teen versus adult), and NMNH visitation (first-time versus repeat).

FIGURE 17



LEVEL 4 – ACCOMPLISHED

The 4 percent of interviewees that scored at the accomplished level clearly describe an interaction with experts, researchers, or facilitators. Interviewees may not remember the name of the person, but they remember specific details about natural history as conveyed by the expert, researcher, or facilitator, such as what the scientist studies or what topic they discussed (see the quotations below).

> There was a shark tooth. [The facilitator] seemed to know a lot about everything. [S/he] knew where it was at and knew the history about it and [s/he] was able to teach me. (Why does that stand out for you?) I guess you could say they're scientists, and they're teaching us how to become scientists ourselves. [male 16, first-time visitor]

> Some lady over there just like taught me about types of moles and muskrats. I just didn't realize the importance of them. [female 14, first-time visitor]

LEVEL 3 – DEVELOPING

The 13 percent that scored at the developing level clearly describe interacting with an expert, researcher, or facilitator in *Q?rius* but their recollection of the interaction does not clearly indicate that the interaction was personally relevant. For instance, the majority of interviewees described how the experience was important to them, but their explanation did not suggest how the interaction made a natural history topic relevant to them (see the first quotation below). A few described what they learned from the interaction but did not expand upon why it is personally relevant to them (see the second and third quotation).

> I really like how the people at *Q?rius* ask you questions and they give you examples like, 'Hey, if you do this, then it'll sound a little similar or if you do this, then it'll look really cool, or, 'Hey, how about you put this here,' and then you can look at it, see little part right there. That's really cool. And then they can sort of guide you in what they think—they've seen other people do or

they've done themselves. And it's really cool because they are experts and they know what happens if you do certain things. [female 13, first-time visitor]

Well, I know I met someone that was like when I went to the one about Mars, she was asking me if I was interested in science, and I said yes. And she was talking with me, and she told me that she was going into geology. [male 12, repeat visitor]

The girl in the video—I forgot her name already. She put that camera down under the sea like it was a tiny like video thing, and you get to find out like what was living on there. [male 10, first-time visitor]

LEVEL 2 – BEGINNING

The 26 percent that scored at the beginning level recalled interacting with an expert, researcher, or facilitator in *Q?rius* but did not describe or suggest that the interaction was personally relevant. Most described how the expert, researcher, or facilitator helped them in *Q?rius* (see the quotations below).

I liked this women in the vest; she sort of kind of made it clear how to interact with the information and the artifacts, which was good, because you sort of aren't sure what you can and cannot touch, and how to interact in the space, so I thought that was good. [male 35, first-time visitor]

There was one lady who helped us with the computers, explaining to me how the different information was related. [female 14, first-time visitor]

LEVEL 1 – BELOW BEGINNING

The 57 percent that scored at below beginning did not recall interacting with or seeing an expert, researcher, or facilitator in *Q?rius*, either through person-to-person interaction or through videos of scientists. Some interviewees described their experience in *Q?rius* as passive—not interacting much or observing only (see the first quotation below). A few provided responses that were off-base or unrelated.

Overall, I kind of stayed in the background. I didn't go up and interact a lot. I was just watching because I feel that this space is more for younger people to really get in here and touch stuff. [male 25, first-time visitor]

CONTROL AND TREATMENT COMPARISON

The following section presents results of a control and treatment comparison used to measure the affects of *Q?rius*. Control and treatment groups were asked identical questions, but the control group was interviewed before visiting *Q?rius* and the treatment group after. Results in the following sections are reported by control and treatment group, but there are no statistical differences in any of the five measures. Results across the continuum, however, present useful information for how visitors think about natural history:

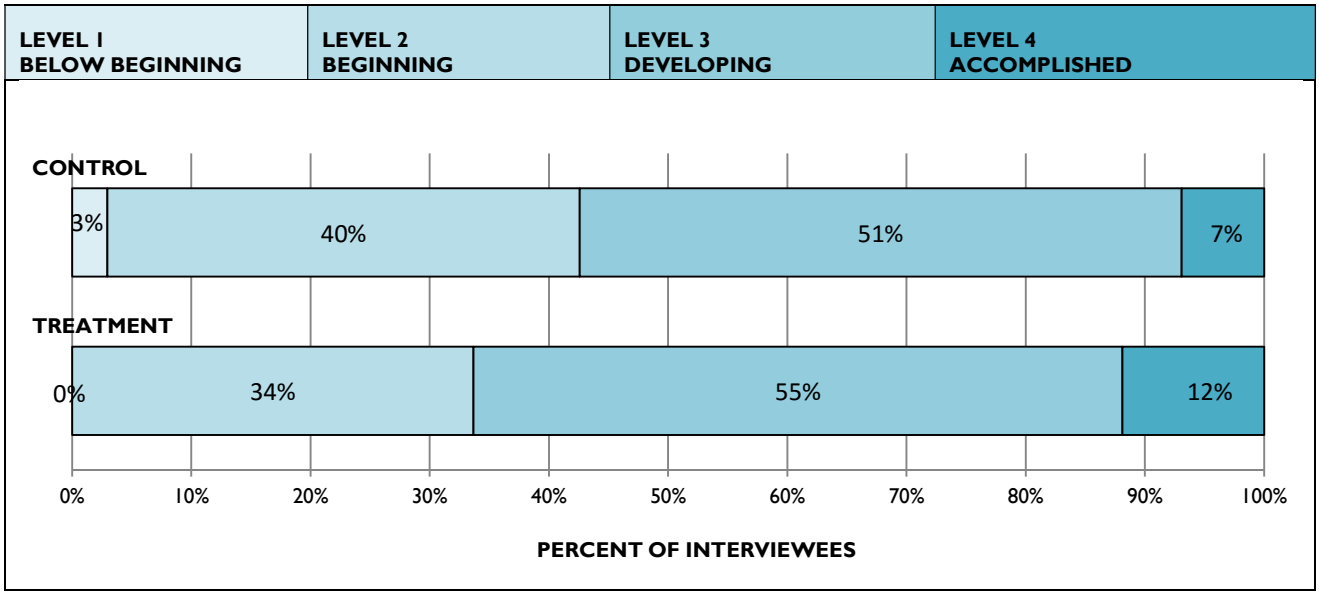
- 62 percent understand how collections are used to understand the natural world.
- 58 percent express interest in natural history research and the natural world.
- 49 percent recognize how natural history is relevant to their life.
- 30 percent are familiar with current natural history topics.
- 19 percent are familiar with types of natural history research and scientists.

The following pages contain an in-depth description of how interviewees scored for each of the six measures described above. Findings are presented in order from highest to lowest achievement.

UNDERSTANDING OF HOW COLLECTIONS ARE USED TO UNDERSTAND THE NATURAL WORLD

The majority of interviewees scored at the top half of the continuum on their ability to describe how natural history collections are used to understand the natural world (see Figure 18). There are no statistical differences in scores by gender and NMNH visitation (first-time versus repeat). However, adults scored statistically higher than youth.

FIGURE 18



LEVEL 4 – ACCOMPLISHED

The 7 percent of control and 12 percent of treatment interviewees that scored at the accomplished level made a specific and concrete connection between natural history objects and larger environmental and social issues, such as habitat destruction, extinction, climate change, and pollution (see the first quotation below). These responses all evoked or specifically mentioned the ecosystems, the web of life, or generally described how the natural world is connected.

> I think as far as the extinction and kind of propagation of the species. I think it [the object] would probably tell them the impact we're having on the environment of that particular animal, for sure. . . . So, I think by studying the species and animals, plants, whatever that we share our environment with, I think that it can tell us a lot about the impact that we're having, and then figure out what is exactly having the impact, right? Is it because we're polluting? The greenhouse effect? [male 21, first-time visitor]

LEVEL 3 – DEVELOPING

The 51 percent of control and 55 percent of treatments interviewees that scored at the developing level talked about natural history objects in ways that suggest but do not explicitly indicate a larger environmental and social context. The majority of these interviewees broadly or generally refer to environmental and/or social issues in describing ecosystems or the interconnection of life (see the first quotation below).

> I think [natural history scientists may ask] what it ate and what eats it and its habitat, maybe its niche. [Natural history scientists] could probably tell you the health of the ecosystem based on how it died. [female 17, repeat visitor]

> [Scientists might ask] what invertebrate was in there? What life form was living, and what was the age of the rock? When were they living? (So what might this object or these objects tell scientists about the natural world?) What was going on in a different period of time? [female 66, repeat visitor]

LEVEL 2 – BEGINNING

The 40 percent of control and 34 percent of treatment interviewees that scored at the beginning level asked questions or made statements that were focused on specimens; however they do not suggest a larger environmental or social context. Some of the interviewees gave descriptive and accurate responses but they do not go beyond the specimens (see the first quotation below). Additionally, some of these interviewees consider interactions between the specimen at hand and others or forces in the natural world but not to the extent to suggest social and environmental issues (see the second quotation).

> [Scientists] would probably ask why they fly so fast or why they're narrow when they fly. (What might this object tell scientists about the natural world?) How they [hummingbirds] cooperate by eating and drinking and surviving. [male 16, first-time visitor]

> [Scientists may ask] what [the rock] is comprised of and how it was made. (What might this object tell scientists about the natural world?) Previous condition. What these rocks went through for them to form. [male 55, first-time visitor]

LEVEL 1 – BELOW BEGINNING

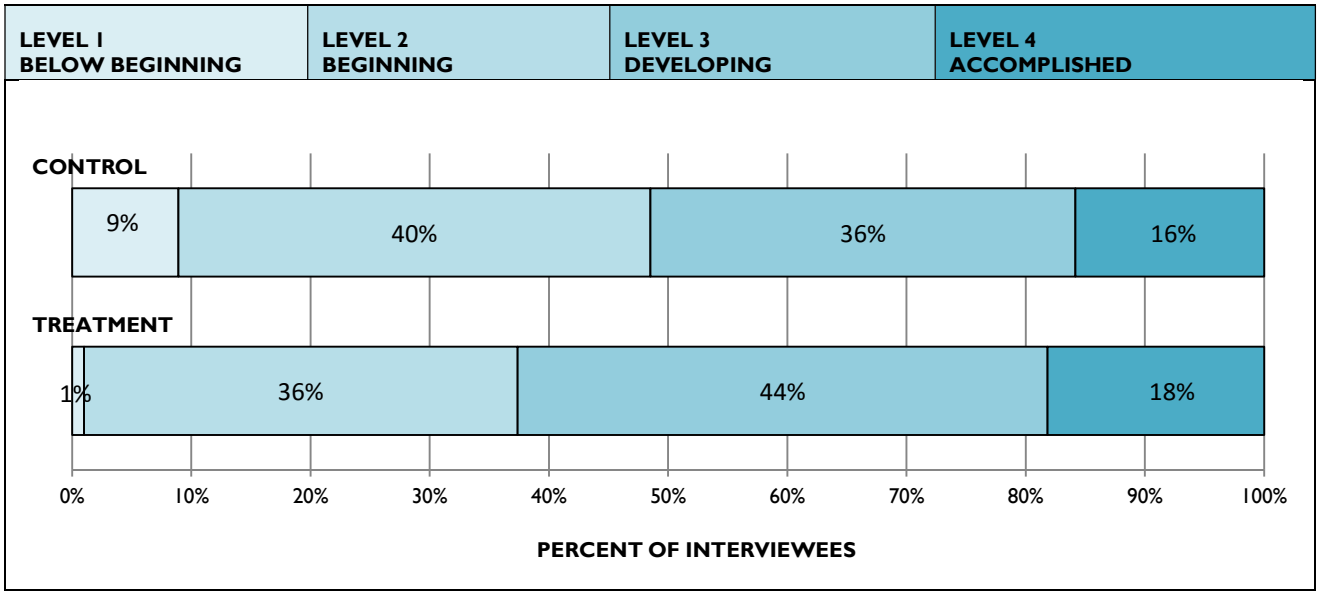
The 3 percent of control interviewees that scored at the below beginning level did not describe how collections are used to understand the natural world. Two interviewees asked questions or made comments that were off-base and not related to the object and its relation to the natural world, and another said she simply did not know (see the quotation below).

> (So what might this object tell scientists about the natural world?) I don't know. Good question. I don't know. [female 36, first-time visitor]

INTEREST IN NATURAL HISTORY RESEARCH AND THE NATURAL WORLD

The majority of interviewees scored at the top half of the continuum for interest in natural history research and the natural world, meaning that they expressed interest in getting involved in natural history research and the natural world (see Figure 19). There are no statistical differences in scores by gender, age (teen versus adult), and NMNH visitation (first-time versus repeat).

FIGURE 19



LEVEL 4 – ACCOMPLISHED

Sixteen percent of control and 18 percent of treatment interviewees expressed high interest in natural history research or with the natural world. These interviewees provided concrete and specific responses either about how a scientific process, such as conducting observations, is interesting (see the first quotation below) or why natural history topics, like evolution, are so interesting to them (see the second quotation). These interviewees spoke with conviction about that interest.

> I like the observation aspect of natural history, like how what many people look over can be observed and something new can be drawn from it. Even though we've been here for thousands of years, we're still learning more and more things. For instance the ocean we've discovered maybe one to two percent of it and we've been here for years and we've only now been able to touch the surface of what's out there and how we can benefit from it. [male 16, repeat visitor]

> I love science, so I think it's all really cool. I think I like to be responsible. I want to be a responsible member of the planet. So, I think that is—I also just find it fascinating. I just think life in general is just fascinating, whether it's plants and animals and how they've evolved to adapt to their environments and all that stuff. I just think that I find it all super interesting. [male 21, first-time visitor]

LEVEL 3 – DEVELOPING

Thirty-six percent of control and 47 percent of treatment interviewees expressed moderate to high interest in natural history research or with the natural world. These interviewees generally described what was interesting to them about natural history, but their responses lacked conviction. For instance, some of these interviewees initially provided a vague response about what interests them and then

elaborated more specifically about why it is interesting (see the first quotation below). A few others described specific interests, but when asked about how they might explore their interests, provided responses that lacked sincerity (see the second quotation).

> (What, if any, parts of natural history research interest you?) Yeah, I mean global warming is one of the areas, evolution of humans, trying to find more answers. (What about those specifically interest you?) Well, one thing, this whole melting which is happening in Alaska area, right? Like, where we are seeing like ice melting, and I'm really curious to see whether it's just because of humans—like effect of humans or maybe just like a natural Earth evolution, where maybe the core of the Earth is warming up. I don't know. [male 37, repeat visitor]

> I would say definitely fossils, really how things from millions of years ago are still preserved today and just that astounds me still. (What about that interests you?) Just it almost seems illogical that it can happen, and it's natural. There's nothing weird about it. It just happens over time and, it's just very weird to me, but I like that. (How might you go about pursuing that interest?) I could go into fossil hunting and research nature and science. [male 23, repeat visitor]

LEVEL 2 – BEGINNING

Forty percent of control and 36 percent of treatment interviewees expressed low to moderate interest in natural history research or the natural world. The majority of these interviewees provided a vague response about what interests them with little to no elaboration about why it is interesting (see the quotation below).

> (Based on what you know about natural history research, what, if any, parts of that research interest you?) I would say probably the reefs and what's in the water. (What about that interests you?) Well, it's because I like swimming in the water. (How might you go about pursuing that interest to learn more about it?) I would probably read books about it or search about it. [female 11, repeat visitor]

LEVEL 1 – BELOW BEGINNING

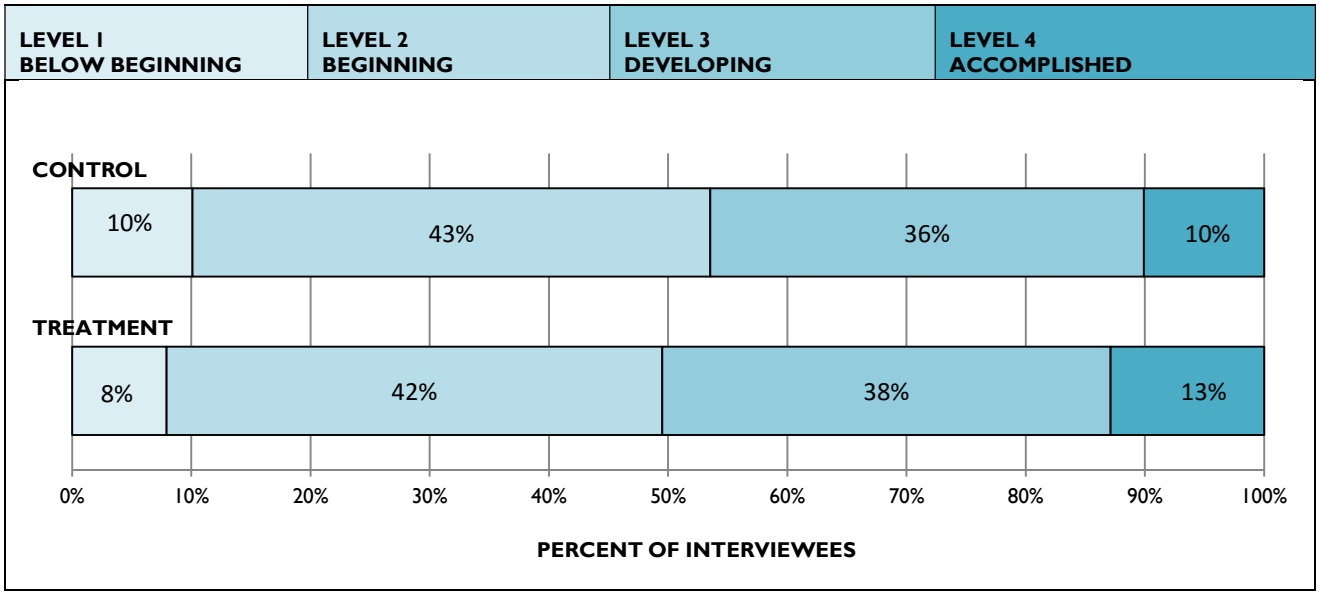
Nine percent of control interviewees and 1 percent of treatment interviewees did not express an interest in natural history research or the natural world (see the quotation below).

> (What about natural history interests you?) Not so much natural history. We just left my favorite, which was the Air and Space Museum. I'm a universe person. [female 66, repeat visitor]

RECOGNITION OF HOW NATURAL HISTORY IS RELEVANT TO THEIR LIFE

The majority of interviewees scored at the bottom half of the continuum for recognition of how natural history is relevant to their life, meaning they generally did not recognize how natural history is relevant to their life (see Figure 20). There are no statistical differences in scores by gender and age (teen versus adult). However, repeat visitors to NMNH scored statistically higher than first-time visitors.

FIGURE 20



LEVEL 4 – ACCOMPLISHED

Ten percent of control and 13 percent of treatment interviewees scored at the accomplished level. Their responses provided clear linkages between natural history research and personal experiences, interests, desires, or responsibilities. These interviewees spoke with conviction about the relevance they described (see the quotation below).

> I think it is important for us to understand the impact that we have on the world around us and how that affects millions of species of plants and animals that we share it with, right? So, if we want those things to be around, then we need to understand those things and modify the way that we live sometimes. [male 21, first-time visitor]

LEVEL 3 – DEVELOPING

Thirty-six percent of control and 38 percent of treatment interviewees scored at the developing level, providing examples of how current natural history research is generally (versus personally) relevant to their life. Some of these interviewees described the connection in broad or general terms such as "all life is connected" or "what affects one species affects another" (see the first quotation below). Additionally, some used terms like "we" or "us" versus "I" or spoke with uncertainty (see the second quotation).

> If the natural world isn't okay, then that's going to reflect back on how the world is for us too. [female 24, repeat visitor]

> You don't know who you are until you know where you came from, so it basically lays the groundwork for where our civilization has been, and maybe help us map out the future. [male 25, first-time visitor]

LEVEL 2 – BEGINNING

Forty-three percent of control and 42 percent of treatment interviewees scored at the beginning level. They generally described a connection between natural history research and their life, but their examples were vague. For instance, some interviewees said natural history research generally increases their or others' knowledge (see the quotation below). A few others provided examples that are circular in logic, such as "it is relevant because it is relevant to everyone" or as in the second quotation.

> So I can learn about the history of my planet. [male 11, first-time visitor]

> The way it [the object] could be utilized for our benefit. [male 55, first-time visitor]

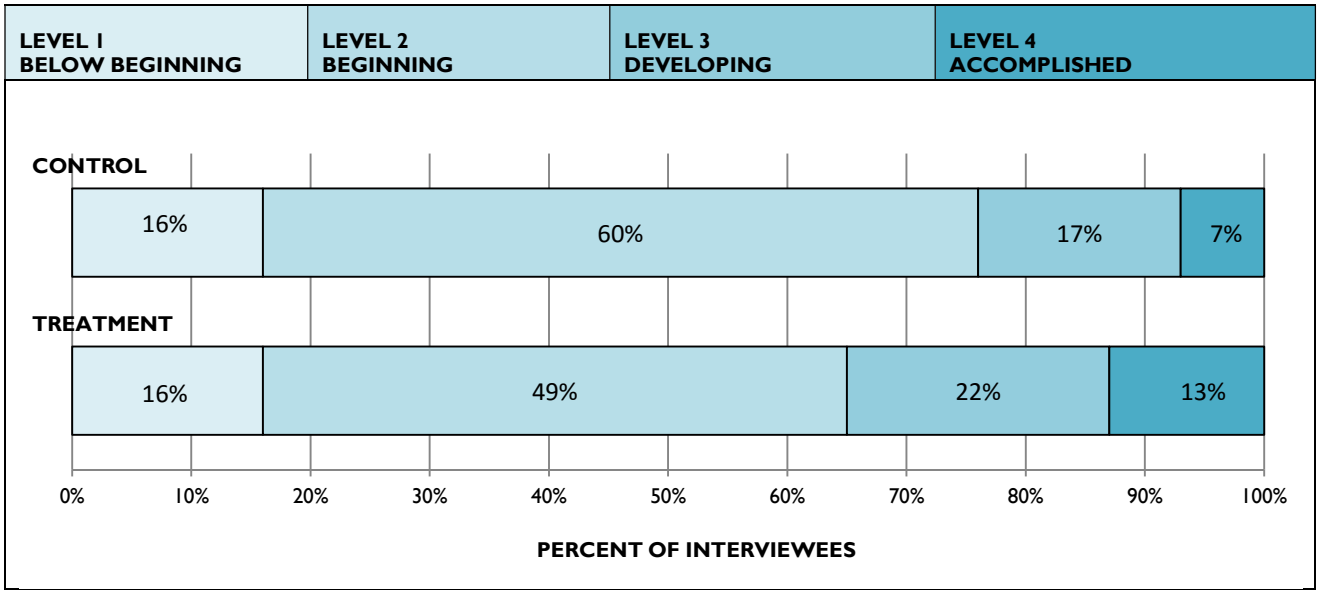
LEVEL 1 – BELOW BEGINNING

Ten percent of control and 8 percent of treatment interviewees scored at the below beginning level; they did not provide an example of natural history research being done that is relevant to their life. Some of these interviewees say they did not know how it relates or that it does not, while some others provided response that were off-base.

FAMILIARITY WITH CURRENT NATURAL HISTORY RESEARCH

The majority of interviewees scored at the bottom half of the continuum for familiarity with natural history research, meaning they either could not describe what a natural history researcher studies or provided an extremely vague response (see Figure 21). There are no statistical differences in scores by gender, age (teen versus adult), and NMNH visitation (first-time versus repeat). Interestingly, when asked how they know about natural history research, there was not a primary source for information; formal education through school was most mentioned (18 percent), followed by television, which included the Discovery Channel, History Channel, and other networks or shows (15 percent).

FIGURE 21



LEVEL 4 – ACCOMPLISHED

Seven percent of control and 13 percent of treatment interviewees scored at the accomplished level, providing examples of natural history research that suggests a greater context for the research (e.g., to what end the research is being conducted) and clearly demonstrates that the research is current (see the quotation below).

> One of my friends is a biologist, and she's studying elephants and how they react to others, how they interact with, talk to other elephants. [female 14]

LEVEL 3 – DEVELOPING

Seventeen percent of control and 22 percent of treatment interviewees scored at the developing level. They provided an example of natural history research that suggests a greater context for the research (e.g., to what end the research is being conducted), but the response is vague and does not clearly demonstrate that the research is current (see the quotations below).

> Biologists are studying how diversity is decreasing on our Earth. [female 43, repeat visitor]

> They study fossils and find out what was there and how it got there. [female 13, first-time visitor]

LEVEL 2 – BEGINNING

Sixty percent of control and 49 percent of treatment interviewees scored at the beginning level. They provided examples of what researchers do, but their responses were too vague to determine whether the work is current or otherwise. For instance, some interviewees just describe what scientists study with no clear link to a time period (see the first quotation below). Other interviewees describe a current event but does not clearly indicate what is being studied (see the second quotation).

> Digging up dinosaurs. [male 10, first-time visitor]

> I heard that [NMNH] has a new T-Rex coming in. . . . I guess it was found in Montana on some woman's ranch. [male 59, repeat visitor]

LEVEL 1 – BELOW BEGINNING

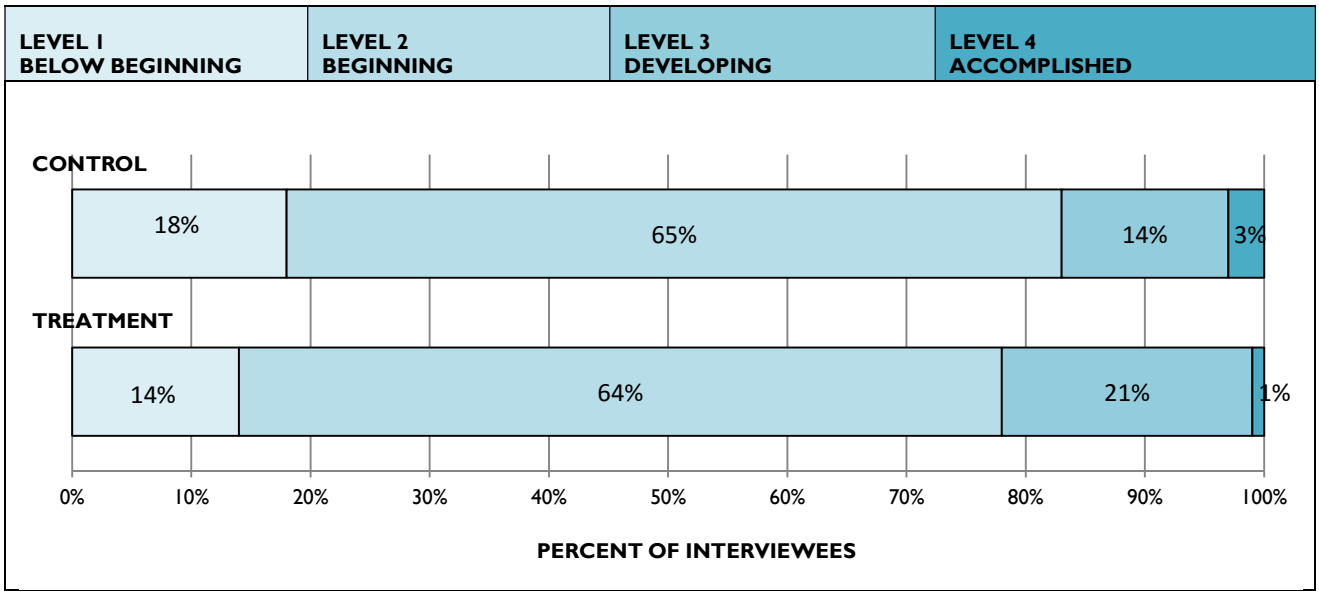
Sixteen percent of control and 16 percent of treatment interviewees scored at the below beginning level. They could not provide an example of natural history research (current or otherwise).

> I actually can't. I don't really know what. . . . I guess different fossil digs and like Egypt or something I've heard about. I haven't really, I honestly don't know of really any. [male 23, repeat visitor]

FAMILIARITY WITH TYPES OF NATURAL HISTORY RESEARCH AND SCIENTISTS

The vast majority of interviewees scored at the bottom of the continuum for familiarity with types of natural history research and scientists (see Figure 22). In describing natural history, the greatest percentage of visitors described biologists (35 percent), followed by archaeologists (28 percent) and geologists (23 percent). There are no statistical differences in scores by gender, age (teen versus adult), and NMNH visitation (first-time versus repeat).

FIGURE 22



LEVEL 4 – ACCOMPLISHED

Three percent of control and 1 percent of treatment interviewees scored at the accomplished level. They described a subject that a natural history scientist studies and provided a larger context for the scientist's work (e.g., why the scientist studies what they do) (see the quotation below).

> Biologists—they study cells and microorganisms, things that make our body and how they function, and how they work, and how they relate to things around them. [female 14]

LEVEL 3 – DEVELOPING

Fourteen percent of control and 21 percent of treatment interviewees scored at the developing level. They described the subject a natural history scientists or researchers study, but their responses only suggest a larger context for the scientist's work (e.g., why the scientist studies what they do). For instance, some interviewees provided a larger context for the scientist's study that is vague or general (see the quotations below), while some others provided a larger context that is only partially correct.

> Biologists. (What do biologists study?) Probably life and how it works in the environment. [female 17, repeat visitor]

> Geologists. (What do geologists study?) The earth, the rock layers, and when things occurred. [male 59, repeat visitor]

LEVEL 2 – BEGINNING

Sixty-five percent of control and 64 percent of treatment interviewees scored at the beginning level. They described the subject scientists or researchers study but do not expand beyond that. Some of

these interviewees only named the subject but not what about that subject scientists research (see the first quotation below). A few only referred to a scientist by name but did not expand on what the scientist studies.

> (So what kinds of scientists or researchers work in a museum like this?) They are scientists who study zoology, biology, and stuff. They study animals, and plants, and stuff like that. [male 11, repeat visitor]

> Like dinosaur people that find them. (What do they study?) Dinosaurs. [male 10, first-time visitor]

LEVEL 1 – BELOW BEGINNING

Eighteen percent of control and 14 percent of treatment interviewees scored at the below beginning level. They could not describe a type of scientist or researcher and what they do. Some of these interviewees provided an inaccurate explanation of what scientists do (see the quotation below). A few said they did not know. A few others describe processes but not a subject of study.

> (What kind of scientists or researchers work in a museum like this?) Biologists. [They study] remains from animals and humans from history. [female 50, repeat visitor]

> (What kind of scientists or researchers work in a museum like this?) I can't remember. Arti-something. I can't remember. (What do they study?) They study artifacts. (And how do you know about that?) I came here before and I seen all of these artifacts and the scientists study them. [male 10, repeat visitor]

8. STEM SEMANTICS SURVEY

INTRODUCTION

The RFP for the *Q?rius* evaluation requested that the evaluator compare some data from the *Q?rius* evaluation to a national database. As such, RK&A searched for a national database that honored the qualities of an informal science experience. While there are many databases about students' science learning, they were often not comparable measures for the qualities that an informal science environment might offer learners or did not meet the needs of the *Q?rius* evaluation. However, RK&A identified the STEM Semantics Survey in the research process. While it does not have a national data set, it was funded by NSF and designed and tested by Knezek and Christensen[10] specifically to assess students' interest in STEM content and careers, which aligns with one of NMNH's goals for the evaluation. The survey was administered to a control group (teen visitors to Affiliate museums who had not visited *Q?rius*) and a treatment group (teen museum visitors at NMNH who had visited *Q?rius*).

METHODOLOGY

RK&A administered surveys to teens at the National Museum of Natural History (NMNH) who had just visiting *Q?rius*—the treatment group. Staff and volunteers at three Affiliate Museums—Denver Museum of Science (DMNS), Perot Museum of Nature and Science (PMNS), and San Diego Museum of Natural History (SDMNH)—administered the survey to teens at their museums who had not seen *Q?rius*—the control group.

Surveys were administered from May 2014 through August 2014. Using a continuous random sampling method, data collectors intercepted 884 teenage visitors at the four museums and invited them to participate in the study. In all, 623 teenagers completed the survey for an overall participation rate of 71 percent.[11] The sample of 623 respondents is fairly evenly divided between the treatment group (53 percent) and control group (47 percent) (see Table 25).

TABLE 25

MUSEUMS (*n* = 623)	%
National Museum of Natural History (NMNH: Treatment Group)	53
Denver Museum of Nature and Science (Affiliate: Control Group)	19
Perot Museum of Nature and Science (Affiliate: Control Group)	18
San Diego Museum of Natural History (Affiliate: Control Group)	10

[10] Tyler-Wood, Tandra; Knezek, G; and Christensen, R. (2010). Instruments for assessing interest in STEM content and careers in *Journal of Technology and Teacher Education* 18(2), 341-363.

[11] Participation rate was 68% at NMNH and 74% at the Affiliate Museums. See the Appendix for comparisons between the sample that declined to participate and the sample that agreed to participate.

DATA ANALYSIS

STEM Semantics Survey data are quantitative and were analyzed using IBM SPSS Statistics Version 20, a statistical package for personal computers. The objectives of the study, as well as our professional experience, were used to inform the analyses, which include descriptive and inferential methods. The Appendix contains a list of all statistical analyses that were calculated.

DESCRIPTIVE

Frequency distributions were calculated for all categorical variables (e.g., gender, grade). Summary statistics, including the median (50th percentile), mean (average) and standard deviation (spread of scores: "±" in tables), were calculated for variables measured at an interval level or higher (e.g., age and ratings).

INFERENTIAL

To examine the relationship between two categorical variables, cross-tabulation tables were computed to show the joint frequency distribution of the variables, and the chi-square statistic (X^2) was used to test the significance of the relationship. For example, having taken an Advanced Placement (AP) Science class is compared by gender to determine if there are frequency differences between boys and girls.

To test for differences between the means of two or more groups, an analysis of variance (ANOVA) was performed and the F-statistic was used to test the significance of the difference. For example, mean ratings of students' perceptions of scientific disciplines are compared by treatment and control group to determine if perceptions are affected by *Q?rius*.

For all inferential tests, a 0.05 level of significance was employed to preclude findings of little practical significance.[12]

REPORTING

Data are reported in tables with explanatory text; percentages within tables may not always equal 100 due to rounding. For all items on the survey, data are compared by the treatment and control group and demographic characteristics. In the body of the report, we have described only those inferential statistics that are statistically significant AND have practical significance for the NMNH. However, tables of all statistically significant findings are in the Appendix.

DESCRIPTION OF RESPONDENTS

This section describes demographic and background characteristics of respondents, including language, gender, age, grade, and types of science classes taken.

GENERAL DEMOGRAPHIC CHARACTERISTICS

General demographic characteristics of respondents are presented in Table 2. Respondents from the control and treatment groups are similar with respect to gender, age group, grade, and language. In the sample as a whole, females outnumber males (60 percent versus 40 percent). Two-thirds of respondents are 13 to 15 years of age, and one-third are 16 to 18 years of age. The median age is 14.5 years. Just over one-half of respondents are in high school (54 percent). Almost all respondents completed the survey in English (98 percent) (see Table 26, next page).

[12] When the level of significance is set to $p = 0.05$, any finding that exists at a probability (p-value) ≤ 0.05 is "significant." When a finding (such as a relationship between two variables) has a p-value of 0.05, there is a 95 percent probability that the finding exists; that is, in 95 out of 100 cases, the finding is correct. Conversely, there is a 5 percent probability that the finding would not exist; in other words, in 5 out of 100 cases, the finding appears by chance.

TABLE 26

	CONTROL	TREATMENT	TOTAL
GENDER (*n* = 612)	%	%	%
Female	58	62	60
Male	42	38	40
AGE GROUP[1] (*n* = 620)	%	%	%
13 – 15 years	67	68	67
16 – 18 years	33	32	33
CURRENT GRADE (*n* = 616)	%	%	%
Middle school (6th – 8th)	46	45	45
High school (9th – 12th)	53	54	54
High school graduate	1	<1	1
LANGUAGE (*n* = 623)	%	%	%
English	98	97	98
Spanish	2	3	2

[1]Age (in years): Range 13 – 18; median age 14.5; mean age 14.8 (± 1.6)

SCIENCE CLASSES

From a list of six science classes, respondents indicated the ones they had taken (see Table 27). Control and treatment group respondents had taken similar classes overall. More than three-fifths of respondents had taken Biology (65 percent) and Earth Science (61 percent). Two-fifths had taken Environmental Science (43 percent) and Chemistry (42 percent). One-third had taken Physics (36 percent).

STATISTICALLY SIGNIFICANT DIFFERENCES BY TREATMENT GROUP

- More control group respondents (versus treatment group respondents) had taken an AP Science class (25 percent versus 16 percent).

TABLE 27

	CONTROL	TREATMENT	TOTAL
CLASSES (*n* = 619)	%	%	%
Biology	66	63	65
Earth Science	62	61	61
Environmental Science	40	46	43
Chemistry	40	43	42
Physics	35	38	36
AP Science[1]	25	16	21

[1]$\chi^2 = 7.788$; $p = .005$

STATISTICALLY SIGNIFICANT DEMOGRAPHIC AND BACKGROUND FINDINGS

- Females (versus males) are more likely to have taken:
  - Environmental Science.
  - Chemistry.
- Middle school students (versus high school students) are more likely to have taken Environmental Science.
- High school students (versus middle school students) are more likely to have taken:
  - Biology.
  - Chemistry.

NUMBER OF SCIENCE CLASSES

The total number of science classes taken was calculated by adding up the classes that respondents identified on the list of science classes. NMNH respondents and Affiliate museum respondents have similar results. With a possible range of 0 to 6 science classes, respondents had taken an average of three classes (median = 3) (see Table 28).

TABLE 28

TOTAL NUMBER OF SCIENCE CLASSES TAKEN[1] (*n* = 619)	CONTROL %	TREATMENT %	TOTAL %
None	7	7	7
1 – 2	39	40	40
3 – 4	40	40	40
5 – 6	13	14	14

[1]Total number of science classes taken: range 0 – 6; median = 3; mean = 2.7 (± 1.5).

PERCEPTIONS OF SCIENTIFIC DISCIPLINES

This section of the report presents respondents' perceptions of science, math, engineering, technology, and having a career in a scientific discipline. Perceptions were measured according to 7-point rating scales in which a rating of 1 is the least favorable response and a rating of 7 is the most favorable response.[13]

PERCEPTIONS OF SCIENCE

Table 29 shows the ratings for five 7-point scales regarding perceptions of science. For all five scales, ratings given by control and treatment group respondents are statistically similar. The scale from 1, "Means nothing," to 7, "Means a lot," has the highest overall rating (mean = 5.9). The scale from 1, "Mundane," to 7, "Fascinating," has the lowest overall rating (mean = 5.5).

[13] On the survey, some 7-point scales used the format 1 = most favorable response to 7 = least favorable response while others used the format 1 = least favorable response to 7 = most favorable response (see survey instrument in the Appendix). For all data analyses, RK&A reverse-coded the scales having 1 = most favorable response into 7 = the most favorable response. This was done so the presentation of results is consistent for all scales.

TABLE 29

7-POINT SCALES: TO ME, SCIENCE IS	*n*	CONTROL MEAN	TREATMENT MEAN	TOTAL MEAN
Means nothing (1) / Means a lot (7)	615	5.8	6.0	5.9
Boring (1) / Interesting (7)	614	5.7	5.8	5.8
Unexciting (1) / Exciting (7)	617	5.6	5.7	5.7
Unappealing (1) / Appealing (7)	616	5.5	5.7	5.6
Mundane (1) / Fascinating (7)	622	5.5	5.5	5.5

STATISTICALLY SIGNIFICANT DEMOGRAPHIC AND BACKGROUND FINDINGS

- Males (versus females) have a more favorable perception of science on the scale 1, "Unappealing" to 7, "Appealing."
- AP Science students (versus non-AP Science students) have a more favorable perception of science" on the scales:
  - 1, "Boring," to 7, "Interesting."
  - 1, "Unappealing," to 7, "Appealing."
  - 1, "Mundane," to 7, "Fascinating."

PERCEPTIONS OF MATH

Table 30 shows the ratings for five 7-point scales regarding perceptions of math. For all five scales, the ratings given by control and treatment group respondents are statistically similar. The scale from 1, "Means nothing," to 7, "Means a lot," has the highest overall rating (mean = 5.5). The scale from 1, "Unexciting," to 7, "Exciting," has the lowest overall rating (mean = 4.0).

TABLE 30

7-POINT SCALES: TO ME, MATH IS:	*n*	CONTROL MEAN	TREATMENT MEAN	TOTAL MEAN
Means nothing (1) / Means a lot (7)	616	5.5	5.5	5.5
Mundane (1) / Fascinating (7)	618	4.3	4.4	4.3
Unappealing (1) / Appealing (7)	617	4.3	4.4	4.3
Boring (1) / Interesting (7)	616	4.4	4.2	4.3
Unexciting (1) / Exciting (7)	614	4.0	4.0	4.0

STATISTICALLY SIGNIFICANT DEMOGRAPHIC AND BACKGROUND FINDINGS

- Males (versus females) have a more favorable perception of math on the scale 1, "Unappealing," to 7, "Appealing."
- AP Science students (versus non-AP Science students) have a more favorable perception of math on the scale 1, "Mundane," to 7, "Fascinating."

PERCEPTIONS OF ENGINEERING

Table 31 shows the ratings for five 7-point scales regarding perceptions of engineering. For all five scales, the ratings given by control and treatment group respondents are statistically similar. The scale from 1, "Means nothing," to 7, "Means a lot," has the highest overall rating (mean = 5.4). The scale from 1, "Unappealing," to 7, "Appealing," has the lowest overall rating (mean = 5.0).

TABLE 31

7-POINT SCALES:		CONTROL	TREATMENT	TOTAL
TO ME, ENGINEERING IS:	*n*	MEAN	MEAN	MEAN
Means nothing (1) / Means a lot (7)	615	5.5	5.4	5.4
Boring (1) / Interesting (7)	616	5.2	5.1	5.2
Mundane (1) / Fascinating (7)	617	5.2	5.2	5.2
Unexciting (1) / Exciting (7)	614	5.0	5.0	5.0
Unappealing (1) / Appealing (7)	614	5.0	4.9	5.0

STATISTICALLY SIGNIFICANT DEMOGRAPHIC AND BACKGROUND FINDINGS

- Males (versus females) have a more favorable perception of engineering on the scales from:
  - 1, "Means nothing," to 7, "Means a lot."
  - 1, "Boring," to 7, "Interesting."
  - 1, "Mundane," to 7, "Fascinating."
  - 1, "Unexciting," to 7, "Exciting."
  - 1, "Unappealing," to 7, "Appealing."
- AP Science students (versus non-AP Science students) have a more favorable perception of engineering on the scale 1, "Means nothing," to 7, "Means a lot."

PERCEPTIONS OF TECHNOLOGY

Table 32 shows the ratings for five 7-point scales regarding perceptions of technology. The scale from 1, "Means nothing" to 7, "Means a lot" has the highest overall rating (mean = 6.0). The scale from 1, "Unexciting" to 7, "Exciting" has the lowest overall rating (mean = 5.8).

STATISTICALLY SIGNIFICANT DIFFERENCES BY GROUP

Treatment group respondents (versus control group respondents) have a more favorable perception of technology on the scales:

- 1, "Mundane," to 7, "Fascinating" (mean = 6.1 vs. mean = 5.8).
- 1, "Unappealing," to 7, "Appealing" (mean = 6.0 vs. mean = 5.7).
- 1, "Unexciting," to 7, "Exciting" (mean = 5.9 vs. mean = 5.6).

TABLE 32

7-POINT SCALES: TO ME, TECHNOLOGY IS	*n*	CONTROL MEAN	TREATMENT MEAN	TOTAL MEAN
Means nothing (1) / Means a lot (7)	616	6.0	6.0	6.0
Mundane (1) / Fascinating (7)[1]	620	5.8	6.1	6.0
Boring (1) / Interesting (7)	615	5.9	6.0	6.0
Unappealing (1) / Appealing (7)[2]	617	5.7	6.0	5.9
Unexciting (1) / Exciting (7)[3]	616	5.6	5.9	5.8

[1]F = 6.070; p = .014
[2]F = 4.633; p = .032
[3]F = 4.436; p = .036

STATISTICALLY SIGNIFICANT DEMOGRAPHIC AND BACKGROUND FINDINGS

- Males (versus females) have a more favorable perception of technology on the scales:
  - 1, "Mundane," to 7, "Fascinating."
  - 1, "Boring," to 7, "Interesting."
  - 1, "Unappealing," to 7, "Appealing."
  - 1, "Unexciting," to 7, "Exciting."
- AP Science students (versus non-AP Science students) have a more favorable perception of technology on the scale 1, "Boring," to 7, "Interesting."

PERCEPTIONS OF A CAREER IN A SCIENTIFIC DISCIPLINE

Table 33 shows the ratings for five 7-point scales regarding perceptions of a career in a scientific discipline. The scale from 1, "Means nothing," to 7, "Means a lot," has the highest overall rating (mean = 5.8). The scale from 1, "Unexciting" to 7, "Exciting" has the lowest overall rating (mean = 5.5).

STATISTICALLY SIGNIFICANT DIFFERENCES BY GROUP

Treatment group respondents (versus control group respondents) have a more favorable perception of a career in a scientific discipline on the scales:

- On the scale 1, "Unappealing" to 7, "Appealing," NMNH respondents have a more favorable perception of a career in a scientific discipline than Affiliate Museum respondents (mean = 5.7 vs. mean = 5.3).

TABLE 33

7-POINT SCALES: TO ME, A CAREER IN SCIENCE, TECHNOLOGY, ENGINEERING, OR MATHEMATICS IS:	*n*	CONTROL MEAN	TREATMENT MEAN	TOTAL MEAN
Means nothing (1) / Means a lot (7)	617	5.8	5.9	5.8
Boring (1) / Interesting (7)	616	5.6	5.7	5.7
Mundane (1) / Fascinating (7)	619	5.5	5.7	5.6
Unappealing (1) / Appealing (7)[1]	617	5.3	5.7	5.5
Unexciting (1) / Exciting (7)	616	5.4	5.6	5.5

[1]F = 5.835; p = .016

STATISTICALLY SIGNIFICANT DEMOGRAPHIC AND BACKGROUND FINDINGS

- Males (versus females) have a more favorable perception of a career in a scientific discipline on the scales:
  - 1, "Means nothing," to 7, "Means a lot."
  - 1, "Boring," to 7, "Interesting."
  - 1, "Mundane," to 7, "Fascinating."
  - 1, "Unappealing," to 7, "Appealing."
  - 1, "Unexciting," to 7, "Exciting."
- AP Science students (versus non-AP Science students) have a more favorable perception of a career in a scientific discipline on the scales:
  - 1, "Means nothing," to 7, "Means a lot."
  - 1, "Boring" to 7, "Interesting."

OVERALL PERCEPTIONS OF THE DISCIPLINES

For each science discipline, an overall rating was calculated by adding together the ratings for each of the five 7-point rating scales and then dividing by 5. The overall rating can range from a low of 1 (least favorable) to a high of 7 (most favorable). Table 34 shows the overall ratings for each discipline. Technology has the strongest overall rating (mean = 5.9) and math has the weakest overall rating (mean = 4.5).

STATISTICALLY SIGNIFICANT DIFFERENCES BY GROUP

- Treatment group respondents (versus control group respondents) have a more favorable overall perception of Technology (mean = 6.0 vs. mean = 5.8).

TABLE 34

LEAST FAVORABLE (1) / MOST FAVORABLE (7)		CONTROL	TREATMENT	TOTAL
OVERALL PERCEPTION OF:	*n*	MEAN	MEAN	MEAN
Technology[1]	615	5.8	6.0	5.9
Science	614	5.6	5.7	5.7
Career in a scientific discipline	615	5.5	5.7	5.6
Engineering	614	5.2	5.1	5.2
Math	614	4.5	4.5	4.5

[1] $F = 3.899$; $p = .049$

STATISTICALLY SIGNIFICANT DEMOGRAPHIC AND BACKGROUND FINDINGS

- Males (versus females) have a more favorable overall perception of:
  - Technology.
  - A career in a scientific discipline than females.
  - Engineering.
  - Math.
- AP Science students (versus non-AP Science students) have a more favorable overall perception of:
  - A career in a scientific discipline.
  - Math.

- Biology students (versus non-Biology students) have a more favorable overall perception of a career in a scientific discipline.
- Physics students (versus non-Physics students) have a more favorable overall perception of math.