Nature Research Center Summative Evaluation

Executive Summary & Synthesis

Final Report: December 1, 2013

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North Carolina Museum of Natural Sciences

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Executive Summary

The Nature Research Center (NRC) is an 80,000-square-foot wing of the North Carolina Museum of Natural Sciences (the Museum) that opened in 2012, with a mission to "engage the public in understanding the scientific research that affects their daily lives." To achieve this goal, the NRC includes exhibitions, programs, and featured experiences designed to engage the public directly with research, scientists, and the process of science. The Lifelong Learning Group was contracted by the Museum to conduct summative evaluation of four of these featured elements:

- *Ancient Fossils, New Discoveries* exhibit[1]
- Investigate Labs
- Daily Planet Scientist Talks
- Science Cafés

The evaluation of these four components was conducted as four distinct, multi-method studies. The purpose was to provide targeted understanding of visitor outcomes and experience at each feature; but the studies were planned cohesively, using complementary and, where possible, consistent measures and coding rubrics across studies.

Study Methods

The ***Ancient Fossils, New Discoveries*** (*Ancient Fossils*) study used: 1) timing and tracking; 2) tally of "did not stop" visitors passing by; 3) structured exit interview. 68 groups were observed for timing and tracking study; 60 groups were interviewed.

The **Investigate Labs** study used: 1) timing and tracking; and 2) structured exit interview (non-paired) with parent-child dyads. 46 dyads were observed for timing and tracking (15 each in Natural World and Micro World Labs; 16 in Visual World Lab); 60 dyads were interviewed (20 in each Lab space).

The **Daily Planet Scientist Talks** study used: 1) observational data, including audience composition changes via scan sampling and recording of visitor interactions with presenters; 2) brief exit interviews with those who left before the end; 3) self-complete questionnaire with visitors at the end of a talk. Observations and questionnaires were collected at 10 different talks; 36 exit interviews were collected.

The **Science Café** study used two methods: 1) self-complete questionnaire at the end of Café programs for one month; 2) focus group discussion with regular Café participants. 136 questionnaire responses were obtained, and 21 adults participated across two focus group discussions.

Key Findings by Component

Ancient Fossils, New Discoveries

Although *Ancient Fossils, New Discoveries* is a relatively small exhibit within a much larger Museum floor, it successfully demonstrated its potential for visitors to learn some of the core science

[1] Evaluation of the *Ancient Fossils, New Discoveries* exhibit was funded by the National Science Foundation (*DRL- 1139220)*

concepts presented in its 10 elements of signage, artifacts, and video. Tracking data shows low stop-rate and relatively brief engagement time, interviews showed that visitors who did stop were able to take away one or more core messages.

- There was a low observed rate of visitors stopping at this exhibit; 84% of visitors during observation periods walked past the *Ancient Fossils* station without stopping to engage. The exhibit held visitors for a relatively short period of time (1.5 minutes), and they stopped at an average of about 3 of the 10 elements. Individual signs held visitors for about 30 seconds; but this may reflect the concise presentation of information. The element that held visitors the longest was the film about Dr. Schweitzer (an average of 1:17 for the 22% of visitors who stopped). The positioning and environment as one exhibit of a larger suite of thematic exhibits in an open-design museum floor seemed to impact visitor stopping, engagement, and use.
- Nearly every visitor group interviewed (90%) identified something they were taking away from this exhibit that aligned with one (or more) of the core content themes within this exhibit. Primarily this was awareness of the genetic relationship between birds and dinosaurs (two-thirds of visitors), along with other scientific facts and discoveries covered in the exhibit. However, almost one-third of visitors connected with the idea that scientific theories evolve and change with new scientific discoveries.
- Ratings to closed-ended items also showed greatest learning was related to new discoveries and factual information; rather than connecting to scientists as individuals or their work.
- The fact that dinosaurs and birds are related was not new to all visitors; 67% reported knowing it before. However, several visitors noted that this exhibit helped solidify or give them stronger evidence to understand why and that this statement was true.
- Visitors were also able to draw a connection between the exhibit and current science (90%). These connections were primarily 1) it showed that research is constantly ongoing, or 2) it was a concrete demonstration of methods, techniques, and technologies used in science.
- There were virtually no differences between family and adult groups in how they used the exhibit or what they reported learning from the exhibit. There were similarly very few differences in visitor responses on other variables.

Investigate Labs

Investigate Labs provide experiences for youth and parents that prompt high levels of engagement, excitement, and learning about the process and tools of science research. Youth visitors were generally in late elementary or middle school, near or slightly younger than the NRC's target age range. Although the three Labs provide very different experiences, the common outcomes across the Labs are remarkably consistent. Key variations point to unique elements of each environment.

- Among those who stop, visitor groups stay for an average of almost 26 minutes in the Natural and Micro World Labs and for over 11 minutes in the Visual World Lab. Time at stations is also lengthy, averaging between two and five minutes. This average reflects some stations that are only "sampled" for a brief period, while others are more extensively explored. Families linger, visit several stations, and spend extended time at a few, experimenting with the activities.
- The experience within any one Lab is unique. In Micro World, visitors go to fewer stations, but spend longer at those they visit. In Natural World, visitors stop at more stations, but spend a moderate length of time. In Visual World, visitors stop at a higher proportion of stations, but

spend less time at each. Micro and Natural World Labs emphasis on physical equipment and experiments; while the Visual World Lab has primarily computer equipment to explore visualizations of data and research.

- The open, wall-of-windows design contributes to visitor interest; people stop because it "looks interesting" or, more specifically, because they see the materials and tools inside or at the door and are intrigued. Enjoyment is also high, with an emphasis on the tools, hands-on experience, and the "fun" of the Labs.
- While the content learned in each Lab is specific to that Lab, the similar, underlying themes highlight broad-based outcomes. The main descriptions of learning related to "using real tools," the content of specific Lab stations, and literally seeing something familiar in a new way (e.g., through a microscope or visualization). Recognition of the process of science were secondary outcomes, in terms of frequency mentioned, but were present for about a quarter of visitors.
  - Micro World Lab tended to elicit more descriptions of engaging in scientific process and feeling like a real scientist (the focus on DNA and problem-oriented experiments);
  - Natural World and Visual World Lab tended to elicit more descriptions of new things seen/discovered (microscopes and visualization tools were both major stopping points);
  - Visual World and Natural World Lab tended to elicit descriptions of content or concepts (several key stations led visitors to new information gained).
- Youth tended to feel like they were doing "real science" in the Labs, mainly because of the tools and processes used. But connections with the rest of the NRC were not something youth or their parents could readily identify. Connections directly with the Research Labs were somewhat easier, but only half had seen/were aware of those Labs (just over half), and not all of those could identify a connection. Again, when a connection was made, similar tools and processes in each place were the main focus.
  - Visitors to the Micro World Lab tended to respond more positively that it was "real science" than those in the Visual World Lab; but all were similar to the Natural World Lab, indicating the differences were not substantial overall.

Daily Planet Presentations

Daily Planet Presentations provide a strong way to convey science research information to visitors in a changing, personally-delivered, and multi-media rich environment. These presentations convey specific new facts and information and create positive associations with the scientist-presenters. The format is critical, including multi-media use and a clear, accessible, and (at times) humorous style. The environment is challenging for a presenter, with audience size and composition ebbing and flowing throughout. While the floor-level is more theater-like in style and audience, the upper levels are constantly moving and changing.

- Observed shows had an average audience size of 23 visitors. It is worth noting that the total number of visitors who saw *any* part of a Daily Planet show would be higher than that, as observation and interview data show that visitors drop in and out throughout the program.
- Patterns in the movement of visitors show trends by the three levels of the theater. Audience sizes tend to be greatest on Level 1, and decrease as you move higher in the theater, with Level 3 averaging just 2 audience members, in general. Audience movement also varies by level:

- Audiences on Level 1 tend to grow quickly in the first few minutes of a talk and remain relatively consistent throughout; the vast majority stays for the duration. The theater-like setting may contribute to more traditional audience participation.
- Audiences on Level 2 are the most widely variable, showing the greatest spikes and decreases in audience size. This partially reflects the positioning near the bridge between the two museum wings. The setting also puts audiences further away from the sightline of the presenter(s), and creates a more free-choice, museum environment, where dropping in and out is expected.
- Level 3 seems more removed from the presentation, and audiences do tend to be smaller and less engaged. During Q&A it was never observed that a question came from that level. When the Level 3 bridge opens, this pattern may change.

- The Daily Planet Presentations attract visitors through: 1) the topic being of interest, and 2) curiosity about "what's going on over there?" by passers-by. Those who stay to the end seemed more motivated by the topic, and those who leave early seem more driven by curiosity, or by a child leading them through his/her curiosity. Similarly, the two main factors that cause early departure were: a group's children/friends were the drivers to leave, or there was a concern about time (wanting to see more of the Museum or having a limited window of time).
- The visual aids, style and approachableness of the presentation, and the specific content addressed were all things that visitors like most about the Daily Planet; and there were generally very few visitors who expressed any areas of dissatisfaction. Visitors responded positively to the scientists and presentations. Data showed primary interpretation of it as a cognitive experience – scientists were described as "knowledgeable" and events were informative, interesting, and detailed. Secondary characteristics identified the scientists' communication skills and style.
- Visitor learning tended to focus on specific facts or information gained from the presentation; but just over one-quarter actually noted some aspect of the relevance of information or what they learned. A majority also felt that they gained a new perspective from the talks on several of the core outcome areas, particularly the science topic itself, followed by how science fits into our lives and what scientists are like.

Science Cafés

The immediate and extended impacts of the NRC's Science Café program show that the format, venue, and professional staffing has been highly successful with its current audience. Attendees are drawn to the events by a range of motivations, and they have created a sense of community among groups of strangers – all around an interest in science and lifelong learning. The atmosphere created, and the NRC's regular delivery of in an intimate and convenient location, has become an anchor for engaging experiences in these participants.

- Science Café attendees at the NRC tend to be older (43% of respondents were over 60), well-educated (87% hold at least a college degree), and from the Raleigh area. But the group is split evenly between those who identify as having training in science or research and those who do not identify this way (similar to other museum visitor samples). Results showed about one-third were first-timers, and the rest were repeat visitors of the Cafes.
- Attendees are motivated by a suite of interrelated factors; interest in the specific topic and science generally top the list of motivations, which is connected to an expressed love of

learning. The atmosphere is also an important attribute – the venue, food, drink, and social experience. Although the social element is not a top-of-mind motivation, the focus group made clear that the social qualities make it a unique experience to other lifelong science learning opportunities (such as watching a documentary).

- The greatest format preference is the traditional scientist presentation followed by Q&A; however, the preparation of the scientist was noted as critical. There was awareness that preference for format related to a scientist's communication abilities; noting that the interview format, with a strong Museum facilitator, worked to make some Cafes more accessible. Science Trivia Night provided a different type of experience, but also seen as valuable by participants.
- Attendees report learning specific information from the presentation, and report that the presentation gave them new perspectives on the topics and how science relates to daily life. There was less of an impact on connection with the processes and approaches of scientific work. Focus group results showed potential depth of connections from participation, including changed views about science, scientific process, and who scientists are.
- Attendees showed a strong, positive-affective response to the scientists and events. Descriptions emphasized scientists being knowledgeable; but secondary descriptors focused more personal and communication qualities, such as audience engagement, entertainment, and being personable – all key goals of the Science Café format. Similarly, attendees focus on the cognitive aspects of the event (informational and interesting); but there is also high association with it as entertaining and interactive.
- There is a strong feeling of community created by the Science Café's venue, format, experience, and consistency for regular attendees. Participants describe an atmosphere that promotes interaction outside of one's own group and a sense of being part of a group of "regulars," all brought together by common interests and passion for learning and science.
- Extending the Café experience by talking about what they learned with others does seem to be widely present. For some, this can extend to pursuing more information about something they learned about or just being more aware when they hear about the concept in the news. Extension is casual, coming up as it relates to other factors in their lives.
- Interest in museum-driven extension opportunities was mixed, with data suggesting that the primary value is from the Café event itself. Focus group and questionnaire respondents both gravitated toward an online "one-stop shop" for Science Café information and resources; but other options seemed less likely to draw large user-groups.

Conclusions

Taken together, these results show that these programs and exhibit features of the NRC are enjoyed by visitors and supporting their learning in many of the ways intended by the Museum. The four components evaluated here appear to be somewhat complementary experiences to one another, with similar themes emerging in the data, but unique strengths demonstrated for each specific experience. Across these components, visitors strongly related their learning often to the information gained about current science topics, discoveries being made, and how it fits into daily life; these areas were only less prominent for the Investigate Labs. Also, perceived learning about the process or techniques of science and what scientists are like was not as strongly demonstrated for most of the experiences, with the exception of Daily Planet Talks, where visitors noted higher discoveries about what scientists are like, and in the Investigate Labs, where the learning outcomes were more related to the processes and techniques of science.

Other areas of data similarly highlighted that the available NRC experiences create some common, broad-level learning outcomes about science, but each element appears to have a "specialty" of learning experiences and outcomes it fosters. For example, while the *Ancient Fossils* exhibit led to robust cognitive learning outcomes (visitors gaining the main content message of the exhibit), the Investigate Labs provided experiences where learners focused on the tools and processes that they engaged it, reporting having fun experiencing science. While visitors' ability was limited in articulating the intended, high-level connections between these experiences and other parts of the NRC, visitors were able to see connection between these experiences and real-world tools and processes of science research.

In the area of programming and engagement between public and scientists, the Daily Planet talks and Science Cafés showed similarities and differences, highlighting the unique role that each opportunity plays in a potential visitor experience. Both formats provide flexible, timely opportunities to share with visitors of-the-moment research and findings from community-based scientists; but the venues create different learner experiences. While the Daily Planet allows for a casual, free-choice opportunity to engage with this information – with visitors able to drop in and out of a talk; the Science Cafés are a venue designed for in-depth engagement. However, visitors' interpretations of Daily Planet events and scientists indicate more emphasis on the cognitive experience than affective levels of engagement or personal connection to the scientists. The Cafés, in contrast, have the primary emphasis on a learning experience (that is what draws visitors to them), but the social atmosphere creates a stronger secondary experience of entertainment than is seen in the Daily Planet. Further, the Café's regularity and consistency creates an environment of sustained, long-term engagement by visitors, one that not only influences attitudes and viewpoints about science, scientists, and the world, but on social bonds between attendees (even those who do not know one another).

Together, the evaluation of these four components of the NRC suggest that it does provide a suite of activities that visitors recognize as being about different aspects of current science and the work of scientists. Whether through learning about discoveries and evolving theories through an exhibit, experiencing the tools, experiments, and visualizations of science in an Investigate Lab, getting a taste of a new piece of information or discovery while happening upon a Daily Planet Talk, or deepening curiosity and perspectives on science in the company of other science-minded individuals in the community through Science Cafés, these NRC components appear to provide visitors with positive and generally successful learning opportunities.

Nature Research Center Summative Evaluation

Part 1: Ancient Fossils, New Discoveries Exhibit

Final Report: December 1, 2013

Prepared by:
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North Carolina Museum of Natural Sciences

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Introduction

The Nature Research Center (NRC) is an 80,000-square-foot wing of the North Carolina Museum of Natural Sciences (the Museum) that opened in 2012, with goals to "bring research scientists and their work into the public eye, help demystify what can be an intimidating field of study, better prepare science educators and students, and inspire a new generation of young scientists." To achieve these goals, the NRC provides visitors with exhibitions, programs, and featured experiences designed to engage the public directly with research, scientists, and the process of science.

The Lifelong Learning Group was contracted by the Museum to conduct summative evaluation of four of the NRC's featured exhibits and programmatic elements:

- *Ancient Fossils, New Discoveries* exhibit[1]
- Investigate Labs (iLabs)
- SECU Daily Planet programming – daily scientist talks
- Science Cafés

The evaluation of these four components was designed as four distinct multi-method studies, each focused on a particular featured area of the NRC. The goal was to provide targeted understanding of visitor outcomes and experience at a particular NRC feature. In addition, the individual studies were planned cohesively, using complementary and, wherever possible, consistent measures and coding rubrics across the four studies. The findings from the study of each component are contained in separate reports. This report presents the findings from the evaluation of the *Ancient Fossils, New Discoveries* exhibit.

Exhibits and Programs Studied

The four featured elements that were evaluated in this study were:

- ***Ancient Fossils, New Discoveries* Exhibit** – a permanent exhibit in the NRC, *Ancient Fossils* highlights the science behind Dr. Mary Schweitzer's research, which included the discovery of preserved soft tissue in fossil material, a landmark scientific breakthrough.
- **Investigate Labs (iLabs)** – hands-on labs for visitor use, with guided activities and research skill-building exercises that allow visitors to explore the process of using scientific tools and engaging in inquiry. Experiences are led and guided by educators, scientists, and graduate students.
- **SECU Daily Planet Scientist Programs** – an immersive, three-story multimedia space, which is used for many purposes. A feature purpose of this space is regular, daily live presentations by scientists discussing the science and research behind current issues.
- **Science Cafés** – the NRC's Daily Planet Café serves as the home for a weekly Science Café series. Each Thursday evening, this free event allows the public to join in conversation about scientific topics, delivered in a range of casual formats – from longer format presentations by scientists, to Science Trivia night, to Lighting Talks of a series of brief scientist presentations. They allow for conversation over food and beverages hosted in the NRC's new Café.

[1] Evaluation of the *Ancient Fossils, New Discoveries* exhibit was funded by the National Science Foundation (*DRL- 1139220)*

Intended Outcomes

At the outset of the project, Lifelong Learning Group evaluators met with Museum staff to discuss the four targeted exhibit and program areas for the NRC, focusing on articulating the intended outcomes for each area, as well as the priority evaluation questions that should guide the study of each NRC area. Below are the outcome statements that resulted from that process.

Ancient Fossils, New Discoveries

- Visitors will demonstrate awareness of one or more of the main content areas or concepts addressed by the exhibit:
    - Organic material can survive millions of years
    - Preserved organic material may contain DNA or proteins
    - Dinosaurs are related to birds
    - Science is a process that continually changes our understanding through research
    - Dr. Schweitzer made a ground-breaking discovery
- Visitors will draw connections with other experiences about current science (from within or outside of the NRC)
- Visitors will show interest in the content or themes of the exhibit
- Visitors will enjoy and be engaged with the exhibit

Guiding Evaluation Questions

Ancient Fossils, New Discoveries

- How do visitors engage with the exhibit (including stay-time, use of components, behavior, movement in the space)?
- To what extent do visitors demonstrate awareness of the main concepts? Which messages are more or less successful?
- What connections do visitors make with the content?
- What about the exhibit or content was new or interesting to visitors?
- Are there any differences in use or outcomes between family visitors and adult visitors?

Methods

Multiple methods were used within each of the four area studies in order to address these evaluation questions. Table 1 below shows the methods selected for *Ancient Fossils, New Discoveries*, as well as how methods were intended to help address the study's specific evaluation questions. Below, each method and study procedure is described in greater detail.

Table 1. *Ancient Fossils* Evaluation Matrix: How evaluation questions are addressed by methods

Evaluation Questions	**Method 1: Timing and Tracking**	**Method 2: Interviews**
How do visitors engage with exhibit?	X	
Demonstrating awareness of the main concepts?		X
What connections do visitors make with the content?		X
What about the exhibit or content was new or interesting?		X
Differences in use or outcomes between families and adults?	X	X

Methods: Ancient Fossils, New Discoveries

Two methods were used to evaluate the *Ancient Fossils, New Discoveries* exhibit (also referred to as *Ancient Fossils*). **Timing and tracking** of visitor groups was used to track several variables of visitor use and interaction with the exhibit: total time spent, which exhibit elements viewed, time spent at exhibit elements, types of interactions. A timing and tracking map was created for the exhibit defining the major signs and elements in the space. Data collectors used continuous random sampling visitor groups, seeking to obtain at least 30 adult-only groups and 30 family groups. Targets for observational data were selected as the first adult to enter the space (an adult group) and the first adult who is with a child (in a family group). Data collectors recorded visual characteristics of the group (number of adults and children; approximate age of children).

Because of the nature of the *Ancient Fossils* exhibit, which is an island within a much larger, open exhibit floor area, it was determined that additional data on the rate of visitors' stopping at the exhibit was informative. Data collectors also maintained a **"did not stop" tally** of visitor groups that entered the tracking map space, but passed through without stopping at the exhibit.

The second method used was a **structured exit interview** with visitors who stopped at *Ancient Fossils* as they left the exhibit area. Because of the flowing nature of traffic and engagement with the exhibit in this space, a threshold was set that visitors must have engaged with the exhibit for at least 30 seconds to be eligible for recruitment for interviews. All visitors were asked the same interview questions and follow-up prompts, and conversations were audio recorded to facilitate data gathering. A final questionnaire page including attitude ratings and demographic items was given to visitors to complete. Visitors were given a small thank-you gift (i.e., a museum pencil) at the end of the interview. As with tracking data, continuous random sampling was used to obtain an even sample of interviews from an adult spokesperson from 30 adult groups and 30 family groups. Interview recording data were entered by listening and typing notes of responses and verbatim quotes into a spreadsheet. A refusal log was maintained.

Study Participants

In total 68 tracks were obtained (38 adult groups and 30 family groups); an additional 356 groups were tallied as "did not stop" during the 8 hours of data collection (spread over multiple days and times). This results in an observed 16% stop-rate of visitors at the *Ancient Fossils* exhibit. In total 60 interviews were completed (30 adult groups and 30 family groups). The refusal rate for interviews was just 6% (4 refusals), very low for a study of this nature, indicating little bias due to refusals in the sample.

Table 2 shows the demographic characteristics for the participants in the two portions of the *Ancient Fossils* study. Both samples were very similar, based upon observable characteristics. Each had a nearly even split of the sex of target subjects (with slightly higher representation of male visitors); just under half of each sample were in their 20s or 30s. Among the interviewees (where more specific data were gathered), the vast majority were from North Carolina (82%), with 42% overall from Wake County. Among the groups with children, there was relatively even representation of children in each grade-range; of greatest interest to the NRC, 30% of groups overall (60% of family groups) contained children in middle or high school grades.

Analysis

All data were entered into spreadsheets and transferred into SPSS for coding and analysis. Open-ended data were coded using coding rubrics developed for this study. When appropriate, coding rubrics were developed to be able to be applied consistently across exhibit/program components in the study (for comparative purposes). This was not done in cases where common rubrics might dilute the unique findings for a specific exhibit or program. Systematic coding was done to allow visitor responses to open-ended questions to be categorized and quantified for analysis. Tests for inter-rater reliability were done to refine and finalize coding rubrics, before final coding was complete. Data were analyzed descriptively and, where appropriate, inferential statistics were used to test specific questions or hypotheses about the data. All inferential statistics used are described in the results section.

Table 2. Sample characteristics for *Ancient Fossils* tracking and interview data

	Interview Data (n=60)		Tracking Data (n=68)	
	Count	**Percentage**	**Count**	**Percentage**
Sex				
Male	34	57%	38	56%
Female	26	43%	30	44%
Age / Approximate Age				
18-29	18	30%	17	25%
30s	11	18%	14	21%
40s	13	22%	14	21%
50s	9	15%	11	16%
60s+	9	15%	10	15%
Grades of Children				
pre-k	6	10%		
K-2	11	18%		
3-5	12	20%		
6-8	10	17%		
9-12	12	20%		
Formal Education				
Some High School	3	5%		
High School Diploma	12	20%		
College Degree	31	52%		
Graduate Degree	14	23%		
Professional Training in Science/Research				
Yes	27	45%		
No	33	55%		
Home State				
NC	49	82%		
Southeast (AL, FL, SC)	5	8%		
Midwest (OH, WI)	3	5%		
Northeast (MA, NY)	2	3%		
International	1	2%		
North Carolina Counties				
Wake County	25	42%		
Orange	4	7%		
All others (<3 each)	20	33%		

Results: Ancient Fossils, New Discoveries

Visitor Use of Exhibit

Tracking data showed that visitors are split in the direction by which they approach the exhibit, although the majority of visitors entered the exhibit via the stairs (65%, 44), rather than through other exhibits on the floor. As noted above, the tracking data also showed that the exhibit generally had a low rate of catching visitors as they entered from the stairs. Out of 424 visitors entering the area, only 68 were observed to stop at one or more of the exhibit elements; 84% of visitors during the observation periods walked past the station without stopping to engage.

The total time that observed groups spent engaging with the exhibit ranged from a low of 17 seconds (someone who stopped at only one sign) to a high of 6 minutes and 12 seconds. The average time spent was around 1:30. From these data, a Sweep Rate Index (SRI) was calculated; SRI is a standardized metric, developed by Beverly Serrell (1998), to compare stay-time at exhibitions of varying sizes. SRI divides the square-footage of an exhibition by the average stay-time in a sample of tracked visitors; the lower an SRI, the more time visitors spent in the exhibition. In this case, the *Ancient Fossils* exhibit covers approximately 875 square-feet[2], which resulted in an SRI of 583. Serrell's analyses from over 100 exhibitions have set a benchmark SRI of 300 (1998; 2011); exhibitions that fell below this number were considered successful, with visitors lingering for a long time.

Data from *Ancient Fossils* observations indicate that the exhibit does not foster extensive lingering or a lengthy stay-time on average. That said, however, the comparison with Serrell's database is somewhat flawed, as the SRI metric is typically used for entire, often multi-gallery, exhibitions (as opposed to one, smaller exhibit component). Although *Ancient Fossils* covers discrete content and themes, it can also be seen as one exhibit station within the larger floor-wide exhibition on this level of the NRC. Due to the nature of an index computation, the layout and small size of *Ancient Fossils* somewhat impact and limit the usefulness of the benchmark.

The average number of stops at *Ancient Fossils* was 2.79 elements (out of 10 possible stops); one-third of the sample stopped at three elements and just under one-third stopped at two elements (see Figure 1). The maximum number of exhibit elements stopped at was 7 (out of 10).

Table 3 shows the distribution of where visitors stopped in exploring *Ancient Fossils*. Three elements were the most frequently stopped at: 55% of tracked visitors stopped at the *T. Rex* fossil (the major object in the exhibit station), and 53% stopped at the "How Are Birds and Dinosaurs Related?" sign. The third most popular stop was the "A New Stand on *T. Rex*" sign, at which 45% of visitors stopped.

In terms of duration at a single element, visitors tended to spend just under 30 seconds (on average) at any individual exhibit element. Given the concise presentation of text on the signage, this seems sufficient in duration to take away the main ideas. The element that held attention the longest was the film about Dr. Schweitzer's work and discoveries. The film held visitors' attention for 1:17, on average, with a maximum of 3:17.

[2] As the exhibit is a platform in the middle of a large, open floor-space, square footage was approximated by the footprint of the exhibit plus a three-foot border of floor space around it.

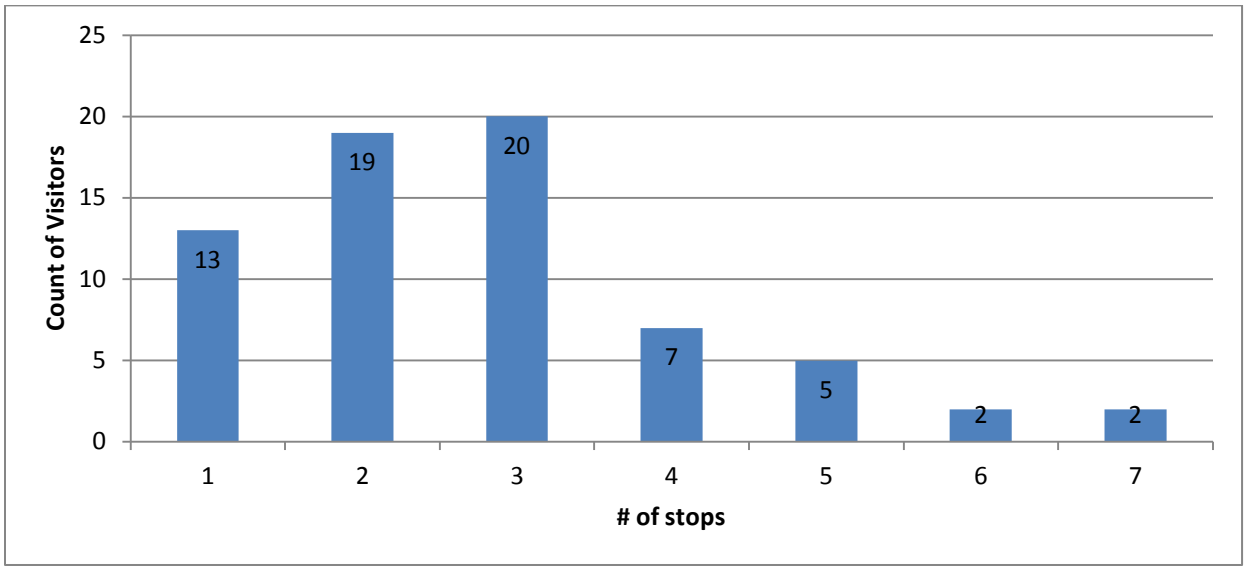

Figure 1. Frequency distribution of number of elements (out of 10) stopped at by tracked visitors (n=68)

Table 3. Tracking data of stops, reading/looking, and time-spent across 10 exhibit elements (n=68)

Exhibit Element	Type	% who stopped	% looked/read, of those who stopped	Average time spent
T. Rex Fossil	Object	55%	100%	0:25
How Are Birds & Dinosaurs Related	Sign	53%	100%	0:31
A New Stand on T. Rex	Sign	45%	100%	0:27
A Dinosaur Pregnancy Test	Sign	32%	100%	0:31
Femur	Object	32%	100%	0:15
Testing Our Assumptions	Sign	25%	93%	0:22
T. Rex, Another Look	Sign	25%	87%	0:16
Identifying Proteins	Sign	22%	100%	0:22
Dr. Schweitzer Film	Film	22%	83%	1:17
Intro Panel	Sign	7%	100%	0:07

Learning Outcomes

In response to a series of four open-ended questions and prompts, visitors reflected on the concepts, ideas, and information that they were taking with them following their visit to *Ancient Fossils, New Discoveries*. The four prompts asked visitors to reflect on: the exhibit's main idea, something interesting to them, something they never realized, and something they were reminded of. This series was designed to give different opportunities and ways of thinking about their experience to express their conceptual understanding. All four items were coded using the same coding framework, which began from the main content themes targeted by the exhibit, and additional categories and codes were developed inductively from the data (see coding framework in Table 4).

Table 4. Coding categories and sub-codes for visitor meaning-making in *Ancient Fossils* exhibit

Top-Level Coding Category	Specific Sub-Codes	Description
Main Ideas / Concepts	Bird-Dinosaur Connection	The relationship or similarities between birds/chickens/ostriches and dinosaurs; also includes inferred from statements like, "how genetically similar different species were"
	Pregnancy	How/that pregnancy was detected using research tools/techniques; concept of medullary bone to determine
	Soft Tissue Analysis	Ability to extract/conduct analysis on soft tissue in bones/fossils after all this time
	Research Process and Findings	How and what scientists learn, including methods, tools, processes of science, and the presentation of their findings.
	Theory Evolving/Changing	How ideas, theories, or understanding changes over time due to new research findings
	Posture	Dinosaurs do not stand upright; comments about dinosaur posture; (sometimes in conjunction with another comment about bird-dinosaur relationship)
	DNA extraction	**Specific** referral to ability to extract DNA from fossils
Personal/Human Connection	Personal Connection to Self	Comment included something about self; personal connection (e.g., memory of an exhibit from childhood; their career; etc.)
	Connection with Humans	Relating exhibit to humans; as in comparing some feature of the animals in the exhibit to human features
	Dangerous	Comment on how the dinosaurs features or behavior would have been threatening or dangerous to humans
	Jurassic Park	Reference to the movie
	Past to Present	Use the past to inform the present and future: "Making relational connection between then and now"
	Human Impact	Referral to human impact on the environment
Other Content	General Learning or Information (not a main idea)	General observations on learning or facts about dinosaurs, e.g., "What we study about the *T. Rex* and learn from it." Concepts other than the specified main ideas from the exhibit
	Evolution	General referral to "evolution" or evolutionary processes within a species over time; but generally mentioned, NOT specific to relationship of birds and dinosaurs (which is coded as a main idea)
Exhibit-Focused	Exhibit Features	Comment on the exhibit design or material itself
	Size of Artifact	Comment on the overall stature of the fossil on exhibit; typically commenting that it is smaller than they expected
Nothing / Don't Know		Respondent unable to give an answer to the prompt; said don't know, not sure, "nothing," or similar
Other		Comment does not fit into any other category

To assess visitor learning at the broadest level, visitors' responses were examined across the entire interview, looking at the frequency with which concepts were mentioned in response to any of the four open-ended prompts. Table 5 shows that the exhibit was very successful at communicating the various main concepts to visitors who stopped. Nearly all of the groups interviewed (92%, 55) mentioned one or more of the exhibit concepts of the exhibit in their interviews. Among the other categories, a substantial number of visitor groups also drew some sort of personal or human connection in their responses to the prompts (45%), and another 38% of the sample drew

connections with other content outside of the main concepts. About 30% of the sample mentioned aspects of the exhibit itself.

Table 5. Frequency of visitors (n=60) who expressed learning in each major category, across all comments made in his/her interview

	Count	%
Main Ideas / Concepts	55	92%
Personal / Human Connection	27	45%
Other Content	23	38%
Exhibit-Focused	18	30%
Other	6	10%
Nothing (to all 4 prompts)	0	0%

Main Ideas Learned

Table 6 shows the distribution of visitor responses within the specific concept sub-categories. The concept that was most frequently recalled was the relationship between birds and dinosaurs, the idea that we now know dinosaurs evolved from birds; 67% of visitor groups recalled that concept when talking about the exhibit. This was a concept that was addressed in several ways through several different signs in the exhibit.

> *The relative closest to the dinosaur was a bird. Because you never really think, birds are so small and so common now, and dinosaurs are extinct, and I would never put that together. (Female, 20s, adult group)*

> *I had heard that dinosaurs and birds were connected, but I didn't know what their connection was so I guess some of the pieces were helped to put together, that it was more than someone hypothesizing that it could be a connection. (Male, 30s, family group)*

Table 6. Frequency of visitors (n=60) who identified specific concepts coded within the "Main Ideas / Concepts" code, across all comments in his/her interview

	Count	%
Bird-Dinosaur Connection	40	67%
Theory Evolving/Changing	19	32%
Posture	18	30%
Pregnancy	17	28%
Research Process and Findings	15	25%
Soft Tissue Analysis	9	15%
DNA extraction	5	8%

Later in the interview, visitors were asked whether they had known this fact (that dinosaurs were related to birds) prior to seeing the *Ancient Fossils* exhibit. Overall, just over half of the sample (62%) indicated they were aware of that information previously; 38% had not known or were unsure. Of the 37 visitors who said they had heard this information previously, the main sources the cited for knowing this were school/college (30%, 11), television (19%, 7), museums (14%, 5), and the film *Jurassic Park* (15%, 5). (See Table 7.)

When looking at those who referred to the exhibit's message of the bird-dinosaur relationship, there was no relationship between who mentioned this concept and whether they already knew this factual information. As the second quotation illustrates, some individuals who had heard about the connection before found this exhibit solidified or added concrete evidence about how this is known.

Table 7. Frequency of sources mentioned by visitors who reported already knowing that birds and dinosaurs were related (n=37)

	Count	%
School	11	30%
Television	7	19%
Museums / NCMNS	5	14%
Jurassic Park	5	14%
Books	2	5%
Radio	1	3%
General / non-specific	4	11%
Don't know	3	8%

Beyond that message, four other concepts were recalled by between one-quarter and one-third of visitors. Two of these concepts referenced facts or content from the exhibit; 30% noted the posture of the dinosaur (horizontal, rather than upright and/or carrying the tail in the air), and 28% noted the information about detecting pregnancy in a female dinosaur/bird via the medullary bone.

> *That the T. Rex walked more like a chicken than a cheetah. It is funny. (Male, 40s, family group)*
>
> *The change in the stance--that they leaned forward. It was different. (Female, 20s, adult group)*
>
> *The pregnancy test, I didn't realize that they had a medullary bone. The fact that they have a bone that is similar to the bird bone, which was what made that leap that there is more evidence. I didn't know, it's new! (Female, 60s, family group)*
>
> *That she was getting ready to lay eggs, and that they could find that from the bones. (Female, 40s, adult group)*

The other two popular comments, interestingly, focused more on process-of-science ideas; 32% of visitors talked about the exhibit showing how scientific theories or understandings change over time via new discoveries, and 25% talked about the research process, methods, and tools that were shown in the exhibit.

> *How dinosaur understanding has changed over the years given the evidence. As we gather more information, our understanding changes over time. (Female, 40s, family group)*
>
> *…The scientific process, that they believe something for a long, long time and then you can make a discovery that changes the way you see it. Something I found really exciting was the film/movie, seeing her excitement....And it felt like it followed her process of discovery which I really liked. (Female, 60s, adult group)*
>
> *The process of science, taking assumptions and proving them. (Female, 50s, family group)*

There are still things we don't know, a lot of stuff we don't know from our past, a lot of studying and research still going on. (Male, 40s, adult group)

Specific references to the process and discovery of being able to extract and analyze soft tissue from a fossil were not mentioned as frequently, although 15% of visitors noted this concept. Another 5 visitors (8%) referred to this concept, but referencing DNA extraction, which was not the exact technique mentioned.

Other Connections & Messages

Another strongly referenced category had to do with personal or human-related connections visitors drew with the content. Chief among these was a personal-level connection between something in the exhibit and their life or experience (23%). This included childhood memories of visiting museums, interest in dinosaurs, or a relationship to a career.

When I was little going to museums. (Female, 20s, family group)

[something I thought was interesting was…] The gait changes, because I am a physical therapist, the dinosaur was more walking humped over than walking upright. (Female, 40s, family group)

Other types of comments were generally less common, and included general connections between past and present, a feeling of the danger related to dinosaurs (had humans been alive), five references to the film *Jurassic Park*, connections between dinosaurs and humans generally (e.g., in physiology), and three references to human impact on the environment and animal extinction (see Table 8).

Table 8. Frequency of visitors (n=60) who identified specific concepts coded within the "Personal / Human Connection" code, across all comments in his/her interview

	Count	%
Personal Connection to Self	14	23%
Past to Present	6	10%
Dangerous	5	8%
Jurassic Park	5	8%
Connection with Humans	4	7%
Human Impact	3	5%

In the final areas, 38% drew connections with other content outside of the main concepts, which were primarily general mentions about learning or dinosaurs that weren't directly connected to the exhibit's themes (32%). And about 30% referenced features of the exhibit itself, primarily comments about the size of the dinosaur skeleton on display (22%). These comments, it is worth noting, sometimes referenced that the artifact was smaller than expected; not all of these expressed having figured out that the specimen was a juvenile.

How small they were, I thought they were bigger. That's not as big as I imagined the T. Rex to be. (Female, 40s, adult group)

Meaning-Making by Question

The above cross-interview analysis provided the most robust picture of overall learning by visitors to the exhibit. However, analysis was also completed at the question level to explore differences based upon the prompt used. This analysis provides further insight into the ways in which these concepts resonated for visitors. Tables 9 and 10 present the frequency distributions for the categories within the responses to each specific question or prompt.

Table 9. Frequency of visitors (n=60) who made connections within each top-level category in response to a specific question or prompt.

	Main Idea of Exhibit		Something Interesting		Never Realized		Reminded Me	
	Count	%	Count	%	Count	%	Count	%
Main Ideas / Concepts	44	73%	49	82%	38	63%	13	22%
Personal / Human Connection	8	13%	7	12%	3	5%	21	35%
Other Content	11	18%	8	13%	10	17%	2	3%
Exhibit-Focused	6	10%	4	7%	8	13%	4	7%
Nothing / Don't Know	1	2%	1	2%	5	8%	12	20%
Other	1	2%	1	2%	1	2%	5	8%

Table 10. Frequency of visitors (n=60) who made connections within each sub-category in response to a specific question or prompt.

	Main Idea of Exhibit		Something Interesting		Never Realized		Reminded Me	
	Count	%	Count	%	Count	%	Count	%
Main Concepts								
Bird-Dinosaur Connection	24	40%	21	35%	21	35%	2	3%
Theory Evolving/Changing	15	25%	3	5%	--	--	9	15%
Posture	6	10%	7	12%	10	17%	1	2%
Pregnancy	8	13%	14	23%	3	5%	--	--
Research Process and Findings	6	10%	6	10%	3	5%	1	2%
Soft Tissue Analysis	--	--	6	10%	5	8%	--	--
DNA extraction	1	2%	3	5%	1	2%	--	--
Connection								
Personal Connection to Self	--	--	3	5%	1	2%	11	18%
Past to Present	5	8%	--	--	1	2%	--	--
Dangerous	1	2%	2	3%	--	--	3	5%
Jurassic Park	--	--	1	2%	--	--	4	7%
Connection with Humans	1	2%	1	2%	1	2%	2	3%
Human Impact	2	3%	--	--	--	--	1	2%
Related Content								
General Learning or Information	8	13%	8	13%	8	13%	2	3%
Evolution	3	5%	--	--	2	3%	--	--
Exhibit-Focused								
Size of Artifact	4	7%	1	2%	6	10%	4	7%
Exhibit Features	2	3%	3	5%	2	3%	--	--
Nothing / Don't Know	1	2%	1	2%	5	8%	12	20%
Other	1	2%	1	2%	1	2%	5	8%

The clearest pattern is that, when asked what the exhibit reminded them of, visitors tended not to talk about content or main ideas, but either struggled to answer the question (20%) or said it reminded them of some sort of personal connection (18%). For the other three prompts – main idea, something interesting, and something never realized – content-related categories dominated visitor responses. In all three of these, the bird-dinosaur relationship was the most common theme. After that, however, the specific responses varied.

Visitors slightly more often related the concept of scientific theories evolving over time as the main idea of the exhibit; whereas the information about determining the dinosaur was pregnant via the medullary bone was more often mentioned as "something interesting," and the dinosaur's posture/gate was more often something "never realized."

Connections to Current Science

In addition to visitor personal meaning-making related to the exhibit content, the survey also explored the extent to which visitors associated the exhibit with other key concepts about current science of interest to the Museum. In response to a series of rating items, visitors were asked to rate how strongly they felt the exhibit "gave them a new perspective on" each of six different topics (Table 11). Visitors rated on a 1 to 7 scale, where 1 meant "not at all" and 7 meant "a great deal." Average ratings to 5 of the statements were in agreement; with visitors reporting strongest agreement that the exhibit gave them a new perspective on *new discoveries being made in science; factual information about dinosaurs;* and *factual information about biology research.* The areas that the exhibit seemed to impact least were new perspectives on *what scientists are like* and *how scientists do their work.* This aligns with the content focus of the exhibit components.

Table 11. Average ratings of the extent to which "the exhibit gave you a new perspective on" each of the following topics. (1-7 scale; 1=not at all; 7=a great deal; n=60)

	Mean	Standard Deviation
New discoveries being made in science	5.9	1.31
Factual information about dinosaurs	5.7	1.15
Factual information about biology research	5.6	1.33
The techniques used in a scientific process	5.3	1.49
How scientists do their work	5.0	1.64
What scientists are like	4.1	2.01

Visitors were also asked whether or not they saw any connections between this exhibit and current science research in general. The majority was able to identify some sort of connection (90%); and three themes dominated these responses. One-third of respondents (20) focused on the idea of discoveries presented in the exhibit, evidence that research is ongoing. Just over one-quarter (27%, 16) talked about the methods, techniques, and technologies in the exhibit being current, such as the analysis of soft tissue. And 15% (9) made a connection with the idea of the progression of research, that everything builds upon what has been discovered in the past (i.e., Dr. Schweitzer's discoveries were the foundation for current research). Although varying in complexity, all three concepts show ways in which the exhibit brought current science to the fore for visitors.

Table 12. Frequency of coded responses of what connections visitors made between this exhibit and current science. (n=60)

	Count	%
Discoveries; research is ongoing	20	33%
Methods, techniques, technologies	16	27%
Progression of research (building on the past)	9	15%
Inference	2	3%
Other	8	13%
No Connection / Don't Know	6	10%

Comparison by Group-Type

One question posed by this evaluation was whether all-adult and family groups would use or learn from the exhibit differently. Looking at the broad level tracking data, although adult groups stayed slightly longer on average (1 min 36 sec; SD=85.5 sec) than family groups (1 min 18 sec; SD=50.5 sec), the variation in stay-time across groups was so wide that these differences in mean were not significant (t=1.02, p=.31). Similarly, the number of elements stopped at by the two group-types were nearly identical, with both stopping at an average of 2.8 elements.

Similarly, in terms of learning, there were almost no differences in the types of meaning visitors took from the exhibit. When looking at the top-level codes for meaning (Figure 2), the number of groups referencing each idea were nearly identical. When looking at the specific sub-concepts that were contained within responses (Figure 3), only one category showed a difference in the frequency with which groups mentioned it. The concept about identifying how a dinosaur (or bird) was pregnant was mentioned significantly more often by family groups (40%) than by adult groups (17%) ($X^2(1, N=60) = 4.02$, $p < .05$). No other measures of reported learning showed significant differences between adult and family groups.

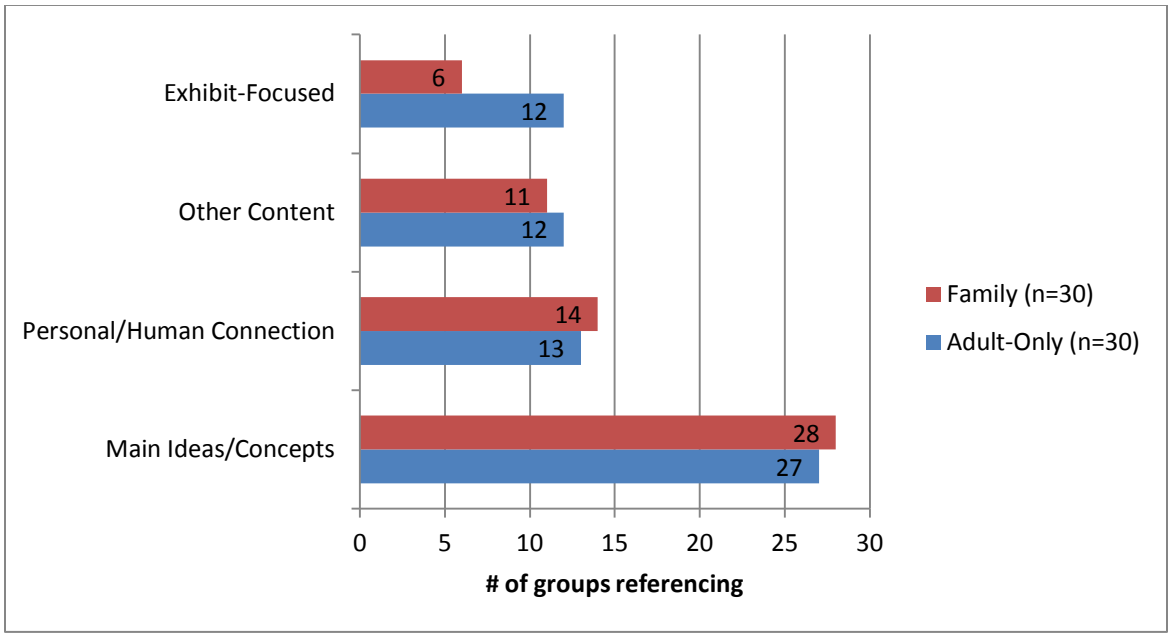

Figure 2. Comparison of coded response distribution to top-level codes between family and adult-only groups.

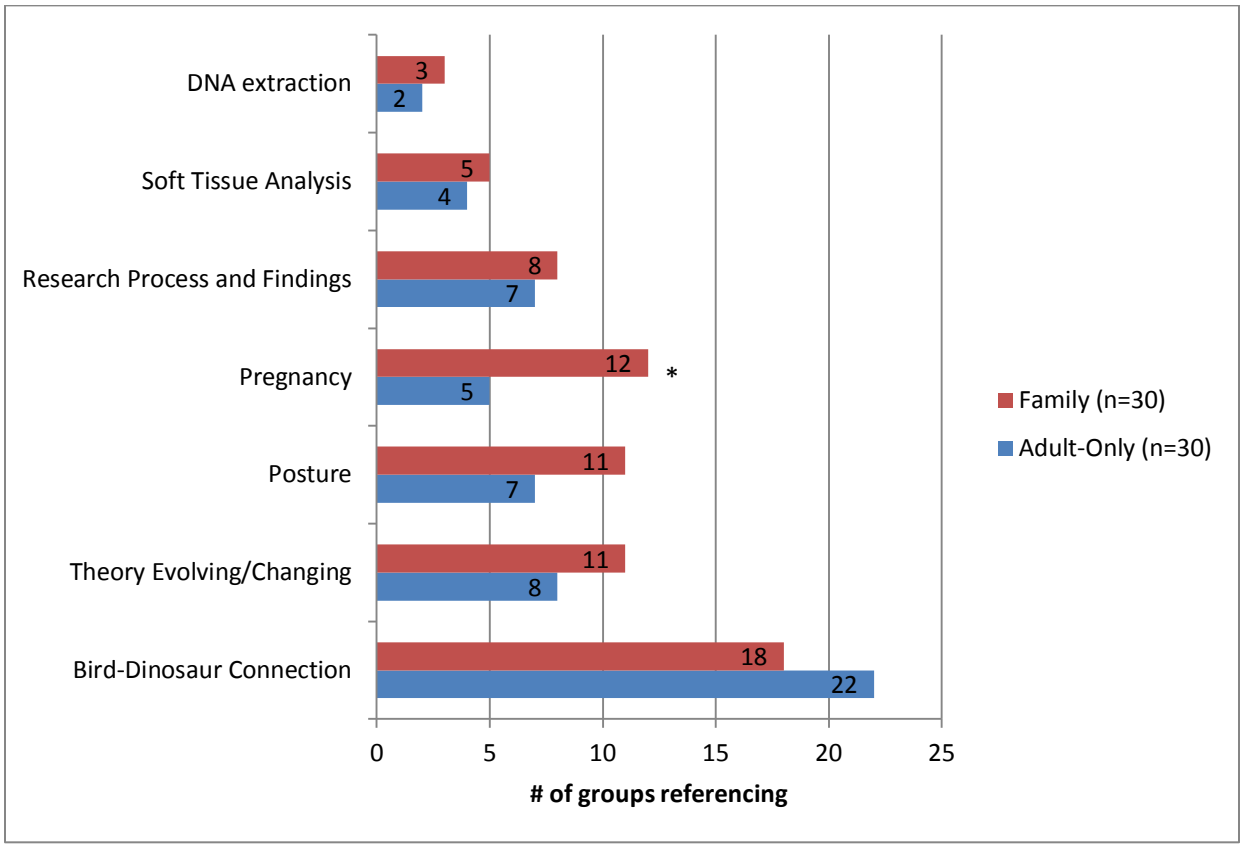

Figure 3. Comparison of coded response distribution to top-level codes between family and adult-only groups.

**statistically significant ($X^2(1, N=60) = 4.02, p < .05$)*

Comparison by Experience

Results were also compared to see if there was substantial influence by a respondent's prior experience or professional training in science or research (one of the demographic questions); given that about 45% of the sample reported some training. Overall, there were very few differences between these two groups. The only differences that emerged were:

- Those with special training were more likely to get the main idea; 100% of those with training, compared with 85% of those without training. ($X^2(1,N=60)=4.46, p<.05$)
- Those with special training gave lower average ratings that they gained a new perspective on how scientists do their work. ($t=-2.2, p<.05$)

Discussion & Conclusions

Although *Ancient Fossils, New Discoveries* is a relatively small exhibit within a much larger Museum floor, containing other exhibits, Labs, and experiences, it has successfully demonstrated its potential to help visitors construct understanding of core science information and concepts through its 10 elements of signage, artifacts, and video. While tracking data shows low stop-rate and relatively brief engagement time, interviews suggest that the clarity of presentation within those elements is allowing visitors to understand and take away core messages that were intended by this exhibition – including implications of the discoveries of Dr. Schweitzer and deeper understanding about the nature of science and current research.

- The positioning and environment of the *Ancient Fossils, New Discoveries* as one component of a larger suite of thematic exhibits in an open-design museum floor seems to impact the nature of visitor stopping, engagement, and use of this exhibit. Tracking data showed some limitations to engagement by this space.
    - Anecdotally, data collectors had a more difficult time getting the targeted number of tracking and interview data-points from family visitors than from adult-only visitors. Although the targets were met, anecdotal observations were reported that family groups seemed more likely to move past at a faster rate. This was not the focus of the present study, but may point to larger questions for the Museum in the future.
- There was a low observed rate of visitors stopping at this exhibit; 84% of visitors who entered the floor during observation periods walked past the *Ancient Fossils* station without stopping to engage.
    - In effect, the *Ancient Fossils* exhibit effectively acted as a single exhibit element within a larger exhibition, in which visitors regularly "pick and choose" to stop only at a subset of available elements.
- The exhibit also only held visitors at its signs, artifacts, and videos for a relatively short period of time (an average of 1 minute and 30 seconds), and visiting an average of just under 3 of the 10 elements in the exhibit. Signs tended to hold people for about 30 seconds; but this may reflect the concise presentation of information on each one. The element that held visitors the longest was the film about Dr. Schweitzer (an average of 1:17 for the 22% of visitors who stopped).
    - The exhibit seems to be the type that visitors take in just a small part of before deciding to move on; considered with the design of the text panels, this may be sufficient to capture a piece of information from the overall story. However, most visitors are not experiencing that entire story of the exhibit.
- Interviews with visitors, however, show the greater potential of the exhibit to communicate its main ideas for those visitors who stop to engage with one or more of the exhibit elements. Nearly every visitor group interview identified something they were taking away from this exhibit that aligned with at least one of the core content themes within this exhibit. Primarily this was awareness of the genetic relationship between birds and dinosaurs (noted by two-thirds), along with other scientific facts and discoveries covered in the exhibit. However, almost a third who connected to the deeper theme that the exhibit was about how scientific theories evolve and change with new scientific discoveries.

- The closed-ended items also support that the greatest learning was related to new discoveries and factual information; with less connection to scientists as individuals or how they do their work.
- The fact that dinosaurs and birds are related was not new to all visitors; 67% reported knowing it before. However, several visitors noted that, although they had heard the fact, this exhibit helped solidify or give them stronger evidence to understand why that was true.
    - This exhibit was very successful at communicating both the content of the discoveries related to Dr. Schweitzer's research, but was also successful at communicating a deeper, underlying message of the exhibit – and all of the NRC – regarding the nature of science. And even when it reinforced prior knowledge, it did so in a way that gave visitors a stronger basis for understanding that information (instead of just knowing a fact).
- The exhibit also proved successful in allowing visitors to make connections between it and current science (90% were able to make some sort of connection). The two main ways were a connection that it showed who research is constantly ongoing and those who connected with a more concrete demonstration of methods, techniques, and technologies used in science.
- Regarding whether adults from family groups and adult groups responded differently to this exhibit, among those who did engage with the exhibit, there were very few differences in the areas of connection or learning. Groups had the same tracking patterns and reported learning outcomes.
    - The only type of comment that showed a difference was a connection with the content about how scientists determined pregnancy in birds/dinosaurs; perhaps stemming from a personal connection made by a parent visiting with his/her child.
- The only other demographic factor that influenced learning was special training in science/research; visitors with specialized training were slightly more likely to get the main idea, and gave lower average ratings to a single item about "how scientists do their work," both likely reflecting the incoming knowledge areas of these visitors.

NORTH CAROLINA Museum of Natural Sciences

CENTER FOR RESEARCH AND EVALUATION
Lifelong Learning Group

Nature Research Center Summative Evaluation

Part 2: Investigate Labs

Final Report: December 1, 2013

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Introduction

The Nature Research Center (NRC) is an 80,000-square-foot wing of the North Carolina Museum of Natural Sciences (the Museum) that opened in 2012, with goals to "bring research scientists and their work into the public eye, help demystify what can be an intimidating field of study, better prepare science educators and students, and inspire a new generation of young scientists." To achieve these goals, the NRC provides visitors with exhibitions, programs, and featured experiences designed to engage the public directly with research, scientists, and the process of science.

The Lifelong Learning Group was contracted by the Museum to conduct summative evaluation of four of the NRC's featured exhibits and programmatic elements:

- *Ancient Fossils, New Discoveries* exhibit
- Investigate Labs (iLabs)
- SECU Daily Planet programming – daily scientist talks
- Science Cafés

The evaluation of these four components was designed as four distinct multi-method studies, each focused on a particular featured area of the NRC. The goal was to provide targeted understanding of visitor outcomes and experience at a particular NRC feature. In addition, the individual studies were planned cohesively, using complementary and, wherever possible, consistent measures and coding rubrics across the four studies. The findings from the study of each component are contained in separate reports. This report presents the findings from the evaluation of the Investigate Labs.

Exhibits and Programs Studied

The four featured elements that were evaluated in this study were:

- ***Ancient Fossils, New Discoveries* Exhibit** – a permanent exhibit in the NRC, *Ancient Fossils* highlights the science behind Dr. Mary Schweitzer's research, which included the discovery of preserved soft tissue in fossil material, a landmark scientific breakthrough.
- **Investigate Labs (iLabs)** – hands-on labs for visitor use, with guided activities and research skill-building exercises that allow visitors to explore the process of using scientific tools and engaging in inquiry. Experiences are led and guided by educators, scientists, and graduate students.
- **SECU Daily Planet Scientist Programs** – an immersive, three-story multimedia space, which is used for many purposes. A feature purpose of this space is regular, daily live presentations by scientists discussing the science and research behind current issues.
- **Science Cafés** – the NRC's Daily Planet Café serves as the home for a weekly Science Café series. Each Thursday evening, this free event allows the public to join in conversation about scientific topics, delivered in a range of casual formats – from longer format presentations by scientists, to Science Trivia night, to Lighting Talks of a series of brief scientist presentations. They allow for conversation over food and beverages hosted in the NRC's new Café.

Intended Outcomes

At the outset of the project, Lifelong Learning Group evaluators met with Museum staff to discuss the four targeted exhibit and program areas for the NRC, focusing on articulating the intended outcomes for each area, as well as the priority evaluation questions that should guide the study of each NRC area. Below are the outcome statements that resulted from that process.

Investigate Labs

- Participants will have a fun and enjoyable experience
- Participants will express an interest in a return visit
- Participants will be aware of the connection between the Investigate Labs and the research labs
- Participants will feel as though they are engaging in real science
- Participants will demonstrate awareness of relevant science content or process concept(s) as a result of engagement
    - Science is a process
    - Science is relevant to their lives
    - Tools and techniques used in science careers
    - Content-specific ideas

Guiding Evaluation Questions

Investigate Labs

- What is the nature of the visitor experience in the Investigate Labs (time spent doing activities and number/types of activities)?
- What motivates visitors to come to the Investigate Labs and are they interested in returning in the future?
- How do visitors perceive the purpose of the Investigate Labs and their connection to the NRC as a whole?
- Do visitors feel as though they are engaged in "real science" in the Labs?
- What do visitors take away from their experience in an Investigate Lab?

Methods

Multiple methods were used within each of the four area studies in order to address these evaluation questions. Table 1 below shows the methods selected for the Investigate Labs, as well as how methods were intended to help address the study's specific evaluation questions. Below, each method and study procedure is described in greater detail.

Table 1. Investigate Labs Evaluation Matrix: How evaluation questions are addressed by methods

Evaluation Questions	Method 1: Timing and Tracking	Method 2: Interviews (parent-child)
What is the nature of the visitor experience in the Labs?	X	X
What motivates visitors to come in / interest in returning?		X
How do visitors perceive the purpose and connection to NRC?		X
Do visitors feel engaged in "real science" in the labs?		X
What do visitors take away from their experience?		x

Methods: Investigate Labs

Two methods were used to evaluate the three Investigate Labs. **Timing and tracking** of parent-child dyads using the Labs tracked several variables: total time spent, which Lab stations were stopped at, time spent at each station, and types of interactions. A timing and tracking map was created for each of the three Labs: Natural World, Micro World, and Visual World. Data collectors used continuous random sampling within each lab, selecting the next entering family group containing a child who was at least six years old. Groups in which all children were under six years old were not tracked. The target for observation was the child in the group who appeared closest to the target 11-14 age range; if no child was in this age range, observers selected the oldest child in the group. Data collectors recorded visual characteristics of the group (number of adults and children; approximate age of children).

The second method was a **structured exit interview** with parent-child dyads at the end of their Investigate Lab visit. Visitors were recruited using a continuous random sampling, selecting the next exiting family group containing a child who was at least six years old. Parent-child dyads were invited to participate in the interview together, targeting the child closest to the target 11-14 age range, or the oldest child (if none was in the target range). All groups were asked the same interview questions and follow-up prompts, and conversations were audio recorded to facilitate data gathering. Visitors were given a small thank-you gift (i.e., a museum pencil) for each child in the group at the end of the interview. Interview recordings were entered by listening and typing notes of responses and verbatim quotes into a spreadsheet. A refusal log was maintained.

Study Participants

In total, 46 Investigate Lab tracks were obtained (15 each in Natural World and Micro World; 16 in Visual World). In total, 60 interviews were obtained, 20 in each Lab space. No visitors refused to participate in the interview.

Tables 2 and 3 show the demographic characteristics for the participants in the two portions of the study. Both samples were very similar, based upon observable characteristics. Each had a nearly even split of the sex of target subjects (with slightly higher representation of male visitors).

Interviewed children tended to be in either late elementary or middle school; observed children were estimated to be slightly younger, but this may reflect the difficulty of visually identifying a child's age. Data about parents accompanying children are in Table 3.

Analysis

All data were entered into spreadsheets and transferred into SPSS for coding and analysis. Open-ended data were coded using coding rubrics developed for this study. When appropriate, coding rubrics were developed to be able to be applied consistently across exhibit/program components in the study (for comparative purposes). This was not done in cases where common rubrics might dilute the unique findings for a specific exhibit or program. Systematic coding was done to allow visitor responses to open-ended questions to be categorized and quantified for analysis. Tests for inter-rater reliability were done to refine and finalize coding rubrics, before final coding was complete. Data were analyzed descriptively and, where appropriate, inferential statistics were used to test specific questions or hypotheses about the data. All inferential statistics used are described in the results section.

Table 2. Sample characteristics for target children observed in Investigate Labs tracking data

	All Labs (n=46)		Natural (n=15)	Micro (n=15)	Visual (n=16)
	Count	Percentage	Count	Count	Count
Sex (observed child)					
Male	24	52%	7	8	9
Female	22	48%	8	7	7
Approximate Age					
5-6	3	7%	2	0	1
7-8	10	22%	4	3	3
9-10	15	33%	5	5	5
11-12	13	28%	3	6	4
13-14	5	11%	1	1	3

Table 3. Sample characteristics for Investigate Labs interview data

	Interview Data (n=60)	
	Count	**Percentage**
Sex (child respondent) (n=60)		
Male	35	58%
Female	25	42%
Current Grade (child respondent) (n=60)		
K-2	6	10%
3-5	21	35%
6-8	27	45%
9-12	6	10%
Grades of All Children in Groups		
Pre-k	7	12%
K-2	18	30%
3-5	25	42%
6-8	19	32%
9-12	6	10%
Parent's Formal Education (n=59)		
Some High School	0	0%
High School Diploma	6	11%
College Degree	31	53%
Graduate Degree	22	37%
Professional Training in Science/Research (n=59)		
Yes	29	49%
No	30	51%
Home State (n=58)		
NC	45	78%
South (GA, MS, SC, VA, MD)	8	14%
Midwest (MO, WI)	2	4%
Northeast (NY, NJ)	2	4%
Northwest (AK)	1	2%
North Carolina Counties		
Wake County	25	43%
Orange	4	7%
Cumberland	3	5%
All others (<3 each)	38	66%

Results: Investigate Labs

Visitor Use and Engagement

The timing and tracking data show that the Investigate Labs have created a highly engaging environment for youth (and their families). Across the three Labs, the average time spent in a Lab is 21 minutes (Table 4). Individually, the Micro World and Natural World Labs each held visitors for an average of approximately 26 minutes each; Visual World held visitors, on average, for over 11 minutes. At the extreme end, some youth spent almost a full hour in a Lab.

From these data, a Sweep Rate Index (SRI) was calculated; SRI is a standardized metric, developed by Beverly Serrell (1998), to compare stay-time at exhibitions of varying sizes. SRI divides the square-footage of an exhibition by the average stay-time in a sample of tracked visitors; the lower an SRI, the more time visitors spent in the exhibition. A Sweep Rate Index was calculated to look at engagement. All three Labs showed a Sweep Rate Index of under 100, the benchmark for an exhibition that successfully achieves "lingering" visitors. Again, SRI is not a precise benchmark, as these hands-on Labs were intended to be more engaging and time-consuming than a traditional exhibition.

Table 4. Tracking data summary for Investigate Labs, combined and separate

	All iLabs (n=46)	Natural World (n=15)	Micro World (n=15)	Visual World (n=16)
Average total time spent	20:59	25:45	25:57	11:17
Maximum time spent	59:02	59:02	51:00	18:34
Minimum time spent	4:00	6:57	5:20	4:00
Sweep Rate Index	n/a	38	48	86
Avg. # of station stops	6	7 (of 18)	5 (of 16)	5 (of 13)
Average time per station	3:15	3:14	4:31	2:02

Tracking data also show that youth tended to engage broadly in the stations provided within a given Lab. On average, youth stopped at six stations during a Lab visit, generally exploring about one-third of the available stations. Figure 1 shows the overall distribution of the number of stops in a visit by the observed children, including the breakdown by individual Lab; Figure 2 shows the distribution of total length of stay in the Lab, including a breakdown of time by Lab.

Together, all of these tracking data show that visitors tended to spend the most time-per-station in the Micro World Lab and the least in the Visual World. In general, visitors to the Micro World tended to go to relatively fewer stations, but spend longer at each station; in the Natural World they visited more stations and spent a moderate time at them; and in the Visual World they visited a high proportion of stations, but spent less time per station.

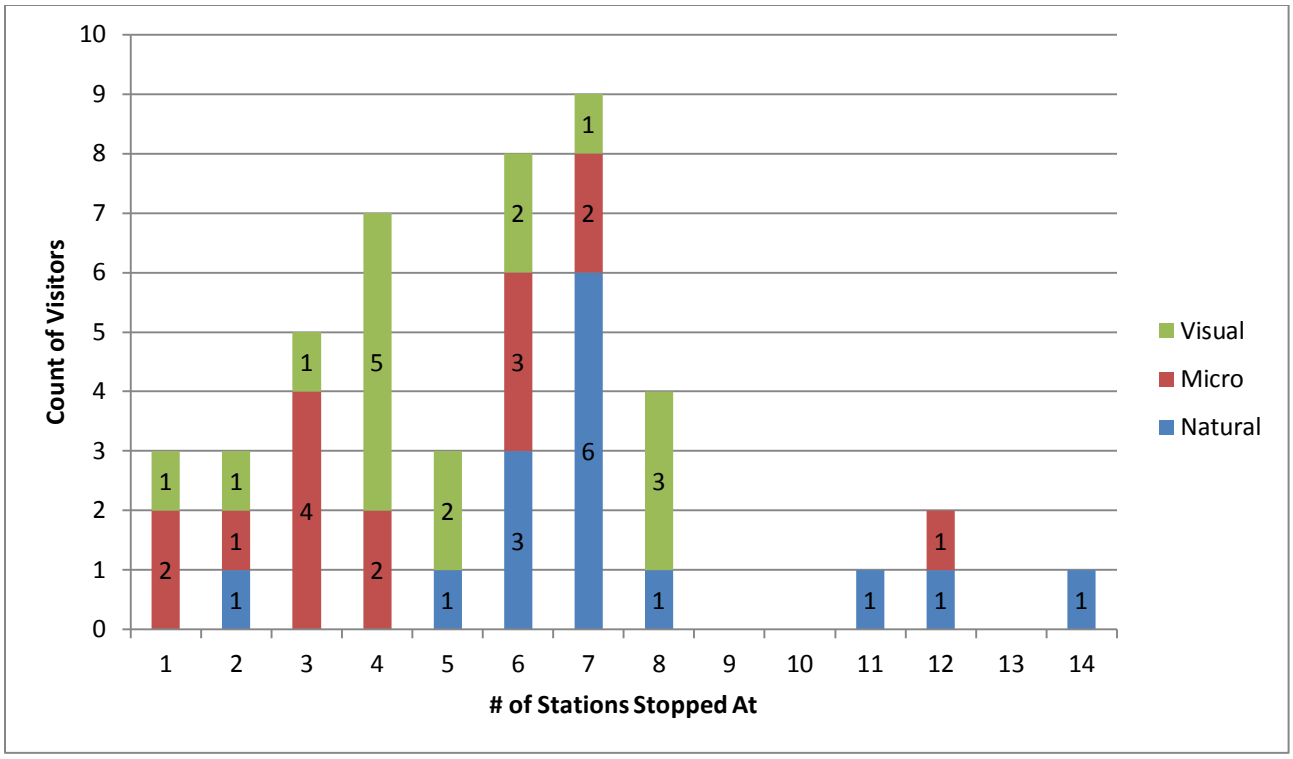

Figure 1. Frequency distribution of number of Investigate Lab stations stopped at by tracked visitors, color-coded by individual Lab (n=46)

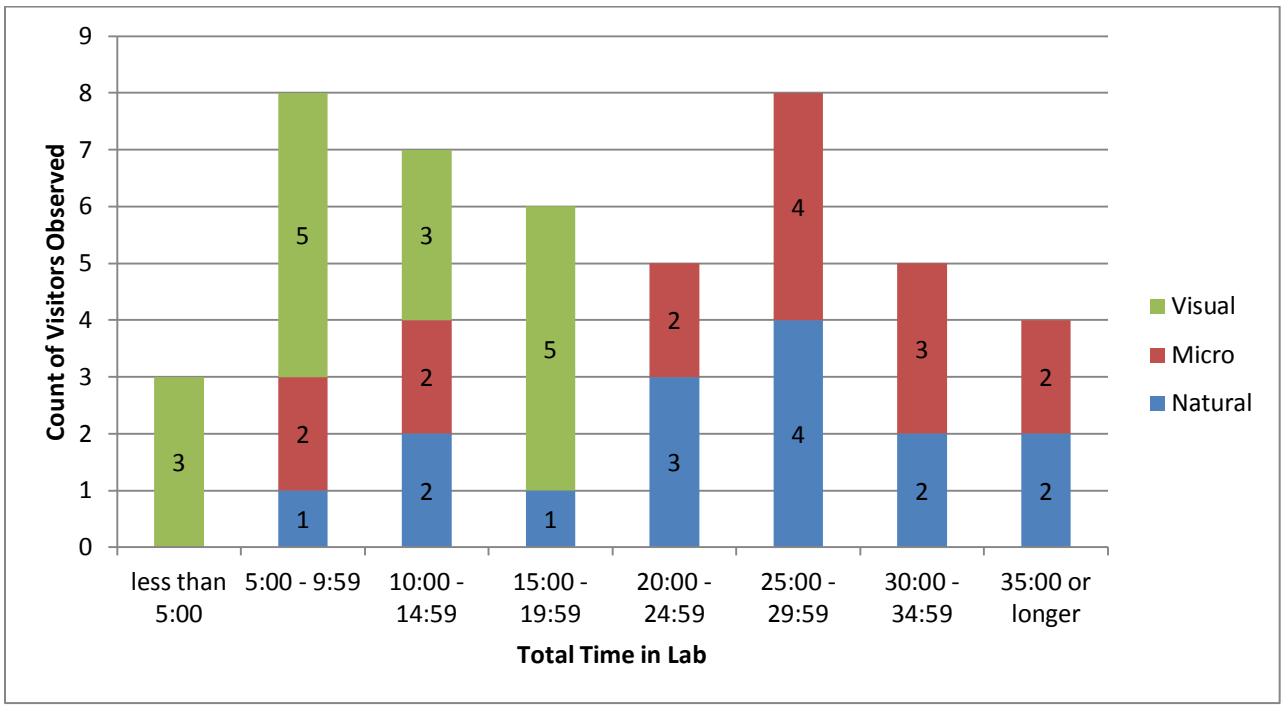

Figure 2. Frequency distribution of total length of time spent in Investigate Labs by tracked visitors, color-coded by individual Lab (n=46)

Tracking data also showed which of the stations were more and less popular in each Lab, as well as which tended to hold visitors for the longest amount of time (Tables 5, 6, and 7). In the Na**tural World Lab,** the stations that attracted 67% or more visitors observed were:

- Orientation
- Projection Microscope
- Microscopes (5 different stations)
- From Algae to Ethanol

The stations that held youth interest for the longest time were different than those that were most popular, however. Those that held visitors, on average, for more than 5 minutes were:

- Volumetrics
- Counting Life / Recycling
- Nature's Design

For the **Micro World Lab** the most popular (stopped at by 46% or more of those observed) were:

- Orientation
- Lab Coats
- Micro Pipetting
- Confused Chemicals

In this Lab, there was some overlap between the most popular stations and those that held visitors the longest. The three stations that held visitors, on average, for more than 10 minutes were:

- Peanut Allergy Test[1]
- Confused Chemicals
- Wheat Germ DNA

For the **Visual World Lab** the most popular (stopped at by more than half of those observed) were:

- Earth
- World Wide Telescope (multiple stations)
- Fold It
- Nova with Dinosaur

Again, there was one overlap and two differences between the stations that were most stopped-at and those that were strongest at holding visitors for extended time.[2] The three stations that held visitors longest, on average more than 3 minutes were:

- Robots
- Chimpanzees
- World Wide Telescope

[1] Note: Peanut Allergy Test was added midway through tracking data collection; and was present for most of the interview data collection. This explains why it was not among the most popular, but was among the most mentioned by children.

[2] The Visual World Lab had the greatest frequency of changing content of stations overall, which can impact the frequency with which visitors could be recorded stopping at a station.

Table 5. Tracking data from youth use of stations within Natural World Lab (n=15)

Station	# of Stops	Avg Length of Stop	Child-Adult Interact	Child-Child Interact	Child-Staff Interact	% Child-Led
Orientation	14	2:22				
Projection Microscope	13	4:06	92%	31%	15%	38%
Microscopes (5 Stations)	11	3:10	55%	18%	0%	100%
From Algae to Ethanol	10	1:35	30%	30%	0%	50%
Volumetrics	9	6:13	67%	33%	0%	56%
Measuring Trays	8	4:43	38%	13%	25%	38%
Science of Scent	8	0:14	0%	0%	0%	25%
Nature's Design	7	5:13	57%	29%	14%	29%
Fingerprint Forensics	7	1:58	43%	29%	0%	43%
Counting Life/Recycling	5	7:02	60%	20%	0%	40%
Tree Rings	4	0:32	50%	0%	25%	75%
Scale	4	2:48	75%	0%	25%	25%
Burner Display	3	0:07	0%	0%	0%	67%
Mosquito Diving Chamber	3	1:04	0%	33%	0%	100%
Cockroaches	3	2:24	0%	0%	33%	33%
Sink	2	0:15				
Lab Coats	1	0:51				
Flies	0					

Table 6. Tracking data from youth use of stations within Micro World Lab (n=15)

Station	# of Stops	Avg Length of Stop	Child-Adult Interact	Child-Child Interact	Child-Staff Interact	% Child-Led
Orientation	13	0:57				
Lab Coats	12	1:25				
Micro Pipetting	12	8:03	50%	17%	92%	25%
Confused Chemicals	7	12:26	71%	43%	57%	71%
Projection Microscope	6	4:44	50%	33%	83%	50%
Wheat Germ DNA	5	10:03	60%	60%	80%	40%
Large Quarter	5	4:49	40%	40%	20%	60%
Aquariums (2)	5	1:02	20%	60%	20%	60%
Mushroom Farm	5	0:35	0%	40%	40%	40%
Projection Microscope (2)	4	1:23	0%	75%	0%	75%
Mushrooms Under the Microscope[3]	4	1:31	50%	0%	50%	50%
Cell Models/Mitosis and Meiosis	3	1:39	33%	33%	0%	67%
Vinegar Experiment	2	0:08	0%	0%	0%	50%
Peanut Allergy Test[4]	2	16:15	50%	50%	0%	50%
Bonsai	1	0:11	0%	0%	0%	0%

[3] This station was added partway through collection of tracking data.
[4] This station was added partway through collection of tracking data.

Winograsky Column	1	0:08	0%	0%	0%	0%
Projection Microscope (door)	0					
Sink	0					

Table 7. Tracking data from youth use of stations within Visual World Lab (n=16)

Station	# of Stops	Avg Length of Stop	Child-Adult Interact	Child-Child Interact	Child-Staff Interact	% Child-Led
Earth	11	1:58	36%	18%	36%	18%
World Wide Telescope (solar system, multiple stations)	11	3:04	36%	9%	45%	55%
Orientation (not a station)	10	2:40				
Fold It	9	2:19	33%	33%	0%	67%
Nova with Dinosaur	9	1:34	22%	33%	0%	44%
Early Earth	6	0:37	33%	17%	0%	67%
Helium	6	0:53	33%	0%	17%	50%
Chimpanzees	6	3:26	50%	33%	17%	83%
Active Earth	4	2:20	75%	0%	50%	50%
Video Stop 1	3	0:18	67%	33%	0%	67%
Robots	2	5:25	0%	50%	100%	50%
Projection Microscope & Tank	2	0:56	0%	0%	0%	0%
Video Stop 2	2	0:21	0%	0%	0%	50%
Video Stop 3	0					

Motivation and Satisfaction

When asked to describe why they had stopped at the Lab, visitors reported two main motivations (Table 8): 37% (22) of groups gave a general response that the Lab "looked interesting" as they were passing by, suggesting a casual curiosity; 35% (21) of groups were more specific in stating that what they could see inside or around the Lab, specifically the tools or video screens, were what attracted them. Other reasons mentioned including seeing that it was interactive (17%) and that they had been to an Investigate Lab before (17%).

> *We stumbled across the lab and thought it was interesting. I wanted to see what else was up here. (Visual World, male, 2nd grade)*
>
> *I thought the things in there were kind of cool, the tubes and the liquids. (Micro World, female, 6th grade)*
>
> *It sounded fun. The measuring and the microscope. (Natural World, male, 3rd grade)*

Table 8. Reasons visitors reported for deciding to stop at an Investigate Lab (n=60)

	Count	Percent
Looked interesting	22	37%
Materials/Tools drew me in	21	35%
Interactive	10	17%
Have been to Lab before	10	17%
Staff invited in	2	3%
Other	10	17%

Youth ratings of how much they enjoyed the Lab experience were high: 78% rated it a 6 or 7 on a 7-point scale (median=6). When explaining the reasons for their ratings (Table 9), three reasons dominated the explanations for the high ratings: the tools used (often specifically naming a tool), that it was "fun" (only children who described it with this word), and that it was hands-on or let them do experiments. Each of these was mentioned by more than 1 in 6 of the youth. Among those who rated the experience less enjoyable (4 or 5), their main reasons were that it was "just OK" or they weren't able to give an answer.

Table 9. Frequency distribution of visitor explanations for their rating of enjoyment, organized by rating given (n=60)

	7 Rating	6 Rating	4-5 Rating	Total
Fun	8	3	1	12
Tools	6	3	3	12
Hands-on/Experiments	7	3	0	10
Content	5	2	1	8
Good (general)	3	2	2	7
It was just OK	0	4	3	7
No answer	1	2	3	6
Other	1	2	1	4
Experienced difficulties	0	2	1	3
Have done it before	0	2	0	2
	31	25	15	

In further support of youth enjoyment of the Lab, when asked how likely they were to come back to the Lab if they visited the Museum again, 62% rated it a 7 (out of 7, meaning "extremely likely"); another 23% rated it a 6 out of 7. (Median rating = 7).

Comparison by Lab

In the ratings of enjoyment and interest in returning, ratings were high across all three Labs, with no significant differences found between them.

Learning Outcomes

In response to a series of three open-ended prompts, youth reflected on their experience and learning from the Investigate Labs. The prompts asked visitors to reflect on: something interesting to them, something they never realized, and what they might remember in a month. All items were coded using the same coding framework, developed inductively from the data (see coding framework in Table 10).

Table 10. Coding categories for visitor meaning-making in Investigate Labs

Code Category	Description
Knowledge: Content	describes the content, information, or facts a station intended to communicate
Knowledge: Process or Tools	describes understanding the scientist's or science's process for figuring something out, doing an experiment
Doing: Using Real Tools	describes using scientific tools
Doing: Engaging in Process	describes being engaged in a scientific process (e.g., we had to figure it out; not being cookbook; etc.)
Hands-on (general)	generic response of "hands-on" or "interactive" without additional explanation
Seeing Something New: Discovery	describes the Lab making something visible to them that hadn't been before; generally literally visible or "seeing" (i.e., Lincoln on penny; early earth; solar system)
Feeling: Curiosity, Real Science	the feeling that one was engaged in real science; was curious; feeling empowered
Other	other statements, including things too generic to fall into other categories
Nothing	no answer; don't know

Visitors' responses were examined across the entire interview, looking at the frequency with which concepts were mentioned in response to any of the open-ended prompts. Table 11 shows that the Labs were successful at engaging visitors in active learning and discovery, as intended. More than half (57%, 34) of the groups interviewed talked about learning through using real tools in the Lab, specifically their use of real scientific tools, including micro pipettes, microscopes, and robotics (to name a few).

> *[One thing that was interesting was…] The new pipets. …They are more specialized for just putting one drop in. I've never seen that before. [Why so interesting?] I haven't used those before in the lab. (Micro World, male, 10th grade)*
>
> *How you could move the planets around, rotate it. I liked how it seemed like it could go on the axis. (Visual World, female, 10th grade)*
>
> *[What I'll remember is…] The microscopes and the animals I saw under the microscope. (Natural World, female, 7th grade)*

Table 11. Frequency of visitor groups (n=60) who expressed learning in each category, across all comments made in an interview

	Count	Percent
Doing: Using Real Tools	34	57%
Knowledge: Content	25	42%
Seeing Something New / Discovery	24	40%
Doing: Engaging in Process	15	25%
Knowledge: Process or Tools	13	22%
Feel: Curiosity, Like It's Real Science	10	17%
Hands-on (general)	5	8%
Other	17	28%
Nothing	0	0%

Just under half of the groups (42%, 25) talked about content communicated through the Labs they visited.

> *The algae, it shows you how it grows, and how long it takes (Natural World, female, 7th grade)*
>
> *Chip the robot. The fact that he can respond which way to go, he can look both ways and find which way to go on his own. (Visual World, male, 6th grade)*
>
> *I learned more things, like about iodine, and the water that we drink...the worms/organisms in our water. Iodine is a good antiseptic for living tissue. (Micro World, female, 6th grade)*

Another 40% (24) talked about literally seeing something they thought they knew well in a new way – including the penny, microorganisms in water, and the universe.

> *I got to see what the Earth looked like in early times. (Visual World, female, 4th grade)*
>
> *That you could see Abraham Lincoln in the background of the penny. It makes you think of all the hard work they put into making a penny, they could just leave that out. (Natural World, male, 6th grade)*
>
> *How I was able to see what I normally wouldn't be able to. (Micro World, female, 5th grade)*

Other areas of learning for one-quarter or fewer of visitors included talking about process – either their engagement in the process (rather than the tools) of science (25%, 15) or communicating about cognitive gains related to processes or tools of science (22%, 13). Another 17% of groups described feelings of curiosity and a sense that the Lab allowed them to really engage in science.

> *They use most of programs [to do this work], I thought it was all wires, but when she showed us chips I was like, "Oh this is a lot more interesting than I thought." You could see these tiny chips that would actually programmed to move the wheels. (Visual World, male, 5th grade)*
>
> *[I will remember…] That we had fun, and that we got to see scientists work on their creativity and they could tell us how it was. Scientists are really important to our lives; they help us find different things that we didn't know about. (Natural World, male, 7th grade)*
>
> *The iodine, trying to figure out which one was which. Because it feels like you really matter and you have to figure it out and you have to correct somebody [who is] wrong. (Micro World, male, 6th grade)*

When looking at how responses differed by prompt, across the interviews, we can see that different aspects resonated differently as being interesting, memorable, or something they never realized. Groups tended to report that the most interesting areas were using new tools and/or seeing something new (each mentioned by 30% of groups to that prompt). Most memorable was also the act of using real tools (32% of groups), as well as mentions of specific stations that they would remember. When asked something they never realized, content learning was mentioned more often; 30% of groups described a concept they learned from the Lab or an experiment they did. This question also proved to be difficult, with 25% not able to state something they had never realized.

Table 12. Frequency of visitor groups (n=60) who expressed learning in each category, separated by prompt

	Something Interesting		Never Realized		Remember Most	
	Count	Percent	Count	Percent	Count	Percent
Doing: Using Real Tools	18	30%	4	7%	19	32%
Knowledge: Content	11	18%	18	30%	6	10%
Seeing Something New / Discovery	18	30%	6	10%	6	10%
Doing: Engaging in Process	10	17%	0	0%	8	13%
Knowledge: Process or Tools	5	8%	9	15%	2	3%
Feel: Curiosity, Like It's Real Science	3	5%	7	12%	1	2%
Hands-on (general)	2	3%	1	2%	2	3%
A specific station (only thing said)	0	0%	0	0%	14	23%
Other	5	8%	3	5%	10	17%
Nothing	0	0%	15	25%	1	2%

Groups were also verbally asked to rate how much they felt like they learned about five of the core learning components of the Lab. To some extent, these results reflect the findings from the open-ended data (see Table 13). Youth seemed to associate their learning in the Lab most strongly with the relevance and practice of scientific work: 72% strongly agreed that they had learned about how scientists do their work, 65% strongly agreed they learned how science fits into our lives; and 55% strongly agreed they learned about the steps it takes to do science. Less strong associations were made with learning about science concepts or skills, although there was still slight agreement with these statements overall. Compared with the open-ended data, this shows that there may be areas in which youth are not always aware when they are learning what an educator would consider to be concepts or science skills.

Table 13. Average ratings, and % giving highest ratings, by groups in response to "How much do you feel like you learned about each of these things while in the Lab today?"(on a 1-7 scale)Frequency of visitor groups (n=60)

	% 6 or 7	Median	Mean	Std. Dev.
About how scientists do their work	72%	6.5	5.8	1.64
About how science fits into our everyday lives	65%	6.0	5.7	1.52
About the steps it takes to do science	55%	6.0	5.5	1.64
A new science concept	47%	5.0	5.2	1.66
A new science skill	48%	5.0	5.1	1.71

Differences between the Labs

In addition to these results examining the outcomes of Lab participation in the aggregate, analyses were also done to look at results between the Labs. Because samples were relatively small, nonparametric analyses were used. Results showed that, in many aspects, the Labs performed similarly to one another. Visitors' ratings of enjoyment and likelihood of coming back were not significantly different, nor were their reasons for why they enjoyed the Labs.

In terms of learning, the ratings to the closed-ended items showed no significant differences between the three Labs. However, when examining the open-ended data, several significant trends

emerged in the kind of language visitors used to describe their learning across the three Labs. Figure 3 depicts the distribution of codes across the major categories of data, separated by each Lab. Four of the major areas of learning expressed showed significant differences in how frequently it was mentioned by visitors of the three different Labs:

- Describing engaging in a scientific process (rather than a tool) ($X^2(2,N=60)=20.8$, $p<.001$)
- Describing seeing something new ($X^2(2,N=60)=10.4$, $p=.005$)
- Describing feeling curiosity, like it was real science ($X^2(2,N=60)=8.9$, $p=.01$)
- Describing new content or concepts understood ($X^2(2,N=60)=6.7$, $p=.04$)

Visually looking at the differences (Figure 3), it is evident that:

- Micro World Lab tended to elicit descriptions of engaging in scientific process and feeling like a real scientist more frequently than the other Labs;
- Natural World Lab and Visual World Lab tended to elicit descriptions of new things seen/discovered more often;
- Visual World Lab and Natural World Lab tended to elicit descriptions of content or concepts learned more often

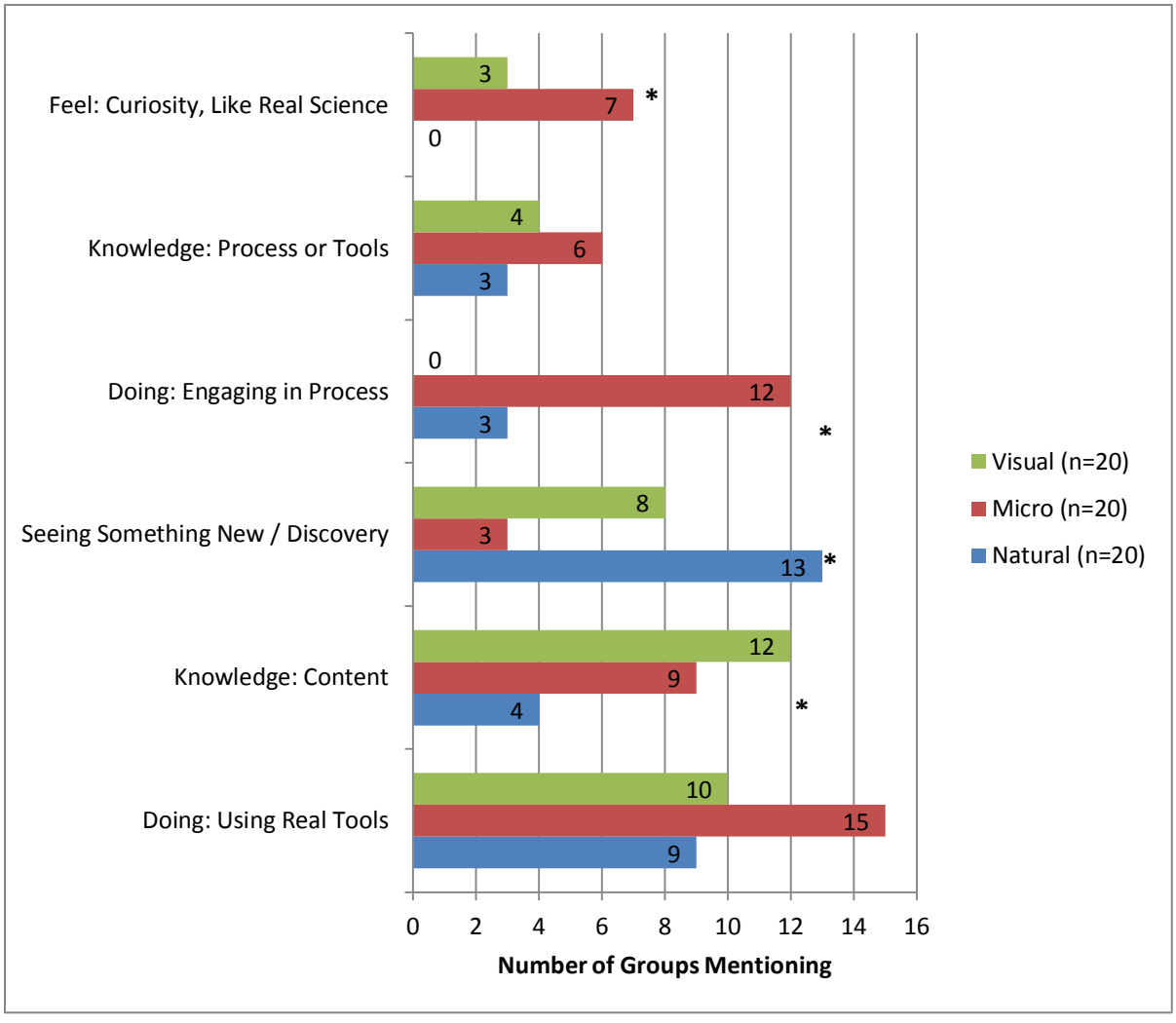

Figure 3. Comparison of coded response distribution by Investigate Lab.

**statistically significant (p <.05)*

Connection to NRC & Real Science

Visitors were asked to rate whether or not they felt like they were "doing real science" in the Lab, on a scale of 1 to 7, and then describe the reason for their rating. Ratings were on the positive side of the scale, but were widely distributed. The average rating was 5.7 (out of 7; median=6), with nearly even numbers selecting 7, 6, and 5 ratings (Figure 4).

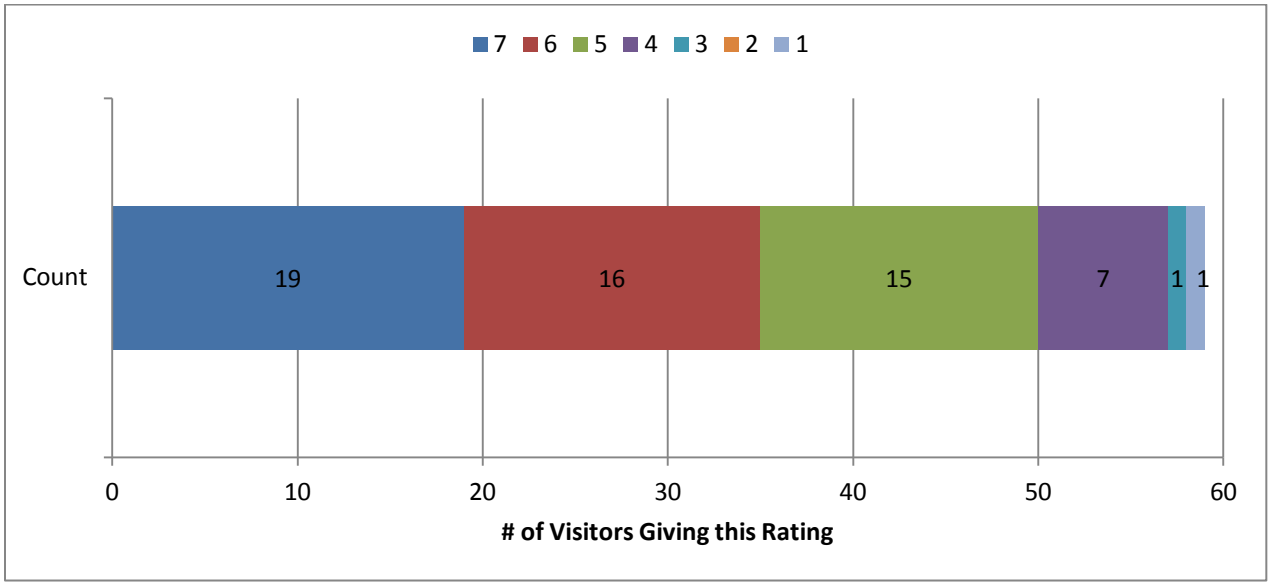

Figure 4. Distribution of ratings by visitors to "How much did you feel like you were doing 'real science'" in the Lab (1-7 scale; 1=not at all; 7=a great deal). (n=60)

More helpful are the reasons given for these ratings. Those who said it felt more like real science tended to cite the tools they used as being real scientific tools (19 groups) or the process they used was like real scientists (14 groups).

> *Because that is basically what I have seen scientists do, what my science teacher does. It felt like I could do it with real stuff. (Micro World, female, 8th grade; rating 7 for "real science"*
>
> *I actually felt like I was experimenting a lot of things. (Natural World, female, 7th grade; rating 7 for "real science")*
>
> *I felt like I was studying the planets, how they looked when you zoomed into them and stuff. (Visual World, female, 4th grade; rating 6 for "real science)*

Those who were less convinced tended to just report their rating reflected that what *they* had done did not seem real (7) or that they just didn't feel it was real science (4 groups).

> *It doesn't really seem like science because it's too much fun. (Visual World, female, 5th grade; rating 4 for "real science")*
>
> *Have done more science other places- I'm more of a chemistry guy, but this is good. (Natural World, male, 11th grade; rating 5 for "real science")*
>
> *When you did the syringe thing [micropipette], it was just food coloring and water. But the good part was iodine, I had not heard of it before, and that was new to me. (Micro World, male, 5th grade; rating 5 for "real science")*

Another area of interest was the extent to which visitors were aware of the intended connections and parallels between the Investigate Labs and the nearby Windows on Research Labs and/or the NRC as a whole. A series of questions delved into visitors' perceived connections in these areas. Regarding visitors' sense of connection with the Nature Research Center/Museum, many visitors found this question difficult to answer; 32% (19) of groups gave no answer to the question or said they weren't sure of a connection (about 4 groups). Some of these groups noted that they hadn't yet fully explored the Museum and didn't feel they could answer.

Of those who did see some connection, many answers only articulated a vague connection such as both being "about science" (13%, 8) or noted that similar, specific content areas were covered in exhibits and in the Lab (8%, 5). Other visitors focused on the nature of the Lab experience that it provided something *different* than the rest of the Museum (13%, 8). A small subset did articulate understanding of the deeper connection that the NRC intended – that the Labs allowed visitors to engage with the "how" of doing science, rather than the facts presented in other areas (7, 12%).

Table 14. Frequency of connections made by visitor groups (n=60) between the Investigate Lab and the rest of the NRC/Museum.

	Count	Percent
No Answer / Don't Know	19	32%
About Science, general	8	13%
Offers Something Different (than rest of Museum)	8	13%
Explains How (instead of what)	7	12%
Content-based Connection	6	10%
Describing it as an exhibit strategy	5	8%
Other	7	12%

To probe in more depth, a follow-up directed question asked visitors about whether or not they were aware of the Research Labs and any connection with the Investigate Labs. Overall, 60% of the interviewed groups indicated they had noticed the Research Labs during their visit. Of those 36 groups, the majority of groups did connect with one or more of core aspects of connection between the two sets of Labs. Nineteen of the groups who had noticed the Research Labs (52%; 32% overall) noted that both used a similar science process (11, 31%); used similar tools (9, 25%); and/or were about similar science content (3, 8%). Some of these groups mentioned more than one of these ideas (Table 15).

> *You get to do what they do, you get to look at stuff and see what happens. You get to look at stuff and see what is going on and why it is doing that. (Visual World, female, 7th grade)*
>
> *Well they still have to measure and look at stuff closely, that way you can look at stuff that you can't see naturally. (Micro World, female, 5th grade)*
>
> *Seeing scientists do that work- I do that work in here. (Natural World, male, 6th grade)*
>
> *They might have the same stuff, but here it is to learn about them, but in their labs it is their job. (Micro World, male, 7th grade)*

Table 15. Frequency of similarities or differences mentioned by visitor groups (n=60) between the Investigate Lab and the Research Labs (n=36 who were aware of the Research Labs).

	Count	Percent
Similar Process	11	31%
Similar Tools	9	25%
No Connection / No Answer	7	19%
Differences: Investigate Labs are Better	5	14%
Similar Content	3	8%
About Science, general	2	6%
Other	4	11%

In addition, five groups (14%) noted difference between the Research and Investigate Labs, generally noting that the Investigate Labs were better because the visitor got to do things, rather than watch others do things. Overall seven groups (19%) who had seen the Research Labs were not able to describe a connection.

Comparison by Lab

For the quantitative items in this section, results were compared by individual Lab for potential differences. No effect by Lab was found for whether or not visitors were aware of the Research Labs. Some, although minimal, differences were found in groups' ratings of how much they felt like they were doing "real science." Table 16 shows the mean and median ratings by individual Lab. A Kruskal Wallis test revealed a significant effect of Lab on rating of "doing real science" (X^2 (2)=6.09, p=.048). However, as the table shows, the magnitude of those differences is not great. A post-hoc test to compare the Labs with each other directly (Mann-Whitney U) showed the only significant difference was between the Visual World and the Micro World Labs (U=99.5, z=-2.66, p=.008), with the Micro World Lab receiving a higher median rating.

Table 16. Central tendency of ratings, by Lab, in response to "How much do you feel like you were doing 'real science'" in this Lab, (1-7 scale)

	Median	Mean	Std. Dev.	N
Natural World	6	5.8	1.28	20
Micro World	6	6.2	0.75	20
Visual World	5	5.1	1.45	19

**Significant effect of Lab on median ratings (X^2 (2)=6.09, p=.048); post-hoc analysis shows only difference between Micro and Visual World Labs (U=99.5, z=-2.66, p=.008).*

Discussion & Conclusions

Investigate Labs provide experiences for youth and their parents/adults that prompt high levels of engagement, excitement, and learning about the process and tools of science research. Visitors to the Labs tended to be in, or just slightly younger than, the targets of the NRC; children were generally in late elementary or middle school. Only a few high-schoolers were in the sample. These young visitors demonstrated high engagement in the Labs and core learning outcomes related to the active doing and understanding of science process. And although the three Labs provide very different experiences, the common outcomes across the Labs are remarkably consistent. Key variations point to unique elements of each environment.

- Investigate Labs are highly engaging portions of some families visits to the NRC, holding visitor groups for an average of almost 26 minutes (in the Natural and Micro World Labs) and over 11 minutes in the Visual World Labs. Given their relatively small footprints, these spaces show visitors are giving them a lot of time and attention compared to benchmarks of visitor "sweep-rate" for conventional exhibit experiences.
- Time at stations is also lengthy, averaging between two and five minutes; an average which reflects some stations that are only "sampled," while others are more extensively explored.
    - These experiences are designed to and succeed at holding visitors for extended periods of time, a contrast to the experience of the rest of a typical museum visit. Families linger, visit a handful of stations, and spend extended time at several of them experimenting with the activities.
- While trends hold across Labs, the experience within any one Lab is unique. This reflects the types of activities and equipment available and the time each one may take to have a meaningful engagement. The greatest apparent contrast is that the Micro and Natural World Labs emphasis on a variety physical equipment and experiments; while the Visual World Lab has primarily computer equipment to explore visualizations of data and research.
    - In the Micro World Lab, visitors tend to go to fewer stations, but spend longer at those they visit.
    - In the Natural World Lab, visitors tend to visit more stations overall, but spend a moderate length of time at them – some of the stations getting just quick passes, and others longer periods of time.
    - In the Visual World Lab, visitors stop at a high proportion of the available stations, but generally spend less time per station and less time overall.
- Factors that draw visitors into the Lab related to the open wall-of-windows in their design; people stop because it "looks interesting" or, more specifically, because they see the materials and tools inside (or near the door) and are intrigued. Enjoyment of the experience is also high, with an emphasis on the tools, hands-on experience, and the "fun" of the Labs.
    - These motivations and satisfaction are consistent across the three Labs, reflecting the consistency of presentation and experience, despite the very different content and types of engagement in the three Labs.
- While the content learned in each Lab is very different, the underlying themes of what and how youth described their learning and takeaways had many similarities to highlight the broad outcomes of these Labs. The main learning outcomes related to "using real tools," the content of specific Lab stations, and literally seeing something familiar in a new way. Connections with

understanding and engaging in the process of science were secondary outcomes, in terms of frequency mentioned, but were present for about a quarter of visitors.

  - The interesting and memorable aspects were generally the ability to use real tools and discover new things through these tools (whether a microscope or a visualization). The new realizations, in contrast, tended to be about content from one of the stations or a relationship to the process and feelings in the Lab.
  - Micro World Lab tended to elicit more descriptions of engaging in scientific process and feeling like a real scientist (the focus on DNA and problem-oriented experiments may contribute);
  - Natural World Lab and Visual World Lab tended to elicit more descriptions of new things seen/discovered (microscopes and visualization tools were both major stopping points in these Labs, both of which address tools to see aspects of the world with new "eyes");
  - Visual World Lab and Natural World Lab tended to elicit descriptions of content or concepts learned (several key stations led visitors to new information gained through what they saw or did).

- Youth did tend to feel like they were doing "real science" in the Labs, mainly because of the tools and processes they used. The connections with the rest of the NRC were not something youth or their parents could readily identify; connections with the Research Labs were somewhat easier to make, but only for those who had yet seen/were aware of those Labs (just over half). Again, the tools and processes were the main connections that visitors saw between the two.
  - This indicates that visitors do understand the parallels between the two types of Labs in the NRC, but this awareness will not be overall dominant in visitor minds because not all visitors are aware of or have noticed the Research Labs in order to draw that connection. This may point to the need of better understanding of how and to what extent visitors are seeing and engaging with the Research Labs as exhibits within their experience.
  - The Labs are generally similar to one another in this outcome, with the exception that visitors to the Micro World Lab tended to respond more positively than those in the Visual World Lab; but all were similar to the Natural World Lab, indicating the differences were not substantial overall.

NORTH CAROLINA Museum of Natural Sciences

CENTER FOR RESEARCH AND EVALUATION
Lifelong Learning Group

Nature Research Center Summative Evaluation

Part 3: Daily Planet Programs

Final Report: December 1, 2013

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Introduction

The Nature Research Center (NRC) is an 80,000-square-foot wing of the North Carolina Museum of Natural Sciences (the Museum) that opened in 2012, with goals to "bring research scientists and their work into the public eye, help demystify what can be an intimidating field of study, better prepare science educators and students, and inspire a new generation of young scientists." To achieve these goals, the NRC provides visitors with exhibitions, programs, and featured experiences designed to engage the public directly with research, scientists, and the process of science.

The Lifelong Learning Group was contracted by the Museum to conduct summative evaluation of four of the NRC's featured exhibits and programmatic elements:

- *Ancient Fossils, New Discoveries* exhibit
- Investigate Labs (iLabs)
- SECU Daily Planet programming – daily scientist talks
- Science Cafés

The evaluation of these four components was designed as four distinct multi-method studies, each focused on a particular featured area of the NRC. The goal was to provide targeted understanding of visitor outcomes and experience at a particular NRC feature. In addition, the individual studies were planned cohesively, using complementary and, wherever possible, consistent measures and coding rubrics across the four studies. The findings from the study of each component are contained in separate reports. This report presents the findings from the evaluation of the Daily Planet Presentations.

Exhibits and Programs Studied

The four featured elements that were evaluated in this study were:

- ***Ancient Fossils, New Discoveries* Exhibit** – a permanent exhibit in the NRC, *Ancient Fossils* highlights the science behind Dr. Mary Schweitzer's research, which included the discovery of preserved soft tissue in fossil material, a landmark scientific breakthrough.
- **Investigate Labs (iLabs)** – hands-on labs for visitor use, with guided activities and research skill-building exercises that allow visitors to explore the process of using scientific tools and engaging in inquiry. Experiences are led and guided by educators, scientists, and graduate students.
- **SECU Daily Planet Scientist Programs** – an immersive, three-story multimedia space, which is used for many purposes. A feature purpose of this space is regular, daily live presentations by scientists discussing the science and research behind current issues.
- **Science Cafés** – the NRC's Daily Planet Café serves as the home for a weekly Science Café series. Each Thursday evening, this free event allows the public to join in conversation about scientific topics, delivered in a range of casual formats – from longer format presentations by scientists, to Science Trivia night, to Lighting Talks of a series of brief scientist presentations. They allow for conversation over food and beverages hosted in the NRC's new Café.

Intended Outcomes

At the outset of the project, Lifelong Learning Group evaluators met with Museum staff to discuss the four targeted exhibit and program areas for the NRC, focusing on articulating the intended outcomes for each area, as well as the priority evaluation questions that should guide the study of each NRC area. Below are the outcome statements that resulted from that process.

Daily Planet Scientist Talks

- Visitors will demonstrate awareness of relevant science content or process concepts as a result of the program
    - Science is a process
    - Science is relevant to their lives
    - Scientists are real people
    - Content-specific ideas
- Visitors will feel amazed, interested, or excited by the program
- Visitors will feel a positive affective response to the featured scientist (e.g., approachable, cool, interesting, etc.)
- Visitors will engage with the program and the scientist
- Visitors will enjoy the program and experience

Guiding Evaluation Questions

Daily Planet Scientist Talks

- What is the flow of visitor traffic during a presentation?
- Why do visitors stop at the program? What compels them to stay? Why do visitors leave early?
- How do visitors and scientists interact during and after the program?
- What ideas or concepts do visitors take away from a Daily Planet presentation?
- What is the affective response to a Daily Planet presentation?
- What do visitors like most/least about Daily Planet presentations?
- Are there trends in which visitors respond more positively/negatively to the presentations?

Methods

Multiple methods were used within each of the four area studies in order to address these evaluation questions. Table 1 below shows the methods selected for the Daily Planet Scientist Talks, as well as how methods were intended to help address the study's specific evaluation questions. Below, each method and study procedure is described in greater detail.

Table 1. Daily Planet Evaluation Matrix: How evaluation questions are addressed by methods

Evaluation Questions	Method 1: Show Observation	Method 2: Questionnaire	Method 3: Exit Interview
What is the flow of visitor traffic during a presentation?	X		
Why do visitors stop, stay, and/or leave early?		X	X
How do visitors and scientists interact during/after?	X		
What ideas or concepts do visitors take away?		X	
What is the affective response to a presentation?		X	
What do visitors like most/least?		X	
Trends in who responds more positively/negatively?		X	

Methods: Daily Planet Presentations

Three methods were used to evaluate the scientists' presentations within the Daily Planet. Systematic **observational data** were collected to track the audience flow and engagement with daily scientists talk programming across 10 presentations using a scan sampling technique, with additional data on engagement. In order to gather comprehensive data on the entire, three-level Daily Planet theater, a data collector was stationed at a corner of Level 2, where she would able to see audience on all three levels from a single position. However, because all three levels cannot be visually seen together, scan sampling was used throughout the length of a presentation to assess the crowd size and increases and decreases over time. Starting with the first speaking by presenter(s), observers started a stopwatch and began a systematic counting and recording of audience members on each level. At each one-minute interval thereafter, the scan count and recording of the three levels was repeated. If any substantial changes or movements in visitors were noticed qualitatively, but not evident in the scan-counts, they were noted descriptively. Timing and scan sampling stopped at the conclusion of the formal presentation. At the conclusion of the presentation, observers recorded the questions asked by the audience, who asked (child or adult), and what level of the theater questions came from.

The second method was a **brief exit interview** for visitors who left the presentation midway through. The interview was very short and focused on why they had stopped and what made them leave early. Visitors who had stopped to watch for at least 30 seconds were eligible for recruitment. Responses were written directly on the data sheet. A total of 36 interviews were obtained.

The third method was a **self-complete questionnaire** for adult visitors in the audience who stayed to the end of a Daily Planet presentation. Museum staff and volunteers assisted with data collection; the presentation leader invited and encouraged the audience to share their feedback with the questionnaires, and volunteers on each level of the theater aided with distribution and collection of forms. Data were entered into a spreadsheet for analysis.

Study Participants

A total of 36 brief exit interviews were obtained; and staff collected data from 89 valid questionnaires after presentations. The characteristics of the study participants in each sample are presented in Table 2.

Analysis

All data were entered into spreadsheets and transferred into SPSS for coding and analysis. Open-ended data were coded using coding rubrics developed for this study. When appropriate, coding rubrics were developed to be able to be applied consistently across exhibit/program components in the study (for comparative purposes). This was not done in cases where common rubrics might dilute the unique findings for a specific exhibit or program. Systematic coding was done to allow visitor responses to open-ended questions to be categorized and quantified for analysis. Tests for inter-rater reliability were done to refine and finalize coding rubrics, before final coding was complete. Data were analyzed descriptively and, where appropriate, inferential statistics were used to test specific questions or hypotheses about the data. All inferential statistics used are described in the results section.

Table 2. Sample characteristics for Daily Planet Questionnaire and interview data

	Questionnaire Data (n=89)		Exit Interviews (n=36)	
	Count	**Percentage**	**Count**	**Percentage**
Sex (n=70)				
Male	31	44%	9	25%
Female	40	56%	26	68%
Age / Approximate Age (n=68)				
18-20s	17	25%		
30s	8	12%		
40s	21	31%		
50s	12	18%		
60s+	11	16%		
Group Type (n=68)				
Adult Group	22	32%	23	64%
Family Group	47	68%	11	31%
Grades of Children (n=47 family groups)				
pre-k	5	6%		
K-2	16	18%		
3-5	21	24%		
6-8	10	11%		
9-12	14	16%		
Formal Education (n=72)				
Some HS	4	6%		
HS Diploma / Some College	13	21%		
College Degree	37	51%		
Graduate Degree	19	26%		
Training in Science or Research (n=76)				
Yes	32	42%		
No	45	58%		
Home State (n=68; n=34, respectively)				
NC	55	81%	32	94%
Southeast (FL, MD, VA, GA, VI)	6	9%	2	6%
Northeast (NY, PA)	5	7%	0	0%
Southwest (AZ)	1	1%	0	0%
Midwest (IL)	1	1%	0	0%
Northwest (OR)	1	1%	0	0%
North Carolina Counties				
Wake County	35	51%	16	47%
Durham	4	6%	3	9%
Johnston	1	1%	3	9%
Orange	1	1%	3	9%
All others (<3 each)	14	16%	7	21%

Results: Daily Planet Programs

Attendance and Audience Flow

Observational data were collected over ten presentations at the Daily Planet, on a range of topics and with different presenters. Table 3 presents data about the overall timing and flow of these presentations. On average, Daily Planet presentations observed lasted about 30 minutes, with 22 minutes of presentation by the scientist, and about 8 minutes of audience Q&A. The length varied based upon the needs of the presentation, and each Talk was facilitated by a staff moderator/MC, who always introduced the presentation and facilitated engagement with the audience; one observed presentation was done in an Interview-Style, in which the scientist and moderator engage in conversation, rather than a direct presentation.

Table 3. Descriptive statistics of observed program length (n=10 programs)

	Total Length (minutes)	Presentation (minutes)	Q&A (minutes)
Mean	30	22	8
Maximum	45	35	12
Minimum	19	11	3

Looking at all of the observed presentations combined, we see an average total audience of around 23 people watching at any one time (Table 4). In general, the audience is greatest on the floor level, moderate on the second level, and lowest on the third level. There is great variability in attendance at any moment, however; the maximum observed audience observed over 10 presentations was 54 visitors (Symbiosis in Nature, minute 18), and the minimum audience observed at one time was 7 visitors (Weather and Military Operations, minute 30).

Table 4. Descriptive statistics of audience patterns, on average across 10 programs

	Total Audience	Level 1	Level 2	Level 3	
Mean	23	14	7	2	
Median	24	14	7	2	
Std. Dev.	3.4	2.8	1.8	0.9	
Maximum Size	54	38	11	5	"Symbiosis in Nature" Minute 18
Minimum Size	7	5	1	1	"Weather and Military Operations" Minute 30

Figure 1 shows a line graph of the average audience size, across the 10 observed shows, at each minute; it ends at 24 minutes (which includes the entirety of half of the observed shows). These averages smooth out some of the individual variability of a given show to see overall patterns in audience growth and shrinking across the three levels of the Daily Planet Theater.

These data show the consistent trend that audiences on Level 1 are the largest (averaging between 10 and 20 people), and observationally we see that they tend to be the most consistent and least variable. Audiences on Level 2 are moderately sized (averaging 5-10 visitors) and tend to show greater variability. Audiences on Level 3 of the theater are generally very small (fewer than 5

people on average). These data also show a trend of audience sizes increasing slightly over time in Level 1; but audience sizes tend to decrease in levels 2 and 3.

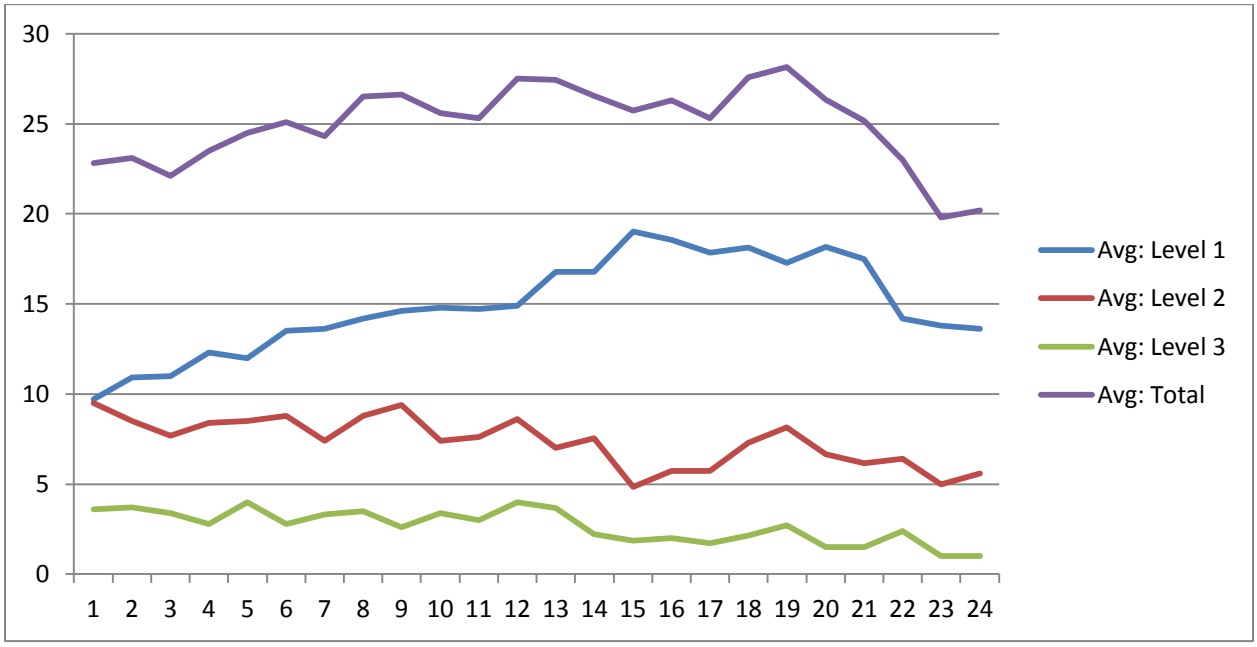

Figure 1. Average audience sizes across 10 observed shows at each minute-mark of the presentation (minutes 1-24)

These averages do, however, mask some degree of the variability and trends that are seen in audience movement during any single given show. Table 5 presents more detail on the 10 individual presentations that were observed, through which some of that variability can be seen. Average audience sizes ranged from 16 to 48, likely influenced by many factors. Within a single show, one can see that audience size could range between, for instance, a low of 8 people and a high of 33 people (A Baby's Story). Graphs of detailed data for three of these shows are shown below (Figures 2, 3, and 4) to illustrate the patterns observed.

Table 5. Descriptive statistics for observations of specific Daily Planet programs observed

Title	Date	Total (in min.)	Presentation (in min.)	Q&A (in min.)	Avg Audience	Max Audience	Min Audience
The Sun (Interview)	6/14	22	11	11	22	30	17
Entomology Tree of Life	6/14	22	13	9	29	47	22
Drowning	6/15	35	24	11	16	19	10
A Baby's Story	6/15	41	35	6	17	33	8
Cardiology	6/15	35	27	8	32	42	23
Fit in Your Fitness	6/15	29	26	3	23	37	13
Symbiosis in Nature	6/21	24	20	4	48	54	40
Insect Photography	6/21	19	13	6	30	38	23
Weather and Military Operations	7/24	45	33	12	17	25	7
Military Base Ecosystem and Wildlife	7/24	29	18	11	23	32	9

In these individual presentations you see some of the general trends holding true: audiences tend to be largest on Level 1, smallest on Level 3; audiences tend to grow in the first few minutes of a presentation (as audiences are attracted by the sound and visuals). These also show other trends more clearly. For example, Level 1 audiences tend to ramp up in the first few minutes and then hold very steady throughout a Talk. Observationally, this consistency reflects individuals staying for the majority of a presentation. It also shows that the small Level 3 audiences tend to drop off more at the middle or end.

Perhaps most notably, all three show that Level 2 has the greatest variability in audience sizes from minute-to-minute; and it is the movement of these audiences that cause the overall spikes and dips in total audience for a single Talk. Observationally, while some individuals on Level 2 arrive and stay, much of the variability represents turnover of audiences after a few minutes of viewing.

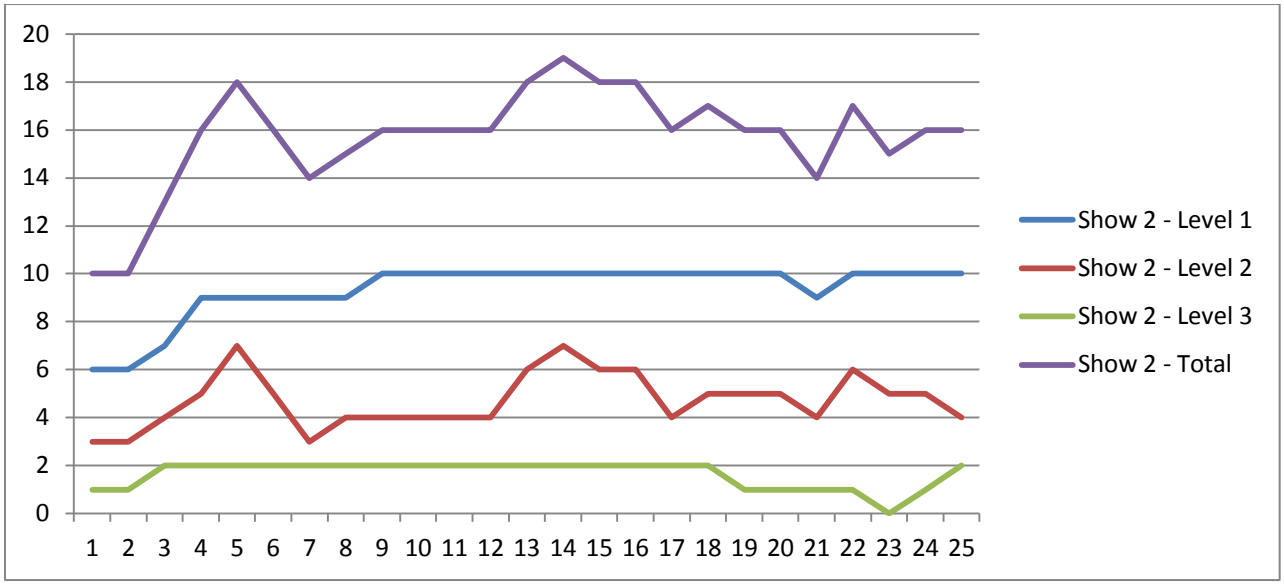

Figure 2. Graph of audience size trends for Daily Planet Presentation "Drowning: Noticing the Unnoticeable"

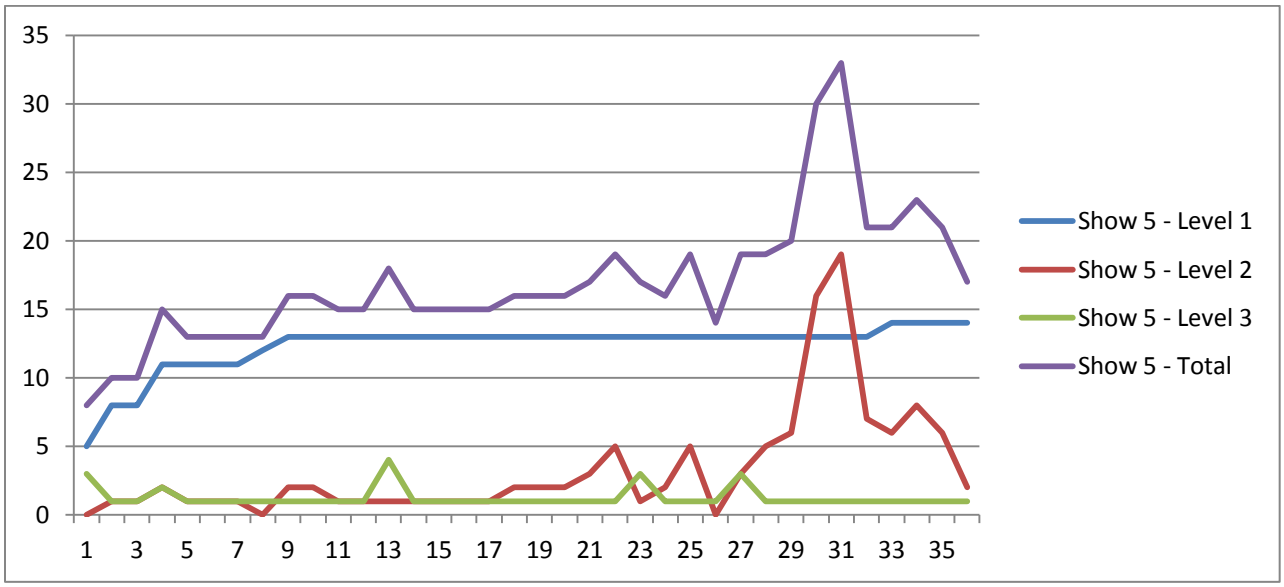

Figure 3. Graph of audience size trends for Daily Planet Presentation "A Baby's Story"

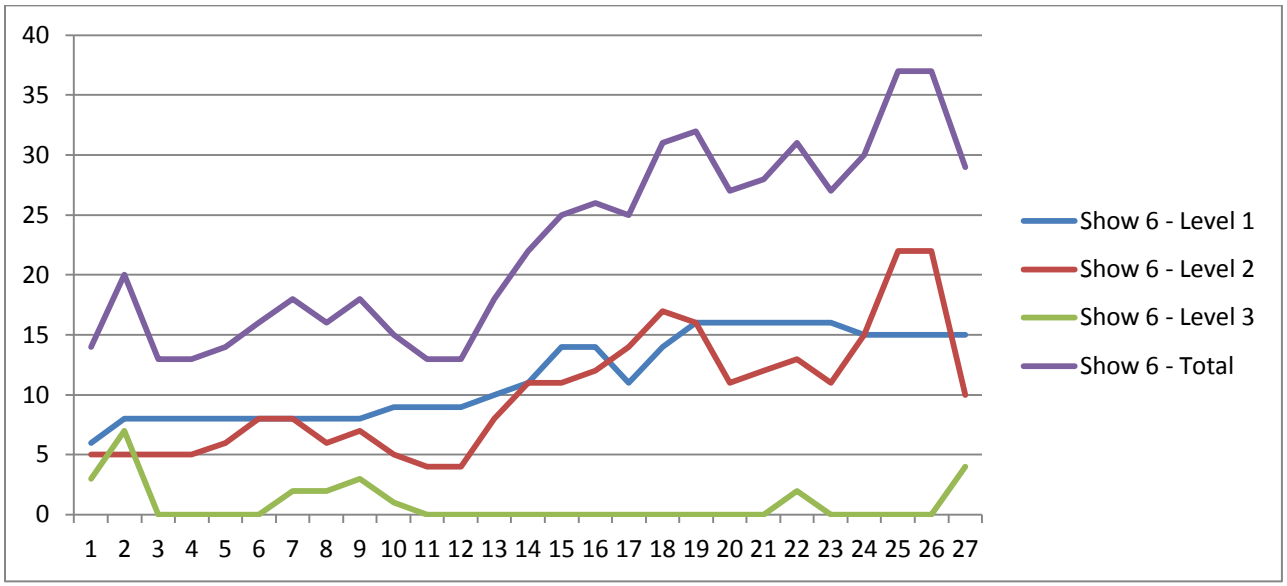

Figure 4. Graph of audience size trends for Daily Planet Presentation "Fit in Your Fitness"

Audience engagement during the Q&A session was also observed. Table 6 shows the distribution of audience questions from different levels of the theater; the vast majority of questions come from Level 1, including typically one or two questions by staff (either the facilitator or other staff) to help spark engagement or encourage the scientist's dialogue. A few questions were observed to come from Level 2 and none from Level 3; engaging these audiences after the talk ends appears to be more difficult.

Audience engagement also tended to show more participation by adults in the talks that were observed. Adults made up about three-fourths of the audience questions, with youth making up only about 24% of the audience questions. The presentations about Entomology and Symbiosis in Nature had the most child-initiated questions (2 and 3, respectively).

Table 6. Frequency of questions during Q&A portion of observed Daily Planet programs, by level of the theater

	Staff (Level 1)	Level 1	Level 2	Level 3
Total # of Questions	10	27	6	0

Table 7. Frequency distribution of types of visitors who asked questions in observed programs

	# of Questions	% of Questions
Adult Visitors	25	76%
Youth Visitors	8	24%

Motivation and Satisfaction

Looking across the two datasets, there are two common motivations for stopping at a Daily Planet Talk. On one hand, visitors report they stopped at the talk because of the topic and being interested (51% of questionnaire respondents; 33% of exit interviews). On the other, about one-third of those responding report it was more casual curiosity that stopped them, either seeing or hearing something happening and wanting to see what it was (see Table 8).

Looking at the differences in data from the two sets, it seems that those who completed the questionnaire (i.e., were present at the end of a Talk) tended to report a motivation to stop was the topic or their interest (51%) more often than exiting visitors (33%). "To hear from a scientist" was an option given for the questionnaire, and selected by 15% (13); but it was not mentioned to the open-ended question by exiting visitors. Similarly, many visitors in exit interviews (i.e., leaving early) referenced a reason for stopping was child-led (22%, 8); this was not an option for the questionnaire and was not written in as an "other" response.

Table 8. Distribution of responses in questionnaires and interviews about why visitors stopped at the Daily Planet Talk

	Questionnaire (closed-ended) (n=86)*		**Exit Interview (open-ended) (n=36)**	
	Count	Percent	Count	Percent
The topic was interesting	44	51%	12	33%
I was walking by and decided to stop	27	31%	12	33%
To hear from a scientist	13	15%	0	0%
Other	10	12%	3	8%
Children stopped (only in open-ended)	n/a	n/a	8	22%

**Although asked to report just one main reason, eight respondents checked multiple boxes and those responses are included in these data.*

The influence of children was also seen in the responses in the exit interviews about why visitors were leaving the Talk prior to its conclusion. A range of answers were given (Table 9), but the most common was again child-directed; 14 visitors (39%) indicated their reason for leaving was the child wanting to leave or losing interest. The social group was another driving factor; 17% indicated some factor of their group (meeting them, following them) caused them to leave early. Other factors were time-related, either wanting to get to see more of the Museum (17%, 6) or other time constraints on their visit (11%, 4). Only 4 visitors (11%) reported they left because they had lost interest in the presentation.

Table 9. Distribution of reasons for leaving the Daily Planet Talk early (n=36)

	Count	**Percent**
Child left / wanted to leave	14	39%
Want to see more of the Museum	6	17%
Group dynamics (finding, following)	6	17%
Time constraints	4	11%
Lack of / lost interest	4	11%
Other	3	8%

Visitors who completed questionnaires at the end of a Daily Planet Talk reported high enjoyment of the presentation. On a scale of "how much did you enjoy the presentation" (1=not at all; 7=a great deal), the mean and median rating was a 6.0 (std. dev.=.90); about one-third of respondents selected 7 and one-third selected 6.

In reporting what they liked most about the presentation (77 responding), responses were divided between several main themes (Table 10). The greatest number of people (36%, 28) referenced the visuals used by the presenters (images, slides, and videos) as what they liked most. Next, 25% reported that the most enjoyable element was the specific content presented; and another 25% referenced some quality of the style of the Daily Planet Talk, including the discussion, the clarity of the presentation/concepts, and even the use of humor. One other interesting area of enjoyment, although only mentioned by 10%, were people who focused on the relevance or ongoing aspect of the science being presented as what they most enjoyed.

Table 10. Distribution of what visitors liked most about a Daily Planet Talk (n=77)

	Count	Percent
Visuals	28	36%
Style of Presentation (discussion, clarity, speaker, humor)	19	25%
Specific Content / Topic	19	25%
Informative / Learning	10	13%
Relevance / Current Science	8	10%
Interesting (general)	5	6%
Experts / Scientists	4	5%
Other	4	5%

Regarding areas of weakness, visitors generally had very few comments. Only 36 visitors (40%) reported an aspect of the Talk that they disliked. Of these, responses were quite varied (with 10 being so specific they couldn't be grouped into categories). The most common theme related to critiques related to the style of the Talk (10 visitors). These were generally very specific regarding the presentation or presenter, such as:

> *I wish it would have been more interactive.*
>
> *2 photos at a time, I often didn't know which one he was talking about.*
>
> *[The speaker] says um way too much.*

Table 11. Distribution of what visitors liked least about a Daily Planet Talk

	Count	Percent of Dislikes (n=36)	Percent Overall (n=89)
Style of presentation	10	28%	11%
Not kid-friendly / age-appropriate	5	14%	6%
Something related to the content of the presentation	4	11%	4%
Technical problems	3	8%	3%
Length (too long or too short)	3	8%	3%
Environment (dark, seating)	3	8%	3%
Other	10	28%	11%

There were no significant differences in ratings of enjoyment between family and all-adult groups or based on prior professional training or interest in science.

Connection to Scientists

Visitors used a wide variety of adjectives and descriptors when asked to provide three words to describe the scientist(s) in the Talk, and nearly all of the adjectives were positive or neutral descriptors. Figure 5 shows a word cloud of the actual words written by visitors in response to this question; the larger a word, the more often it was used.

Because multiple words have similar meanings, the words were recoded into categories to get a systematic picture of visitors' reactions to scientists through the Daily Planet (see coding categories in Table 13). Seventy-four visitors provided at least one descriptor to this question (Table 12); and the majority of those used at least one descriptor that referred to the scientist's intelligence and being knowledgeable (54%, 40). However, the next four most common descriptor-categories all related to the personality and presentation style of the scientist: communication ability (often referring to making complex ideas understandable); entertaining/humorous; engaging/interesting; and approachable. This suggests Daily Planet format is achieving a balance of sharing expertise in an engaging and approachable way.

Table 12. Coding categories for scientist descriptor words

Code Name	Description	Example words
Knowledgeable	Relates to intelligence and/or knowledge held by the speaker	smart, intelligent, brilliant, knowledgeable, informed expert, insightful, comfortable with topic, thoughtful
Informative	Used the word informative	informative, educational
Engaging	Relates to being engaging or interesting	engaging, interesting, stimulating
Approachable	Relates to a demeanor being open, friendly, and approachable	approachable, friendly, non-threatening, down-to-earth, helpful, reassuring, sympathetic, concerned
Good Communicator	Relates to the communication or speaking skills of the scientist	good speaker, direct, prepared, interactive, good stories, effective, concise, brief (not too wordy), clear, relaxed, articulate, organized, informal, focused, detailed
Passionate	Relates to the speaker being passionate about work and/or inspiring to listener	passionate, inspiring, enjoys work, hopeful, dedicated, excited, exciting
Image	Relates to the image or appearance of the scientist (i.e., non-geeky, cool)	nice shoes, accessories, cool
Professional	Relates to the professionalism or qualifications of the scientist	professional, qualified, experienced, current, innovative
Entertaining	Relates to qualities of being fun and entertaining	entertaining, fun, enthusiastic, funny, lots of personality, animated, dynamic, charismatic, peppy, energized
Negative	Negative or potentially negative descriptions	snarky, biased, geeky, hard to understand, vague, monotonous, fast-paced speech, mumbling, quiet
Other	words that couldn't readily be coded into other categories	

Table 13. Distribution of types of words visitors used to describe the scientist presenters in Daily Planet Talks (n=74)

	Count	Percent of Visitors
Knowledgeable	40	54%
Good Communicator	30	41%
Entertaining	24	32%
Engaging	19	26%
Approachable	16	22%
Informative	13	18%
Passionate	10	14%
Professional	7	9%
Image	4	5%
Negative Descriptor	3	4%
Other	17	23%

Figure 5. Word cloud depicting the words/adjectives used by visitors to describe scientist(s) in Daily Planet talks; the size of the word relates to the frequency of its use.

Visitors were also asked to select three words from a list of descriptors to best describe what they thought about the Daily Planet Presentation; 58 visitors completed this question correctly (circling just three words), and 20 additional visitors responded, but circled more or fewer words than three. Results are presented in Table 14, with the sample of correct completions and total sample presented.

Overall, visitors gravitated toward the descriptors that focused on the cognitive response to the presentation; a majority selected *informational* and *interesting* as one of their three words, and more than one-third selected *detailed*. In the middle of the frequencies were the more affective descriptors, each selected by between 12% and 28% of respondents, and including *entertaining, surprising, innovative,* and *personal.*

Table 14. Distribution of which descriptors were selected by visitors about the Daily Planet presentations

	Correct Completion (n=58 visitors)		All Words Circled (n=78 visitors)	
	Count	Percent	Count	Percent
Informational	42	72%	55	71%
Interesting	40	69%	53	68%
Detailed	22	38%	29	37%
Entertaining	16	28%	20	26%
Surprising	9	16%	13	17%
Innovative	7	12%	10	13%
Personal	7	12%	9	12%
Interactive	6	10%	10	13%
Cool	6	10%	11	14%
Exciting	5	9%	9	12%
Amazing	5	9%	8	10%
Storytelling	4	7%	5	6%
Slow	3	5%	3	4%
Boring	1	2%	1	1%
Traditional	1	2%	1	1%
Lame	0	0%	0	0%

Learning Outcomes

Because each Daily Planet Talk addresses a new scientific topic and area of research, the specific topics of learning varied widely in visitors' responses to the open-ended prompt to report something they "never realized." In total 67 visitors responded to this prompt (75% of the total sample); the majority of these visitors (64%) reported a specific fact or concept from the presentation that was new information to them (Table 15). These tended to be quite specific facts (see Appendix for complete list of visitors' direct answers). The next most common way of describing what was learned was focusing on the relevance of the information in the presentation; these visitors focused on some element of the talk that related to their daily lives, the community, or how the science relates to people generally (27% of those responding).

Table 15. Distribution of coded responses to "I never realized…", following a Daily Planet Presentation (n=67)

	Count	Percent
Facts from presentation	43	64%
Relevance of information from presentation	18	27%
Value statement based on presentation (e.g., insects are beautiful)	5	7%
Other	2	3%

To examine visitors' reports of cross-cutting learning from the Daily Planet Talks, despite the wide ranging topics, visitors were also asked to rate the degree to which they felt the presentation gave them a new perspective on several key themes (Table 16). Overall, a majority of visitors tended to feel like they had gained new perspective on these topics; 50% or more rated each item a 6 or 7 out of 7. The strongest area of new perspectives gained seemed to be around, again, the topic covered (mean=5.9; median=6) and about how science fits with daily life (mean=5.7, median=6). The generally least associated theme was the approaches used in a scientific process, with a mean rating of 5.1 (still agreement; but slightly less strong than the others).

Table 16. Average ratings of the extent to which "the presentation gave you a new perspective about" each of the following topics. (1-7 scale; 1=not at all; 7=a great deal)

	% Rating 6-7	Median	Mean	Std. Dev.	N
The science topic(s) covered	68%	6.0	5.9	1.1	79
How science fits into our everyday lives	60%	6.0	5.7	1.5	78
What scientists are like	63%	6.0	5.5	1.6	75
How scientists do their work	55%	6.0	5.3	1.7	75
The approaches used in a scientific process	50%	5.5	5.1	1.8	76

Differences in Sub-Groups

The ratings to the scale items and the distribution of open-ended comments were analyzed to compare results by group-type (family vs. adult groups) and training in science/research, and no significant differences were found in any of these areas.

Discussion & Conclusions

Daily Planet Presentations have a strength in conveying science information to visitors a constantly changing, personally-delivered, and multi-media rich environment. This seems to resonate with visitors, conveying specific new facts and information and creating positive associations with the presenters. The format appears to be key to enjoyment; the multi-media visuals that accompany talks are critical, as is the style of the communication that includes humor and clear delivery and accessibility. The environment is tricky for presenters, however, with audience sizes and composition ebbing and flowing throughout a presentation. While the floor-level may be more theater-like in style and audience, there is an ever-changing audience the upper levels of the theater. While current strategies are effective, further creative thinking to adapt and prepare for this natural setting may maximize the unique venue.

Below is a synthesis of the key findings from these data and what they may mean for the NRC's consideration of programming going forward:

- Daily Planet Presentations regularly generated good-sized audiences for the space during the observation period (weekdays in the Summer 2013). Observed shows had an average, audience size of 23 visitors at any one time. It is worth noting that the total number of visitors who saw *any* part of a Daily Planet show would be higher than that, as observation and interview data show that visitors arrive and leave throughout the program.
    - When thinking about audiences, it's important to understand the nature of the space and the free-choice environment, in which visitors will come and go as needed by their visit and motivations. This presents challenges for the Museum if collecting an audience attendance count per show is a desired regular data-point to collect. As audiences ebb and flow, the Museum will have to understand that any number is a best estimate of audience size and create a protocol for its collection that minimizes variability in the collection method (as the audience is variable enough).
- Patterns in the movement of visitors in this space show trends by the three levels of the theater. Audience sizes tend to be greatest on Level 1, and decrease as you move higher in the theater, with Level 3 averaging just 2 audience members, in general. Audience movement also varies by level:
    - Audiences on Level 1 tend to grow quickly in the first few minutes of a talk and remain relatively consistent throughout the talk; the vast majority is staying for the duration. The theater-like setting may contribute to this more traditional audience participation.
    - Audiences on Level 2 are the most widely variable, showing the greatest sudden spikes and decreases in audience size from minute to minute. This partially reflects the positioning of Level 2 near the bridge between the two museum wings. Visitors are attracted to the sound and sights and stop; some may stay for a longer period, but many listen for a few minutes and then move on. The setting puts audiences further away from the sightline of the presenter(s), and creates a more museum-like environment, where dropping in and out is natural and expected.
    - Level 3 seems much more removed from the presentation, being that high, and audiences do tend to be smaller and less engaged. During Q&A it was never observed that a question came from that level; although often there were no visitors remaining after the presentation ended.

- The Daily Planet Presentations attract visitors through two main means: 1) the topic being of interest, and 2) curiosity about "what's going on over there?" as people walk by. It seems that those who stay to the end were likely more motivated by the topic, and those who leave early may have been driven more by curiosity, or (it emerged) by a child leading them over there through his/her curiosity.
- The two main factors that cause people to leave early reflect the common experience of a museum environment: either a group's children/friends were the drivers to leave or factors related to time (wanting to see more of the Museum and having a limited window of time).
    - Lack of interest in the topic or dissatisfaction with the presentation was almost never mentioned as a reason for leaving. This suggests that the current ebb-and-flow of audiences may just be a reality of the set-up and environment. Additional efforts to remain engaging for audiences will be positive, but not likely to overcome other common reasons for leaving.
- The visual aids, style and approachableness of the presentation, and the specific content addressed were all things that visitors like most about the Daily Planet; and there were generally very few visitors who expressed any areas of dissatisfaction.
    - Comments from visitors indicate continued emphasis on visuals to enhance presentations and continual efforts to maintain and build presentation skills for informal audiences all would contribute to continued high satisfaction with Daily Planet presentations.
- Visitors responded positively to the scientists and to the presentations at the Daily Planet, showing a primary emphasis on a cognitive connection – scientists being knowledgeable and events being informative, interesting, and detailed; but secondary characteristics identified the scientists'' communication skills and style. Descriptors of the event were less strongly affective for the Daily Planet, but more than a quarter of visitors noted it as "entertaining."
    - The Daily Planet seems to be best at developing connections with the scientist as more than just an information-giver, but as a good communicator; the program itself, however, is mostly seen as a chance to learn about interesting information; affective variables are less strongly associated.
- Visitor learning tended to focus on specific facts or information they gained from the presentation; but a substantial number (more than a quarter of those responding) actually noted some aspect of the relevance of information or what they learned. A majority also felt that they gained a new perspective from the talks on several of the core outcome areas, particularly the science topic itself, followed by how science fits into our lives and what scientists are like.
    - Visitors most associate their learning with the information presented, and they do recall specific facts and ideas that were core to the scientists'' talks when leaving these presentations. This immediate understanding of key messages (see Appendix) indicates that each talk has success at communicating its objectives.

Appendix

Table 17. Raw data given in response to open-ended prompt "I never realized…", coded as facts, in Daily Planet questionnaires

Open-ended responses to "I never realized..." coded as Facts
150,000 people under the age of 68 die each year
26% of the death people are from heart diseases, & The rates of obesity increased this much from 1994-2008
A child looks silent when drowning
Bacteria could cause a glow in the dark effect on squid
Bugs were colorful
coyotes are docile
Diversity of flies!
dragonflies are not flies
Drowning was a major cause of death
Drowning was the #1 cause of death for children under 5.
Drowning was the leading cause of death for kids under the age of 5
Flies live on bees
Fly will pollinate
gust fronts cause haboobs
Horse flies ate in a weird manner. Three eyes that detect light.
how colorful bugs could be
How many flies there are
infrared could be used in the day
infrared technologies can also be used where visible light is available
insects were so detailed in their appearance up close
It could happen to everyone at 40s
leaf hoppers were so colorful
Mosquitos and fruit flies are not very related.
Mosquitos were flies
Pool visibility
Rain cause pool opacity
Rain would make it difficult to see someone underwater
sun
sun had over 4 billion years to go
Sun will burn to white dwarf star
That its bacteria that smells in armpits
The birth defect existed
the different types of night vision goggles
The insects could be so small.
The opacity of water was so great on that. 85% of kids that drown don't have lessons
The sun was so big
there are dinosaur birds
There are so many life forms living in/on us
There is a fly that mimics a bee
There were 150,000 species of fly
there were different types of night vision
they targeted certain rocks that aged the same as the dinosaurs they are looking for
variable contrails depend on conditions and altitudes

NORTH CAROLINA Museum of Natural Sciences

CENTER FOR RESEARCH AND EVALUATION
Lifelong Learning Group

Nature Research Center Summative Evaluation

Part 4: Science Cafés

Final Report: December 1, 2013

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Introduction

The Nature Research Center (NRC) is an 80,000-square-foot wing of the North Carolina Museum of Natural Sciences (the Museum) that opened in 2012, with goals to "bring research scientists and their work into the public eye, help demystify what can be an intimidating field of study, better prepare science educators and students, and inspire a new generation of young scientists." To achieve these goals, the NRC provides visitors with exhibitions, programs, and featured experiences designed to engage the public directly with research, scientists, and the process of science.

The Lifelong Learning Group was contracted by the Museum to conduct summative evaluation of four of the NRC's featured exhibits and programmatic elements:

- Ancient Fossils, New Discoveries exhibit
- Investigate Labs (iLabs)
- SECU Daily Planet programming – daily scientist talks
- Science Cafés

The evaluation of these four components was designed as four distinct multi-method studies, each focused on a particular featured area of the NRC. The goal was to provide targeted understanding of visitor outcomes and experience at a particular NRC feature. In addition, the individual studies were planned cohesively, using complementary and, wherever possible, consistent measures and coding rubrics across the four studies. The findings from the study of each component are contained in separate reports. This report presents the findings from the evaluation of the Science Café program.

Exhibits and Programs Studied

The four featured elements that were evaluated in this study were:

- **Ancient Fossils, New Discoveries Exhibit** – A permanent exhibit in the NRC, "Ancient Fossils" highlights the science behind Dr. Mary Schweitzer's research, which included the discovery of preserved soft tissue in fossil material, a landmark scientific breakthrough.
- **Investigate Labs (iLabs)** – hands-on labs for visitor use, with guided activities and research skill-building exercises that allow visitors to explore the process of using scientific tools and engaging in inquiry. Experiences are led and guided by educators, scientists, and graduate students.
- **SECU Daily Planet Scientist Programs** – an immersive, 3-story multimedia space, which is used for many purposes. A feature purpose of this space is regular, daily live presentations by scientists discussing the science and research behind current issues.
- **Science Cafés** – the NRC's Daily Planet Café serves as the home for a weekly Science Café series. Each Thursday evening, this free event allows the public to join in conversation about scientific topics, delivered in a range of casual formats – from longer format presentations by scientists, to Science Trivia night, to Lighting Talks of a series of brief scientist presentations. They allow for conversation over food and beverages hosted in the NRC's new Café.

Intended Outcomes

At the outset of the project, Lifelong Learning Group evaluators met with Museum staff to discuss the four targeted exhibit and program areas for the NRC, focusing on articulating the intended outcomes for each area, as well as the priority evaluation questions that should guide the study of each NRC area. Below are the outcome statements that resulted from that process.

Science Café

- Participants will have a fun and enjoyable experience
- Regular participants will have a sense of belonging/community
- Participants will feel they have a new perspective on science, scientists, and/or topics covered by the events.
- Visitors will feel a positive affective response to the featured scientist (e.g., approachable, cool, interesting, etc.)
- After the event, participants will talk with others about the event and/or the science topic covered by the event

Guiding Evaluation Questions

Science Café

- Who attends Science Cafes and what are their motivations or preferences related to attending?
- In what ways has attending the Science Cafes changed participants' attitudes toward science, scientists, and topics covered at the events?
- What is the affective experience of attendees at Science Cafes?
- How do participants'' extend the Science Café experience after the event? What is their interest in museum-supported options for extending the experience?
- Are there trends in which visitors respond more positively/negatively to the programs?

Methods

Multiple methods were used within each of the four area studies in order to address these evaluation questions. Table 1 below shows the methods selected for the Science Cafés, as well as how methods were intended to help address the study's specific evaluation questions. Below, each method and study procedure is described in greater detail.

Table 1. *Science Café* Evaluation Matrix: How evaluation questions are addressed by methods

Evaluation Questions	**Method 1: Questionnaires at Café**	**Method 2: Focus Groups with "regulars"**
Who attends Cafes and what are motivations/preferences?	X	X
Changed attitudes towards science, scientists, and topics covered?	X	X
What is the affective experience of attendees?	X	
How do participants extend the experience? Interest in museum-supported extensions?		X
Trends in who responds more positively/negatively?	X	

Methods: Science Cafés

Two methods were used to evaluate the Science Café programming that has become a weekly part of the NRC's programming. The primary method was a **self-complete questionnaire**, distributed by staff at the end of a Science Café over the course of 5 weeks: all Cafes in June and one in July. Adults completed the form and returned it to staff for entry.

To get greater depth about the impact of Science Café programming, particularly related to extended engagement, two **focus group discussions** were held with regular participants of the NRC's Science Café. Participants were recruited through an email invitation to the NRC's list of past registrants and attendees. Two focus groups were held at the Museum in May 2013, with 21 adults participating in the discussions. Discussions lasted about 1 hour, and participants were provided with food and beverages, as well as receiving a $25 Visa gift card and dinner as a thank-you for their time and participation.

Study Participants

In total, 98 valid questionnaires were obtained; in addition, 38 data points were collected at a Café in which the Daily Planet questionnaire had been distributed by mistake. The data for questions that were the same between the two forms was included for analysis, as well, bringing the total respondents to 136. Of the data collected, 113 were at Science Café weeks, and 23 were collected on a Science Trivia night.

Twenty-one adults participated in the focus group discussions, all identified as previous and regular attendees of the NRC's Science Café programs. Further discussion about the group composition is discussed in the results section.

Table 2. Sample characteristics for Science Café questionnaire data

	Questionnaire Data (n=136)	
	Count	**Percentage**
Sex (n=120)		
Male	56	47%
Female	64	56%
Age / Approximate Age (n=110)		
18-20s	20	18%
30s	10	9%
40s	15	14%
50s	18	16%
60s	37	34%
70s+	10	9%
Formal Education (n=119)		
Some HS	3	3%
HS Diploma / Some College	13	11%
College Degree	52	44%
Graduate Degree	51	43%
Training in Science or Research (n=118)		
Yes	62	53%
No	56	47%
Home State (n=112)		
NC	107	96%
All other states	5	4%
North Carolina Counties		
Wake County	90	80%
Durham	4	4%
Johnston	4	4%
All others (<3 each)	9	8%

Analysis

All data was entered into spreadsheets and transferred into SPSS for coding and analysis. Open-ended data were coded using coding rubrics developed for this study. When appropriate, coding rubrics were developed to be able to be applied consistently across exhibit/program components in the study (for comparative purposes). This was not done in cases where common rubrics might dilute the unique findings for a specific exhibit or program. Systematic coding was done to allow

visitor responses to open-ended questions to be categorized and quantified for analysis. Tests for inter-rater reliability were done to refine and finalize coding rubrics, before final coding was complete. Focus group data was coded thematically for patterns and trends in participant conversation, guided by the evaluation questions for that component of the study. Data were analyzed descriptively and, where appropriate, inferential statistics were used to test specific questions or hypotheses about the data. All inferential statistics used are described in the results section.

Results: Science Cafés

Who Attends

Attendees of Science Cafes at the NRC tend to be fairly evenly distributed between men and women, with a slightly higher number of women responding to the questionnaire. They also tend to be older than general museum visitors; the largest number of visitors reporting their age were in their 60s or 70s (43% of those reporting an age); the next highest group were attendees in their 20s (18% of those reporting an age). Lowest attendance seems to be from those in their 30s and 40s. Attendees are also very highly educated, with 87% of those responding reporting they had a college or graduate degree; however, the representation of those with professional training in science/research is similar to the rest of the data (just over half reported having training).

Attendees are generally split between newcomers and regulars at the NRC Science Cafes; 36% of respondents indicated this Café was their first one; 33% reported they had been to 1-4 Cafes before; and the other 31% reported having been to 5 or more of the Science Cafes. Trivia experience was less common; 60% reported not having been (or this being their first) Trivia Café, 21% had been to one Trivia Night, and the remaining 19% had been to multiple Trivia Nights.

The focus group data supports these trends. These interviews included both those with a background in science and those without; about a third of all attendees reporting that they were in (or had been in) a STEM-related profession. Seven of the attendees were retired from fields including engineering, education, accounting, and social work. Two attendees were pursuing post-secondary degrees, one at the college level and one a PhD. Of those who were working, their professions included computer programmer, web strategist, writer, chemical engineer, sociology professor, and science teacher.

Motivation and Preferences

Questionnaire respondents described their reasons for attending across a broad range of themes, but the most dominant by far was their interest in the topic being presented (58%, 72). Some of these respondents articulated specific interest in *learning* about the topic, while others were not specific. Driving reasons for others were the entertainment value of the event, the friends-and-food atmosphere (13%) or just saying that it is "fun" (11%). Another 8% said they came because they wanted to hear from the scientist.

Table 3. Distribution of coded responses about why they attended this Café (n=124)

	Count	Percent
Topic	72	58%
Atmosphere / Social (food, friends, drinks)	16	13%
Fun	14	11%
To hear from a scientist	10	8%
I like science	9	7%
Regular/previous attendees	9	7%
Spur of the moment/happened by	6	5%
Personal connection to topic	5	4%
To Learn (general)	4	3%
Other	12	10%

In line with these motivations, the attendees of the café are also report very high satisfaction with all aspects of the Science Café (Table 4), but particularly with the event overall, the topic presented, and the scientist speaker (all receiving a mean rating of 6.4 out of 7; and 90% or more rating it a 6 or 7). Food, beverage, and the atmosphere were also rated highly.

Table 4. Average ratings of the satisfaction with different elements of the Café. (1=not at all satisfied; 7=extremely satisfied)

	% Rating 6 or 7	Median	Mean	Std. Dev.	N
Event overall	92%	7	6.4	0.8	89
Topic	90%	7	6.4	1.0	87
Scientist(s) who spoke	90%	7	6.4	1.2	79
Food and beverages	67%	6	5.9	1.0	84
Café atmosphere	65%	6	5.9	1.1	96

Focus Group Results

Educational or learning motivations were top-of-mind for about half of all participants when describing why they repeatedly attend the Science Cafes. This perspective was summarized by a woman who said she attends for "love of learning, love of science, love of knowledge, and I like my mind to be challenged." "You always learn something" said a man when speaking of trivia nights, while another said his motivations for attending the events were "curiosity and to learn." These comments paint a picture of attendees who are interested in learning more, regardless of the subject or topic of the event. For them, the exposure to new topics and continued learning is key. A man who was a chemical engineer related the following story, "Somebody asked me just last week…it was like 'How do you know all this stuff?' you know. And part of that is being exposed and coming to science cafes and other sort of things."

Closely related to learning as a motivation was the importance of the **science emphasis** of the events. For about half of the participants in the focus groups, the science-focus or wanting to learn more about science topics specifically was an important factor in their attendance. Some participants had an interest or "love" of science that motivates them to attend. For example, a man in a STEM field explained, "For me it is the science. I always have been interested in science…when I was pretty young I could tell you every single fact about the Apollo space program." Others employed in science fields agreed, highlighting certain topics that were particularly appealing to them or in the case of a science teacher, her interest in sharing current science with her students. For one participant this interest in science combined with a general lack of science in the media led them to attend, as the following quote illustrates:

> *Science gets very short shrift in the popular media these days, a lot less than it used to. And for people who love science, it's sort of like a drought. And you're sort of looking for any avenue, any resource you can find to learn and grow. (Male in his 50s, Focus group 1)*

Other participants identified themselves as not very knowledgeable about science but interested in learning more because it was a new field for them. For example, one woman said that since science was not her career she "comes from a place of ignorance on a lot of topics, which is one of the reasons I like to come and learn." Another man who comes to trivia night regularly echoed this point of view saying, "It's good to hear subjects that I don't read or we do around the house. We're

not scientists either…so it's kind of interesting to come in and actually get three out of 30 questions [correct] on the trivia."

A sub-theme of the science focus of the cafes was that the events provide the audience with an opportunity to learn more about science happening locally. This perspective was mentioned by a few participants. Among participants generally, there was an understanding of the vast amount of work in the sciences being done in the Research Triangle. One called it "a local resource" that is made accessible because of the Science Cafes. For a few participants, the focus of the events on research being done locally was important, as in the following quote:

> *There's enormous amount of research being done at a variety of institutions, colleges, and in industry in the area. And just finding out about what's happening in your back yard is one thing that I want to do, but also that I think everybody in the region could do more of, just because it's so fascinating… (Male his in 30s or 40s, Focus Group 1).*

The **atmosphere and format** of events was a motivating factor for about half of the focus group participants. They tended to highlight positive aspects of the atmosphere and format, although some criticisms were raised. Positive aspects were many and included format-related characteristics and venue-related characteristics. Format-related included the ability to hear from scientists in person, to ask questions, and the adult-nature of the events. Participants liked hearing from experts on specific topics in-person. The in-person nature of the interactions can "fire up the audience and get them riveted on what's going on in the sciences" said one man. Another liked how in person you get a sense of the scientist's personality and "their enthusiasm" for the topic. Others noted that the in-person interaction allows you to ask questions or the speaker, and just as importantly, hear other people's questions. This was explained by one man who said, "I think the questions are important and not just questions I want to ask but listening to the questions that other people ask that I hadn't thought of to ask that bring out things that I would like to know." A few noted that the format had been successful in cutting out the "jargon" of science without "dumbing it down;" one man noted that this made the topics "available to everyone." There was some discussion among participants in the focus groups about the adult-nature of the events and the presence of children. There was general agreement that having an all (or mostly) adult audience was part of what made the events unique; the level of discussion was aimed at adults on topics of interest to adults. Some participants felt that having children present was fine as long as they were well behaved and did not dominate the question and answer session. Others preferred that children not attend but accepted that fact that certain topics, like dinosaurs, were likely to draw a more family-oriented audience.

Venue characteristics that were seen as positives included the room or café setting, the downtown location, ease of parking. The focus groups were specifically asked about their likelihood to attend the events if they were held at a local bar or restaurant versus the current location in the NRC. It was generally agreed that the museum venue was preferable, even for those who had regularly attended at non-museum locations. Benefits of the museum location included the larger venue, the ease of parking, not feeling pressure to purchase food (which was a concern at the restaurants), the feeling of the museum as a "public space" where everyone is welcome, and the ability to pair the event with a visit to the museum. In terms of the food service, many thought the food at the café was very good and well prices; they did request for more menu items to be available or perhaps a rotating menu so that the food choices were different from week to week.

Criticisms of the atmosphere mostly centered on the venue, and issues of crowding levels at the events and the ability to see screens or monitors from some areas of the venue. One man who

compared the events to Macy's on Christmas Eve said the venue was "really nice" when it was "not quite so crazy." Others said the crowding made it difficult to find a seat, sit with friends, or bring friends who used wheelchairs or had mobility issues. Related to crowding was the criticism raised by a few participants about seeing the screen or TV monitors from the back of the room. One suggestion to the crowding was to hold the Science Cafes in the auditorium or to have overflow room in the auditorium with a video feed. When this suggestion was raised, however, other focus group participants objected, saying the like the current space and its "intimate" feel.

It should be noted that despite their concerns with crowding, this did not stop the focus group members from attending. However, this might not be the case for others who are not regular attendees.

Social reasons for repeat attendance were mentioned less often than the other reasons, with about a third of respondents specifically mentioning a social reason for attending. However, it was clear through the conversation that the social aspect played a large role in attendance for many individuals. Focus group participants reported attending with groups of friends, as a married couple for "date night," with their children, and to join meet-up groups. One woman in her 60s summarized the social aspect of the Science Cafes well by saying: "It's a nice place even to just meet friends and kind of do something and also spend time with them…It's a pleasant venue to meet friends and be engaged and be learning, both." Others said that when they attend with friends or co-workers the cafes become a topic of conversation among the group long after the specific event. For example, one woman who attends regularly with the same group of friends said, "It's an event to come [to] and then after it we discuss all the stuff that we've never thought about before. And invariably a couple months later someone will say I found out about [a topic of a prior café]." As illustrated by these examples, the social aspect is closely related to other motivations, such as continued learning.

One man in his who attends with his wife picked up on the idea that the Science Cafes are social but also unique: "A night out I think is a reason [to attend] but it's not a typical night out, so it's kind of interesting because it's not like going to a movie or dinner or some place. It's a night out doing something different." Another couple agreed saying it was a night out in the midst of their busy lives.

There was also a sense that being among other people added to the overall atmosphere. When asked what makes going to the Science Cafes different from watching a science-oriented show on the Discovery channel or PBS, the social aspect was repeatedly raised by participants. "I like the environment in terms of the fact that you're around other people," said one man. Others agreed saying that the social aspect of the event is what allows participants to ask questions of the speaker, to ask questions of others at your table, and to hear what others might be thinking about the topic. For these respondents, the social part of the events is critical to the atmosphere and format that make the events successful.

The **topics presented** at the Science Cafes were another motivating factor for regular attendees with about a third of focus group participants mentioning this aspect. Members of the focus group appreciated the variety in general, the focus on specific topics, and how the events often introduced them to new topics. Most who highlighted the topics as a motivator focused on the variety of topics, noting how many different fields of science were covered. One man mentioned how the Science Cafes introduced a variety that otherwise was not possible through static exhibits at the museum. Others attendees appreciated how the Cafes allowed them to learn more about specific topics of

interest to them. In some cases, the topic was related to their career. For others, it was to learn more about current topics, like climate change, that they wanted to understand better.

A few participants specifically mentioned how the Cafes introduced them to new topics. In two instances, the topic at first glance was not of interest to the attendee. Then after hearing the speaker, they had a new appreciation for it. For example, one man in his 60s said, "We come to some subjects by presenters that we thought 'That's going to be boring,' and it was just, 'Wow! That was interesting.'" When asked if they preferred topics that had a direct application to daily live versus those that were more abstract, participants said they appreciated both with the variety and exposure to both an important quality of the cafes.

Format Preferences

When considering the possible formats of Science Cafes, the most familiar format to most (n=70) was the presentation by a scientist, followed by Q&A. This was also the highest rated format, with 93% of attendees rating it a 6 or 7 (mean=6.5; Table 5). The other two formats were only familiar to just over 40 of those surveyed; the ratings for those formats were high (mean ratings of 5.9 and 5.6), indicating they are enjoyed, but attendees may prefer the traditional talk format overall.

Table 5. Average ratings of how much different Café formats are enjoyed by participants who have attended them. (1=do not enjoy at all; 7=enjoy a great deal)

	% Rating 6 or 7	Median	Mean	Std. Dev.	N
Presentation by a scientist (w/ Q&A)	93%	7	6.5	1.0	70
Trivia Night	64%	6	5.9	1.3	42
Interview between scientist and a host (w/ Q&A)	62%	6	5.6	1.7	45

Differences in Enjoyment by Sub-Groups

Some differences in these ratings were found among different sub-groups of attendees. The most influential factor related to reported enjoyment at the event was whether the respondent reported having professional training in the topic (Table 6). Those without professional training gave higher mean satisfaction ratings related to the event overall, the topic, and the scientist speaker. This perhaps suggests that those with professional training take a slightly more critical eye to events; however, the results from both groups are still very positive, pointing to little concern about this finding.

Table 6. Differences in attendees' ratings of satisfaction, compared by reported professional training in science or research.

	Professional Training		No Professional Training			
	mean	SD	mean	SD	*t*	*df*
Event overall	6.29	0.84	6.70	0.47	-2.65*	72
Topic	6.33	1.06	6.79	0.41	-2.69**	63
Scientist(s) who spoke	6.21	1.30	6.81	0.40	-2.71**	45
Food and beverages	5.77	1.03	6.14	1.04	-1.48	70
Café atmosphere	5.72	1.07	6.15	1.06	-1.80	81

*=p<.05, **=p<.01

No differences in responses based on education or frequency of attending were found.

Focus Group Results

Giving more insight into these ratings, when considering the main format-types, all three formats had strong supporters among the focus group participants; pros and cons for each format were named through the conversation and the post-it note feedback. Desirable qualities regardless of format were the use of slides and the ability to ask scientists questions. The focus group attendees also liked having a variety of formats that rotated throughout the month. The feedback on each format is detailed below.

Scientist presentation followed by Q&A: As seen in the questionnaire data, this format seemed to have the most supporters among the focus group participants. The general consensus among the group seemed to be that if the scientist could give a good presentation supported by slides then this format was preferable. They liked hearing from the scientist directly, the use of slides, and the Q and A sessions. A few participants also mentioned that this format seemed more "in-depth" and "informative" than the others. In some cases, participants felt it would be helpful for the host or another staff member to help during the Q&A sessions because sometimes the scientists did not manage this portion very well.

Scientist interviews by host followed by Q&A: Focus group attendees said that this format was a good choice for scientists who might not be good speakers: "Some very brilliant people simply cannot stand up and make a logically coherent presentation" suggested one man. If this is the case with a particular scientist, participants felt it was the museum staff's role to find this out ahead of time and choose the interview format. Positive aspects of the interview format named by focus group members included that the host brings "logic" to the interview while the scientist supplied the content and expertise; the host draws out the scientist and serves as "an interpreter" if the scientist has trouble translating the science into something understandable for laypeople; and the host brings humor and a "light" aspect to the event. The humor or "light" quality of the interview format was seen as both a pro and a con by focus group participants. Some appreciated the way a host could infuse humor into the presentation while others found it either distracting or unnecessary. A few people said that the interview format felt like it broke the train of thought of the scientist, not allowing him or her to go into as much detail or give examples because of the follow-up questions being asked. One suggestion made via the post-it notes was to have the scientist present for 5 to 10 minutes only and then be interviewed by the host.

Science trivia night: Trivia night was appreciated for a number of reasons in common with all the formats, including the variety of topics covered, the social aspect, and the opportunity to learn something new. One participant said he particularly liked how on trivia night he could "learn 20 new facts that I never knew and some pop culture references." Another thought that trivia night was probably more social than the other formats because you had a greater opportunity to learn about the group you were with just by the nature of the interactions. Trivia night was described as crowded, which was seen as a positive for some people and a negative for others. Another negative of the format was that some people were seem as not having enough background in science to participate; however as was mentioned in an earlier quote, one focus group participant felt that getting even three questions correct was an accomplishment. One suggestion for the format was to have more prizes.

Learning and Attitude Outcomes

Because each Science Café addresses a new scientific topic, the specific topics of learning varied widely in visitors' responses to the open-ended prompt to report something they "never realized." In total 109 visitors responded to this prompt (80% of the total sample; see Table 7); the majority of these visitors (75%) reported a specific fact or concept from the presentation that was new information to them. These tended to be very specific facts (see Appendix A for full list of these responses). Far less common were responses that referenced the relevance or applicability of the information (8%), and a new set of response were about "how much I didn't know" (4%). Other statements were widely varied and did not fit into consistent codes (13%).

Table 7. Distribution of coded responses to "I never realized…", following a Daily Planet Presentation (n=67)

	Count	Percent
Facts from presentation	82	75%
Relevance of information from presentation	9	8%
How much I didn't know	4	4%
Value statement based on presentation (e.g., bees are amazing)	2	2%
Other	14	13%

To examine reports of cross-cutting learning despite the wide ranging topics, attendees were also asked to rate the degree to which they felt the presentation gave them a new perspective on several key themes (Table 8). Attendees seemed to most strongly connect to having gained perspective on the science topics and how science fits into our daily lives, which were each rated a 6 or 7 by more than half of respondents (mean=5.75 and 5.41, respectively). The other three statements received weak agreement that attendees had gained a new perspective (mean and median ratings around 5 out of 7), with a larger number of attendees not feeling these were strong personal gains.

Table 8. Average ratings of the extent to which "the presentation gave you a new perspective about" each of the following topics. (1-7 scale; 1=not at all; 7=a great deal)

	% Rating 6 or 7	Median	Mean	Std. Dev.	N
The science topic(s) covered	67%	6.0	5.75	1.20	125
How science fits into our everyday lives	53%	6.0	5.41	1.30	123
What scientists are like	39%	5.0	4.85	1.73	123
The approaches used in a scientific process	40%	5.0	4.77	1.71	124
How scientists do their work	39%	5.0	4.75	1.70	125

Differences in Sub-Groups

Looking at the coded responses about what attendees never realized, there are very few differences between the various sub-groups of interest. There were no significant differences in the type of response based upon training in science/research, how many Cafes they have attended, or by education (comparing undergraduate with graduate degree, the vast majority of respondents).

The only area of slight difference was seen based upon which night the data was collected at – a traditional Café or a Science Trivia Night:

- A higher proportion of those at a Science Café night reported learning facts (80%) than those at Trivia Night (55%); ($X^2(1,N=109)=5.38$, p=.02)
- All four of the "What I didn't know" responses came from Trivia Night attendees

The respondents' self-reported ratings of the extent to which they gained new perspectives on a set of five key themes from the event showed a few differences between sub-groups. When comparing by professional training in science/research:

- *New perspectives about the topic*: Those without professional training rated higher that they had gained new perspectives (mean=6.0, SD=1.05), compared with those with professional training (mean=5.56, SD=1.27); (t(113)=-2.22, p=.03)
- *How science fits into our everyday lives*: Those without professional training rated higher that they had gained new perspectives (mean=5.8, SD=1.09), compared with those with professional training (mean=5.07, SD=1.35); (t(112)=-3.15, p=.002)

This may indicate that those with prior training feeling they had a little less room to grow than others. How often people attend Science Cafes only showed one slight difference in ratings on these items, suggesting frequency has relatively minimal impact on the feeling of gaining new perspectives:

- *How science fits into our everyday lives*: A significant difference was found in ratings of new perspectives on this item between the three groupings (first-time attendees; 1-4 time attendees; "regulars" of 5+ times). [F(2, 71)=3.80, p=.03]
    - A Tukey post-hoc comparison showed that the first-time attendees gave higher average ratings to this item (mean=5.59, SD=1.25) than did the "regulars" (mean=4.63; SD=1.50), p=.02.

The main area of interest, however, is that there were significant differences across-the-board for attendees who were responding from Trivia Night, as compared to a traditional Café night. Trivia Night ratings for new perspectives gained were, understandably, significantly lower than those at a Café night (see Table 9). Those attending Science Cafes tended to have mean ratings of 5.0-6.0; whereas Trivia Night attendees rated themselves between 3.6 and 5.0.

Table 9. Differences in attendees' ratings of areas they gained new perspectives on from the evening, compared by Science Café respondents and Science Trivia Night respondents.

	Science Café (n=103)		**Science Trivia (n=22)**			
	mean	SD	mean	SD	*t*	*df*
The science topic(s) covered	5.90	1.06	5.05	1.56	2.46*	25
How science fits into our everyday lives	5.54	1.22	4.77	1.41	2.61*	121
The approaches used in a scientific process	5.00	1.55	3.73	2.05	3.28**	122
What scientists are like	5.07	1.57	3.76	2.07	3.27**	121
How scientists do their work	4.98	1.55	3.68	2.01	3.38**	123

*=p<.05, **=p<.01

Focus Group Discussion Results

The focus group discussions allowed deeper conversation to understand the longer-term and attitudinal impacts of regular attendance at the NRC Science Cafes. Participants in the focus groups were asked if attending the Science Cafes had changed their view of science, scientists and specific science topics covered by the events. For each of these, the participants raised their hands if they felt they were impacted; using this method, the results mirrored the questionnaire results. The greatest impact seemed to be around the topics covered by the events. However, through the use of a group discussion it was apparent that attendees did have changed attitudes towards science and scientists as well.

When thinking about whether attending the Science Cafes had changed their **views of science**, only 2 of 21 participants indicated by a raise of hands that this was the case. However, through the discussion it was clear that many participants in the focus group had an increased sense of appreciation for science and a greater understanding of what constitutes science. Many participants spoke of how the events had broadened their understanding of the relationship between different fields or which fields can be considered science. For example, one woman said she had not considered how technology had influenced modern science. Another woman indicated that she was more able to understand how different fields of science interrelate as a result of attending. Another attendee felt that the Science Cafes were valuable because instead of viewing science as a series of "equations to figure out what's going on you get an intuitive feel from attending these things about what science is all about." Another participant agreed saying that you come with a "framework for science [that] is a black and white line drawing but coming to the science café adds all the colors and the details that you kind of fill in over a period." This sense that attending the Science Cafes enhanced their general understanding and appreciation of science was prevalent among focus group participants, even though they had initially indicated that no change had occurred in their views.

A few participants indicated that they had a changed view of science that was unrelated to an increased appreciation or deeper understanding of the nature of science. For example, a few participants' views had changed relative to the scientific process. For those who did, they emphasized that science is less about the scientific method as it is taught in school and more filled with "serendipity" and "accidental" discoveries. Finally, one person indicated that they had never thought about how the distribution of scientific findings can be control or limited through a political process.

When asked to consider whether attending the Science Cafes had changed their **views of scientists**, only 2 of 21 participants indicated by a raise of hands that this was the case. Through the discussion it was apparent that a few more than these two participants had examples of how their views of scientists had changed; however there were fewer participant comments regarding this topic than then were about the views of science. When speaking about their changed views of scientists, each of the following changed was mentioned by one person: finding scientists more interesting than before, having a feeling of hope for the future because of the work of the featured scientists, and the amount of time a scientist may spend focused on a relatively narrow topic or question. Most of the conversation surrounding the participants' views of scientists was related to the need for scientists to be good communicators and to communicate directly with the public. This topic of conversation was introduced and carried on mostly by those working in science fields (a research scientist, an engineer, and a science teacher). They felt that those working as research scientists had recognized the need to be good communicators and that there were now many more opportunities for scientists to learn and practice communication skills. It is important to note that line of discussion

was not necessarily related to a changed view of science as those who were speaking knew about this trend because they were in the sciences. However, they were pointing out that the Science Cafes were an expression of the trend towards scientists communicating with the public.

When considering if attending the Science Cafes had changed the way they thought about particular **science topics**, 15 of 21 attendees indicated through a raise of hands that their views had changed. Throughout the focus group discussion the participants highlighted topics that they had either learned more about or become interested in as a result of the cafes, including Higgs Boson and particle theory, climate change, local ants, red wolves, the language of dolphins, chocolate, paper, and nano-fabrics. Participants indicated that the events had the potential to change or challenge what they thought they knew about a subject. This was the case for a college student when he heard the Higgs Boson talk:

> *Just learning that it's like in high school or even some college you talk about proton, electron, and neutron and that's all you really think you are. But then you found out…all those other strange things mixed in with the atomic model. [And it] definitely made me think, 'Huh, that's not what I learned and it's completely different.' So it made me actually go look all that up and figure all about the standard atomic model. (Male in his 20s, Focus Group 2)*

As in this example, a number of participants indicated that the events provoked a new interest in a subject that then led them to find out more about the topic after the event was over. Other attendees spoke about how attending a café fostered a new appreciation of a topic. For example, one woman said she never knew how much engineering and thought went into the making of toilet paper. Some attendees indicated that every topic was an opportunity to learn more. Overall, there was no trend among the topics that supported a change in views, with topics applicable to daily life and more abstract topics mentioned approximately equally by the focus group participants.

Affective Experience & Community Connections

Visitors used a wide variety of adjectives and descriptors when asked to provide three words to describe the scientist(s) at the Science Cafés (data not collected at Trivia), and nearly all of the adjectives were positive or neutral descriptors. Figure 1 shows a word cloud of the actual words written by visitors in response to this question; the larger a word, the more often it was used.

Because multiple words have similar meanings, the words were recoded into categories to get a systematic picture of visitors' reactions to scientists through the Science Café experience (see coding categories in Table 11). Of 113 respondents, 97 provided at least one descriptor to this question (Table 10); the great majority of those used at least one descriptor that referred to the scientist's intelligence or knowledge (64%, 62). The next four most common descriptors, however, all related to the personality and presentation style of the scientist: communication ability (often referring to making complex ideas understandable); entertaining/humorous; engaging/interesting; and approachable/personable. This suggests Science Café format is achieving a balance of sharing the scientist's expertise, but using an engaging and approachable style.

Figure 1. Word cloud depicting the words/adjectives used by Science Café attendees to describe scientist(s) presenting; the size of the word relates to the frequency of its use.

Table 10. Distribution of types of words used to describe the scientist(s) at Science Cafes (n=97)

	Count	Percent of Attendees
Knowledgeable	62	64%
Good Communicator	38	39%
Entertaining	31	32%
Engaging	29	30%
Approachable	21	22%
Informative	18	19%
Passionate	11	11%
Professional	5	5%
Negative Descriptor	4	4%
Image	3	3%
Other	21	22%

Table 11. Coding categories for scientist descriptor words

Code Name	Description	Example words
Knowledgeable	Relates to intelligence and/or knowledge held by the speaker	smart, intelligent, brilliant, knowledgeable, informed expert, insightful, comfortable with topic, thoughtful
Informative	Used the word informative	informative, educational
Engaging	Relates to being engaging or interesting	engaging, interesting, stimulating
Approachable	Relates to a demeanor being open, friendly, and approachable	approachable, friendly, non-threatening, down-to-earth, helpful, reassuring, sympathetic, concerned
Good Communicator	Relates to the communication or speaking skills of the scientist	good speaker, direct, prepared, interactive, good stories, effective, concise, brief (not too wordy), clear, relaxed, articulate, organized, informal, focused, detailed
Passionate	Relates to the speaker being passionate about work and/or inspiring to listener	passionate, inspiring, enjoys work, hopeful, dedicated, excited, exciting
Image	Relates to the image or appearance of the scientist (i.e., non-geeky, cool)	nice shoes, accessories, cool
Negative	Negative or potentially negative descriptions	snarky, biased, geeky, hard to understand, vague, monotonous, fast-paced speech, mumbling, quiet
Professional	Relates to the professionalism or qualifications of the scientist	professional, qualified, experienced, current, innovative
Entertaining	Relates to qualities of being fun and entertaining	entertaining, fun, enthusiastic, funny, lots of personality, animated, dynamic, charismatic, peppy, energized
Other	words that couldn't readily be coded into other categories	

Attendees were also asked to select three words from a list of descriptors to best describe what they thought about the Science Café presentation; 90 attendees completed this question correctly (circling just three words), and 27 additional attendees responded, but circled more or fewer words than three. Results are presented in Table 12, with the sample of correct completions and total sample presented.

Overall, visitors gravitated toward the descriptors that focused on the cognitive response to the presentation; around 7 in 10 selected *informational* and *interesting* as one of their three words. Beyond that, however, key descriptors selected by 40% or more of attendees related to the experience being *entertaining* and *interactive.* In the middle, descriptors included *surprising, detailed,* and *exciting.*

Table 12. Distribution of which descriptors were selected by attendees about the Science Café events

	Correct Completion (n=90)		**All Circled (n=127)**	
	Count	Percent	Count	Percent
Informational	64	71%	91	72%
Interesting	63	70%	88	69%
Entertaining	38	42%	57	45%
Interactive	36	40%	50	39%
Surprising	14	16%	27	21%
Detailed	13	14%	21	17%
Exciting	11	12%	27	21%
Innovative	9	10%	15	12%
Cool	8	9%	24	19%
Personal	5	6%	7	6%
Amazing	2	2%	8	6%
Storytelling	1	1%	3	2%
Slow	0	0%	2	2%
Traditional	0	0%	2	2%
Boring	0	0%	1	1%
Lame	0	0%	0	0%

Interestingly, when comparing the data from those who only selected three words, and those who selected more than three words (the right-hand columns), it indicates what other words attendees associated with the presentation, but that might not have been in their top-three. *Surprising, exciting,* and *cool* were three notable words that were much more common when visitors selected more than three words.

Differences by Sub-Groups

There were very few differences in the way different sub-groups responded to the scientists and presentations at the Science Cafes. There were no differences in frequency of using descriptor words for scientists based upon frequency of attending, and only one small difference found based upon training in science/research or schooling; generally ratings across audiences were the same:

- Those who reported no formal training in science/research tended to describe scientists as "knowledgeable/smart" slightly more often (65%, 33) than those without training (43%, 24). ($X^2(1)=5.12$, p=.024).
- Those who had completed an undergraduate degree tended to use the word "informative" to describe scientists more often (23%, 11) than those with graduate degrees (6%, 3). ($X^2(1)=5.56$, p=.018)

Regarding the words selected to describe the event, there were no significant differences based on an attendees schooling, training in science/research, or their frequency of attending Science Cafes. The only difference was related to whether the data was collected at a trivia or a traditional Café event. In fact, although one might expect substantial differences in reaction to these two formats, there was only one descriptor where selections were significantly different from one another.[1] Science Trivia attendees much more often described their event as *entertaining* (75%, 9) than did Science Café attendees (38%, 30).

Focus Group Results

Participants in the focus groups were asked if they have a sense of community as a result of attending the Science Cafes. Twenty out of 21 participants indicated by a raise of hands that they did. The group was then asked what aspects make it feel like a community. The primary qualities mentioned by the participants that contributed to a sense of community were the social atmosphere, the like-minded people, and the local scientists. Each of these qualities is discussed below.

The **social atmosphere** was the main quality that focus group participants cited when talking about the sense of community at Science Cafes. Many participants highlighted aspects of the social atmosphere when speaking of the community of attendees at the events. Participants agreed that the availability of food and drink was part of the casual, social atmosphere. Another commonly mentioned aspect was feeling that you could sit down with people you did not know and talk with them. Because of the venue and seating options, participants in the focus groups said it was common to share a table with people they did not know. This was seen as a positive characteristic of the events and enhanced the social nature of the event, as illustrated by the following quote:

> *It gives you an opportunity to sit down and talk to people you would never meet anywhere else and if you're sitting at a table with two or three other people you've never met before, it gives you an opportunity to learn what other people in the area are doing. Or if they don't like the presentation, what it is they don't like. So you're learning both ways. So it's meeting new people, making new friends. (Male in his 60s, Focus Group 1)*

Sharing tables and the Q&A sessions were cited as enhancing the opportunities for interaction that typically do not happen in public spaces. For example, one participant said that an auditorium setting would limit the ability to interact with others and other activities, like going to the movies, puts you in a space with others but the norm is to not interact with those outside of your group. Another participant compared the sharing of tables at Cafes to going to the dining car of a train expecting that you will share a table and conversation with other people. Participants felt that the experience created by the Science Cafes was unique and important in modern society:

[1] Because there are few individuals in the Trivia group (only 12 completed correctly), magnitude of difference must be great to show significance. A more in-depth study would be needed if this was a question of concern.

And I want to emphasize that this phenomenon of strangers feeling increasingly comfortable with one another is really, really important because our society, you know the way we developed in the United States in urban places is exactly the opposite. You have people seeking anonymity, separation. And so we're really doing something, maybe it wasn't even intended, that is quite valuable. (Male in his 50s or 60s, Focus Group 2)

Finally, it was noted by focus group participants that the food service staff and Brian, the event host, all added to the feeling of being welcome and the sense of community. One woman who was a science teacher compared the Science Café to the bar in the television program *Cheers*: "You see the same people and it's a place to come. It's *Cheers*." This feeling of being a "regular" was prominent among the repeat attendees who participated in the focus groups.

The **like-mindedness of attendees** was another way that the events supported a sense of community. Some participants in the focus group spoke about fellow attendees as being "like-minded" in their motivations for attending or interests. "You're in a room with people who all want to be there for the same reason," said one man in his fifties. A man in his twenties echoed this idea saying, "The people around you are all coming together in one great group to learn about some highly specific topic that no one else would probably learn about otherwise." This participant highlighted the group's shared interest in the topic, while another participant noted that attendees at the cafes are "people with the same curiosity" to learn.

Another way in which the attendees highlighted the like-mindedness of attendees was when the talked about feeling a sense of contrast between the Science Cafes and the state legislature. "I think the two buildings are almost diametrically opposed," said one attendee referring to the museum building and the legislative building. The contrast between those who attend the events and the legislature "right across the street" helped to create a sense of two opposing groups. In the words of one man, "There's nothing like having an out-group in order to have an in-group. And people regularly make references to a divide" between the two groups. Note that in this use of the word "in-group" the focus group participant is referring to a group to which one self-identifies as being a member. Although participants did not go into more detail about what specifically divides the Science Café attendees from those in the legislature, it is likely that they were thinking of a divide between whether to use a scientific-data-driven approach to policy-making or addressing societal challenges.[2] From the conversation of the focus group participants, it is clear that some attendees feel a shared sense of being "for" something that many in their legislature are "against."

A few focus group participants mentioned that having **local scientists** as presenters contributed to the community feeling of the events. As one participant who was in his twenties explained "I'm fairly new to Raleigh and so the fact that a lot of the presenters are local that makes me feel connected to the Raleigh community or the triangle community in that sense." Although this trend was rather small among the responses, it is supported by the responses regarding motivations for attending the Science Cafes; for some participants the "local" quality of the speakers is an important aspect of the events as a whole.

[2] For example, in May 2012 the NC state legislature adopted a law regarding the calculation of sea level rise based on historic trends and not on predictions of sea level rise (http://www.newsobserver.com/2012/05/28/2096124/coastal-nc-counties-fighting-sea.html).

Extending the Experience

Attendees were asked to report how likely they are to talk about something they learned at the Café with various people in their life. Science Café attendees report very strong likelihood of talking with others in their lives about what they have learned at the Café (Table 13), particularly friends and family members, but also co-workers. This suggests attendees are extending their experience through conversation and sharing with others in their lives.

Table 13. Average ratings of "how likely are you to talk about something you learned tonight with people in each of the following groups?" (1-7 scale; 1=not at all likely; 7=very likely)

	% Rating 6 or 7	Median	Mean	Std. Dev.	N
Family members	78%	7.0	6.14	1.35	91
Friends	74%	7.0	6.07	1.26	92
Co-workers	65%	6.0	5.44	1.89	88

When exploring potential interest and use in online mechanisms to help extend the experience of a Science Café, such as a blog, a Twitter feed, online Q&A with the scientists, or other online resources, attendees' reactions were very mixed, with clear indications that some resources are far less likely to be used than others (Table 14).

Table 14. Average ratings of "How likely would you be to use or explore each of these options if they were offered?" (1-7 scale; 1=not at all likely to use; 7=extremely likely to use)

	% Rating 6 or 7	Median	Mean	Std. Dev.	N
Links to online resources related to the topic	75%	6	5.88	1.43	67
Online Q&A with the speaker(s)	35%	5	4.27	1.96	63
Blog led by museum staff member	30%	4	3.89	2.18	66
Science Café Twitter feed	12%	2	2.59	2.01	66

Overall, the most general of the options – links to online resources related to the topic – was by far the option attendees reported they were most likely to use; 75% rated a 6 or 7 (meaning "very likely"; mean=5.88. The other options did not seem to garner as much traction. The option with the least interest by attendees was a Twitter feed. The vast majority reported they were not at all likely to use this resource (see Figure 2), and it received a mean rating of 2.59 (on the "unlikely" side of the scale). The two other options (online Q&A or a blog) received a moderate response. Overall, this suggests that attendees do not have a strong interest at this time in opportunities for ongoing interaction in between the Café events, as the only option receiving strong interest was the least interactive of the media suggested.

Differences by Sub-Groups

There were no notable or significant differences between subgroups on any of these expressions of interest in or likelihood of engaging in extension activities.

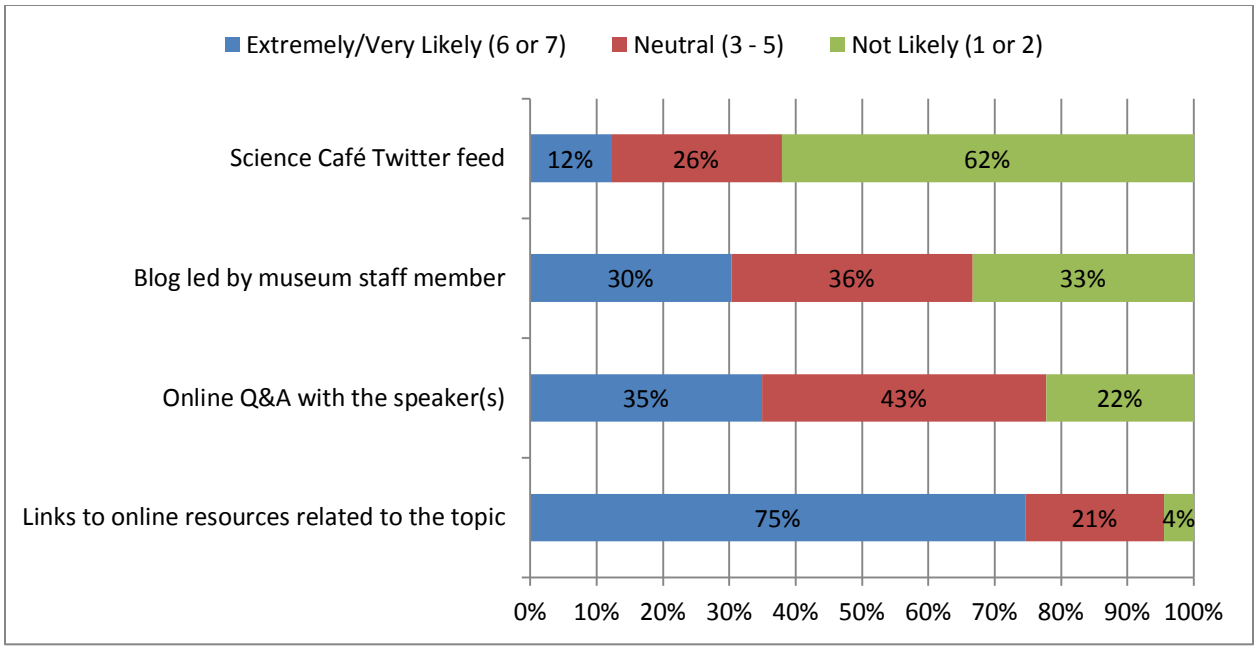

Figure 2. Distribution of ratings to the items in the question "How likely would you be to use or explore each of these options if they were offered?"

Focus Group Results

The focus group was the opportunity to probe into greater depth about these concepts, particularly allowing for participants to reflect on how they have *actually*, rather than hypothetically, extended their Café experience into their daily lives.

Validating the questionnaire results, focus group discussions showed that the most common way participants extended the events was through conversations with friends and family.[3] A few participants also reported they commonly discussed the events with their co-workers. Participants indicated that they talk about the topic of the Science Cafes after the fact with both those who they attended the event with and those who were not at the event. The topics just "comes up in the conversation," said one man, who reported sharing information about chocolate with friends. Another participant mentioned that she shared a book about the intelligence of dogs with a friend as a result of the Café on that topic. Overall, the conversations around the Science Café topics tended to be spontaneous and shared in a casual way with individuals the participant thought would be interested in the topic.

The second most common post-event activity was seeking out more information on the topic after the event. As mentioned above, when participants found a topic particularly interesting, they commonly would look up additional information online. One woman who regularly attends Trivia Night said, "In our group, especially with trivia when we don't know the answer somebody will take it to heart, and when we get home [they will] get more information and then e-mail the rest of us." A few participants mentioned seeking out a speaker's book as well.

[3] A recent evaluation of the SciCafe program at the American Museum of Natural History also found that conversations with friends and family were the most common post-event activity (Foutz, 2013).

Other ways the Science Café experience extended into the lives of the focus group participants included: inviting friends to attend the events; starting to pay more attention to a topic and noticing it when it is covered in the media; testing their dog's intelligence; using Science Café information at school with students; using the topic as a jumping off point for a magazine article; visiting a waterfowl park mentioned by a speaker; and stopping the use of Round-Up as a result of a talk about frogs. Each of these activities was mentioned by between one and three participants.

New Extension Formats

Focus group participants were asked to comment on museum staff members' ideas for supporting and extending the Science Café experience after the event. Three topics were specifically asked about during the discussion (online question and answer sessions with the speaker, online resources gathered and posted by museum staff related to the event topics, and accessing the archived video of the events); participants also volunteered other ideas for continuing involvement after the event.

Overall, all of the museum-supported options were well received by the group. However, participants expressed that the core experience was the Café itself; they preferred that staff time be spent on the Café events and not on extending the experience, especially it if having the additional options meant sacrificing the number or quality of the cafes. Reactions to each of the museum-supported options for extending the experience are detailed below.

Online question and answer sessions with the speaker: Many participants were interested in the ability to continue the conversation with the speaker after the event. Some participants indicated that they commonly thought of questions after the event was over and felt an online format was a good way to have those questions answered. Members of both focus groups suggested that an asynchronous online forum would be the best format for this. One participant suggested using a reddit-style format. These formats would allow for a discussion both with the speaker and other attendees. One participant suggested that there be a short video tutorial on how to use the online forum; she was a retiree and had no experience using forums. With a tutorial, she felt the forum would be made accessible to more people.

Online resources gathered and posted by museum staff: Many participants also were interested in having a "one-stop shop" for the Science Café online where all the event information would be accessible. This seemed to be the most popular of all the museum-supported options participants were asked to comment on. Participants in the focus groups suggested that the Science Café have its own webpage or section of the museum's page. They encouraged the staff to post not only resources or links related to the topic but also coming events, speaker bios, short recaps or summaries of each talk, and links to the videos on iTunes. Some suggested that the site be easily searchable or organized by date so they could quickly find events after the fact.

Accessing archived video of the events: Accessing the video of past cafes was an interesting option for many of the focus group members. They indicated that they would watch the video for events they had missed and also would recommend that friends watch the videos for topics that may be of interest to them. Interestingly, while a few people knew that the videos were available on iTunes, many of the participants in the focus groups did not know that the events were streamed live, recorded, and archived. This was despite being regular and highly interested attendees. It may be that the availability of the videos needs to be disseminated more broadly.

Other options for extending the experience: Some focus group participants also volunteered additional ways they felt the museum staff could support the Science Café experience after an event ended. Suggestions included 1) selling the speaker's book at the event, 2) a short hand-out or take-away about the topic, and 3) easier ways to suggest possible café topics. A number of people felt that if the speaker had a book, this book should be sold at the event itself. They noted that at some events the book was said to be on sale in the gift shop, but since the shop was not open after-hours, they could not buy it. They suggested either having the museum sell the book or encouraging the speaker (or one of their associates) sell the book themselves. A member of the first focus group suggested that the speakers prepare a short hand-out focusing on key terms or concepts, something he felt would be helpful if the talk was "very technical." When the second focus group was asked for their reactions to this idea, they did not feel it was necessary. Some participants said that it might take too much of the speaker's time, and others felt that it would either make the cafes feel too much like school or make the talks themselves more technical since the basics could be explained on the hand-out. The last suggestion was to make it easier to submit ideas for café topics. Some participants in the focus groups did not know that you could suggest topics via the evaluation form available at all events. They had never completed an evaluation despite being regular attendees; as a result, they did not know that it was possible to suggest ideas for events. As a result of this portion of the discussion, the group suggested announcing the presence of the evaluation forms and that they included a way to suggest new topics.

Discussion & Conclusions

Results from the evaluation of the Science Cafes, their immediate and extended impacts with audiences, show that the format, venue, and professional staffing of these events at the NRC has been highly successful with its current audiences. Attendees are drawn to the events by a number of factors, and they have created a sense of community among groups of strangers – all around an interest in science and lifelong learning – in the greater Raleigh area. The unique atmosphere created by this type of program, and the NRC's regular delivery of it in an intimate and convenient location, has become an anchor for engaging experiences in these participants.

Below is a synthesis of the key findings from these data and what they may mean for the NRC's consideration of programming going forward:

- **Science Café attendees at the NRC are a group with some diversity and some similarities**. They tend to be older (43% of respondents were over 60), well-educated (87% hold at least a college degree), and are from the Raleigh area. But the group is split evenly between those with and without training in science or research (similar to other museum visitor samples). During this period, results showed about one-third of attendees were first-timers, and the rest were repeat visitors of the Cafes.
    - Perhaps more than demographic trends, results point to a feeling of like-mindedness that has developed naturally among the regular attendees. Their shared interest in science, lifelong learning, and considering world issues through the lens of science research have seemed to create a sense of shared identity and community among attendees.
- **Attendees are motivated by a suite of interrelated factors; interest in the specific topic and science generally top the list of motivations**, which is connected to an expressed love of learning. The atmosphere is also an important attribute – the venue, food, drink, and social experience. Although attendees don't tend to focus on the social element as their top-of-mind motivation, the focus group made clear that it is the social qualities that make it a unique experience to other, non-social lifelong science learning opportunities (such as watching a documentary).
    - The selection (including diversity) of topics, scientists, and even formats all factor into motivation to attend. A continued path of diverse, relevant, and local speakers within this context should maintain attendance.
- **The greatest format preference is the traditional scientist presentation followed by Q&A**; however, the preparation of the scientist was noted as a critical factor. In the reflections by focus group attendees, there was awareness that their preference for format might have more to do with the scientist's communication abilities; noting that the interview format, with the Museum's strong facilitator, was a great strategy for making some Cafes more accessible. Considerations about tone and depth of content also factor into mixed reactions. Science Trivia Night seems to provide a different type of experience and gain, but also seen as valuable by participants.
    - The use of strong Museum facilitators and planners for these events really enhances value, through the ability to judge and respond to a scientist's style or preparedness for this type of public communication. It must be acknowledged, and attendees even realize, that this facilitation is a critical, if behind-the-scenes, factor to success.

- **Attendees tend to report learning specific information from the presentation**; and also generally strongly associate that the presentation gave them new perspectives on the topics and how science relates to daily life; the processes and approaches of scientific work were less strongly associated learning outcomes. Focus group results better highlight the depth of connections attendees draw from participation, including changed views about science, scientific process, and who scientists are.
    - Contrasts in how individuals responded to wording highlight that generalized wording of some questions and items on surveys about these topics can influence responses. Attendees may need more specific examples to respond to that illustrate what one means by "changing views on science," for instance.
- **Attendees seem to have strong, positive and affective responses to the scientists and the style of the events.** Descriptions of scientists emphasized how knowledgeable and intelligent they seemed; but the secondary descriptors focused more on their qualities of audience engagement, entertainment, and being personable – all key goals of the Science Café format. Similarly, attendees focus on the cognitive aspects of the event (informational and interesting), which makes sense given motivations to learn; but there is also high association with it as entertaining and interactive.
- **Added to this was a strong feeling of community created by the Science Café's venue, format, experience, and consistency.** Focus group participants describe an atmosphere that promotes interaction with people outside of one's own group and a sense of being part of a group of "regulars," all brought together by common interests and passion for learning and science.
- **Extending the Café experience does seem to be a natural part of attendees' daily lives**, **particularly regarding talking about what they learned with family or friends**; and, for some, even pursuing more information about something they were interested in or just being more aware when they hear about the concept in the news. Extension is casual, coming up as it relates to other factors in their lives.
- **As for museum-driven extension opportunities, interest in these options are generally mixed**, with both questionnaire and focus group data suggesting that attendees' primary value is from the Café event itself. Focus group and questionnaire respondents both gravitated toward an online "one-stop shop" for Science Café information and resources; focus group respondents were more favorable to other resources (such as online Q&A with scientists), while questionnaire respondents were not as drawn to these options.
    - Existing dissemination paths, such as the availability of video access of past Science Cafes, are not well known, even by regular attendees. Prioritizing activities to make greatest use of existing resources, while maintaining focus on strong Café programming, may strike the best balance for the already highly-engaged audience.

Appendix A

Table 15. Raw data of open-ended responses to the prompt "I never realized…" that were coded as "facts"

Open-ended responses to "I never realized..." coded as Facts
1-that there were 5 mass [extinctions] and that we're in the 6th / 2-There is so much fossil evidence indicating behavior and general appearance / 3-There are "age" lines in dinosaur bones / 4-There is excess tissue stored in dinosaur bones to lay eggs
1. the worker bees are all female / 2. 1/3 of all bees die each year
a brannock device is that weird thing they measure your feet with
a coalition was a bunch of cats
babies can do algebra
babies can do algebra
babies can do algebra
babies can do complex math
babies could do algebra
bee had mites and diseases
bees are not native
bees communicated through dance
bees danced to communicate
bees debate decisions
bees debated on where to start hives; there are so many jobs in entomology
bees had symbiotic bacteria in their gut
bees sleep
bees were attempted to be brought over on the Mayflower
bird are considered dinosaurs, rather they descended from dinos
birds and dinosaurs are related
birds ARE dinosaurs--not just related to dinosaurs
birds are not dinosaurs / dinosaurs are not extinct
birds are so completely identical to what we know of dinosaurs
birds were dinosaurs
birds were dinosaurs
birds were dinosaurs and the t rex was originally small
birds were dinosaurs! and many other facts
birds were so closely related to dinosaurs
birds? dinosaurs?
children can do math
dino-bird and egg shape-not round but pointed
dinosaurs are not extinct
dinosaurs have nose bones 3 ft. going behind their head for noise
double hawks are real
energy requirements to power spacer raft were so low
extended range of a bee colony
feral bees largely died off in 1980s due to mites, but coming back by mites selecting for less virulent strain
feral populations have less virulent mite strains
Greenland had a national park, Greenland is actually owned by Denmark
gum was in the Smithsonian
honey bees are not native to US

honey bees were brought over by the European colonists
I ate dinosaur eggs for breakfast
Kiravasi is a country
mission vehicles were so big
most species living solitary lives
new horizon probe was specialized
not all bees colonized
not all bees live in large groups/hives / it explains the bees I see coming out of the ground in the woods in the spring...lots of them
pluto was that tiny
queens fight to the death
really young babies can do math
reasons for birds being decended from dinosaurs
science included Hollywood films
Solar Technology used
solitary bees were so numerous and threatened
that dinosaurs and medium birds share similar egg structures
that queens lose 25% of body weight prior to swarming / feral populations have "kinder, gentler" mites infecting them
the brannock device was used to measure shoe size
the brannock was a device measuring shoe size
the colony was made up of different genetic background
the color of dinosaur feather might possibly be determined
the junos probe would be cooked
the shoe size thingy is called a brannock device
the study of bees was so interesting
the survival of the great extinction. who died and who didn't
the USSR put a probe on the moon
there are many missions operating
there are other objects and reiper belt larger than pluto
there are over 20000 species of bees, 4000 in north america
there aren't many feral bees
there were as many missons as mentioned
there were major extinction events where more than 75% of speciesdied out
there were so many different bees- honey bee was N.C. insect
there were so many names for different groups of animals
there were so many probes in space
very young children can do more than counting
we have a very large number of probed exploring our solar system
we only hear from voyager once a month
what we were doing in space. The different missions
wombats could make that face
worker bees were female