Water's Journey through the Everglades

Summative Evaluation

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Prepared for:

University of Central Florida and Museum of Discovery and Science

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Executive Summary

The University of Central Florida (UCF) received funding from the National Science Foundation through the Informal Science Education program (# 0638977) to create a series of exhibits entitled *Water's Journey through the Everglades (Water's Journey).* The project deliverables included ten kiosks integrated into an expansion of the Museum of Discovery and Science (MODS) in Fort Lauderdale, FL, with the new exhibition areas opening in November 2011. The kiosks model aspects of Florida's ecosystems and natural history, highlighting the natural balance of the Everglades and the interplay between Florida's environment and human development. Using interactive display techniques, simulations, models, and game play, *Water's Journey* exhibits were designed by staff at UCF's Media Convergence Laboratory and E2i Creative Studio. Aimed at youth aged 10 to 16 years old, audience outcomes for the project included 1) greater awareness of the role of water in the environment, 2) understanding of the time scales and scope of environmental change, and 3) increased understanding of the relevance of science within the context of Florida's ecosystems.

The Institute for Learning Innovation (ILI) served as the external summative evaluator for the *Water's Journey* project. The summative evaluation was designed to better understand how the *Water's Journey* kiosks were contextualized within MODS exhibition spaces and to document the impacts of the kiosks on children attending MODS with a family group. Two studies, each using a combination of methods, were undertaken during the course of the summative evaluation: 1) a contextual study of the use of *Water's Journey* kiosks within the exhibit spaces, and 2) a kiosk-based study of the use and impact of the kiosks. Interviews with the members of the project also were conducted to provide context to the evaluation results. This document includes an overview of the *Water's Journey* exhibits, a description of the study design and methods, and the summative evaluation findings.

Key findings from the summative evaluation include:

- As a whole, the *Water's Journey* exhibits achieved the three audience impacts for the project. Individually, some exhibits achieved all three impacts while others achieved one or two.
    - Impact 1, the role of water in the environment: Quantitative ratings indicated that visitors in the target age-range did not perceive the role of water in the environment as a message of all of kiosks; however, qualitative data indicated that visitors were able to accurately describe how the topic was incorporated into the exhibits.
    - Impact 2, time scales and scope of environmental change: Quantitative ratings indicated that visitors in the target age-range did not perceive the topic of environmental change over time as a message of all kiosks; qualitative data indicated that for these same exhibits, visitors were not able describe how the topic was incorporated into the exhibits. This finding may be a result of the different methods used to interpret time, with some kiosks using more explicit visualizations or time scales (such as deep time) which are more commonly associated with environmental change.
    - Impact 3, relevance of science: Quantitative and qualitative data both support the findings that this impact was achieved at all *Water's Journey* exhibits, with visitors in the target age-range describing the necessity to care for animals and the environment as reasons why the exhibits were relevant. Issues such as human impacts on the environment and the local/Florida-related scope of the topics were also mentioned by a sub-set of visitors.

- A comparison of pre-interaction ratings and post-interaction ratings for all the *Water's Journey* exhibits found significant differences pre-to-post for *interest in learning more* about and *knowledge* of Florida's environment; post-interaction ratings were significantly higher for both interest and knowledge. When considering the exhibits individually, three out of the five exhibit groupings also demonstrated statistically significant differences pre-to-post (i.e. Human Encroachment, the Florida Table kiosks, and the Hurricanes kiosks).

- *Water's Journey* exhibits attracted the attention of visitors in the target age-range, held their attention, and fostered levels of engagement, performing as well or better than other exhibits in the same sub-sections of MODS.

- *Water's Journey* exhibits located in the Storm Center area of MODS were used more often and for longer time periods than the *Water's Journey* exhibits in other areas when visitors were observed without cuing them to the presence of the evaluator. This finding is consistent with the overall patterns of exhibit usage for the exhibition spaces included in the study, with the Storm Center area having a lower Sweep Rate Index and higher percent of Diligent Visitors than the other spaces included in the study.

- Cued, focused observations at the individual *Water's Journey* exhibits indicated that the exhibits supported 1) repeated interactions, with visitors playing the same game/scenario multiple times and 2) social interactions within visitor groups, including goal setting, hypothesizing, observations of results, and problem-solving between adults and youth and between peers.

- Usability issues were common at the *Water's Journey* exhibits with the sensitivity of the touchscreens a common problem. Usability issues prevented some visitors from accessing deeper layers of content or engaging in the full capabilities of the simulations.

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Introduction

In May 2007, the University of Central Florida and the Museum of Discovery and Science received funding from the National Science Foundation through the Informal Science Education program (# 0638977) to create a series of exhibits entitled *Water's Journey through the Everglades. Water's Journey through the Everglades (Water's Journey)* models a unique ecosystem with rich complexities and contrasts, highlighting the natural balance of the Everglades and the interplay between Florida's environment and human development. Using interactive display techniques, simulations, models, and game play, *Water's Journey* exhibits were designed by staff at UCF's Media Convergence Laboratory, which evolved into the E2i Creative Studio in 2010. The exhibits were integrated into an expansion of the Museum of Discovery and Science (MODS) in Fort Lauderdale, FL. The new 34,000 square foot museum wing, called the EcoDiscovery Center, opened in November 2011.

The goal of the *Water's Journey* project is to engage an adolescent audience with science centers by providing dynamic, experiential learning opportunities that can deliver a continuous flow of compelling interactive content, supporting a lifetime of inquiry and experimentation. *Water's Journey* was envisioned as a project to impact adolescents, their families, and their school groups visiting MODS by providing them with insights into the tools that scientists use in their own research. The core target audience for the project is science center visitors between 10 and 16 years old, and by extension their families and social groups.

The Institute for Learning Innovation (ILI) served as the external summative evaluator for the *Water's Journey* project, with Susan G. Foutz and Kara Hershorin conducting the evaluation. The summative evaluation for *Water's Journey* was designed to assess whether the project achieved its three primary impacts with the target audience:

> **Impact 1:** Adolescents will develop a greater awareness of how water impacts the environment, from the local to the global.
>
> **Impact 2:** Adolescents will gain a clearer concept of the time scales and scope of environmental change.
>
> **Impact 3:** Adolescents' confidence level in their ability to understand the relevance of science will rise as they explore the vast amount of scientific data that has been collected, and answer their own questions about the Florida Everglades' rich and fragile ecosystem, and its importance to their own community.

This document includes an overview of the *Water's Journey* exhibits, a description of the study design and methods, and the summative evaluation findings for the NSF-funded exhibits. This study is not an evaluation of the MODS EcoDiscovery Center although it does attempt to contextualize the *Water's Journey* exhibits within the new wing.

Limitations

The summative evaluation data collection was limited by a number of factors, which, by extension, places limitations on the conclusions which can be drawn from this study. The primary factors limiting data collection were the usage of the *Water's Journey* kiosks and visitation rates of visitors in the 10 to 16 age-range. To take advantage of days with the highest family-group visitation, the majority of the data was collected during holiday weekends (President's Day and Memorial Day) and the week of spring

break. As a result the findings are a reflection of the visitation patterns of target-age youth during these times and may not be reflective of visitation during non-holidays. The data therefore reflect one end of the visitation spectrum, namely days with high family-group visitation. In general, youth in the 10 to 16 age-range are not well represented in this population of visitors to the museum, and this visitation pattern is not unique to MODS. To increase the sampling frame, the evaluation team received permission from the project team to expand the age-range from 8 to 18 years old for data collection. Due the need for parental permission for data collection involving minors and the logistics of obtaining necessary permission from school and camp groups, the sampling frame was limited to youth visiting in family groups. This further limited the population that could be included in the study.

The original study design focused on visitors' naturalistic use of the *Water's Journey* kiosks. However, the timing and tracking study indicated that the *Water's Journey* kiosks in the EcoDiscovery Center were not heavily used (see the Findings section). This visitation pattern fit with the expectations of the project team in that the *Water's Journey* exhibits were not intended to be landmark or iconic exhibits within the larger space. However, this visitation pattern was problematic for the evaluation design. Logistically, it was not practical to continue naturalistic data collection; the time needed to reach the sample size at each kiosk needed for analysis would have exceeded the budget for data collection. Therefore, the evaluation team designed a secondary study based on cued data collection at each kiosk. Cuing creates a "best case scenario" of data collection by inviting visitors to use an exhibit when they know they are being observed. Cuing has been shown to increase the amount of time visitors spend in a gallery.[1] According to Serrell, the cued observation and interview measures the exhibition's potential to communicate.[2] An additional weakness of the method was the convenience sampling method used. With this method there is a risk of an overrepresentation of visitors who are the most readily accessible, and an underrepresentation of visitors who are unseen or not cooperative. However, on most days of cued data collection, data collectors asked every youth who appeared to be in the 8 to 18 age-range to participate in the study and the refusal rate was low.

It is also important to note that this study was not designed to evaluate the success of the EcoDiscovery Center, its sub-sections, or the non-NSF-funded exhibits. The study was designed to focus on the impacts of the *Water's Journey* exhibits and their use within the context of the EcoDiscovery Center. Sub-sections of the EcoDiscovery Center without *Water's Journey* exhibits were not included in the study design. As such the findings reported here do not represent the full potential or impacts of the EcoDiscovery Center or its exhibits.

Description of the EcoDiscovery Center and the *Water's Journey* Exhibits

The *Water's Journey* exhibits are installed in the EcoDiscovery Center of MODS. The EcoDiscovery Center is a two-story, 34,000-square-foot expansion of the museum. On the first floor it includes Otters at Play, Prehistoric Florida, Water, the Everglades Airboat Adventure, and Storm Center. On the second floor it includes a 7,000-square-foot traveling exhibit hall, an overlook of the otter habitat, the Beacon light

[1] Serrell, B. (2000). Does Cueing Visitors Significantly Increase the Time They Spend at a Museum Exhibition? *Visitor Studies Today!*, 3(2), 3-6.

[2] Serrell, B. (1998). Paying Attention: Visitors and Museum Exhibitions. American Association of Museums; Washington, DC.

tower, and four laboratory classrooms that extend off of the second floor exhibit hall. The ten *Water's Journey* kiosks were installed in the following areas of the EcoDiscovery Center: Otters at Play, Prehistoric Florida, Water, Storm Center, and the second floor overlook of the otter habitat. The summative evaluation study of *Water's Journey*, therefore, focused on these sub-sections of the EcoDiscovery Center, and excluded experiences such as the traveling exhibit hall and the Everglades Airboat Adventure. For the contextual study, exhibition spaces were grouped together for the purposes of data collection (see the Evaluation Design and Methods section). These groupings do not necessarily reflect how visitors use the space, but rather serve as units of analysis for this study only:

- The Otters at Play, Prehistoric Florida, and Water areas of the EcoDiscovery Center were grouped for data collection. These areas are part of a 9,000-square-foot, permanent exhibit space with an open floor plan and clear sightlines. These factors and visitors movement through the space supported the grouping these three areas together for the timing and tracking of visitors. A total of seven *Water's Journey* kiosks are in this sub-section. The Everglades Airboat Adventure entrance and exit are within this space however, this experience was not included in the study as it does not include *Water's Journey* exhibits.
- The Storm Center area of the EcoDiscovery Center was not grouped with other areas of the museum for data collection. This 3,200-square-foot space is relatively self-contained, with a design that includes curved walls and distinct entrance ways. As such, it was decided to collect timing and tracking data in this area as if it were a stand-alone space. A total of two *Water's Journey* kiosks are in this sub-section.

A description of each *Water's Journey* kiosk and its location within the above spaces is included below.

Core Sample: Land and Water

The two Core Sample kiosks are in the Prehistoric Florida section of the EcoDiscovery Center. Each kiosk includes two wall mounted, side-by-side monitors mounted above a track ball. Visitors use the track ball to scroll through time, represented on one monitor as layers of rock and the changing Florida coastline on the other monitor. The layers of rock have fossils embedded in them and a timeline on the left edge showing how many millions of years ago the fossilized organism would have been living. As visitors scroll over a fossil, a pop-up appears with information on the organism and an image of how it appeared when alive (Figure 1). The amount of exposed land displayed on the other monitor corresponds to the coastline of Florida for the time period when the organism was alive (Figure 2). One Core Sample kiosk focuses primarily on land-based organisms and the other primarily on water-based organisms. A sub-set of organisms from each kiosk were animated in an environment so that they could be projected on a screen near the kiosk and appear to be life-size. However, the screen connected to the Water kiosk was removed shortly after the opening of the EcoDiscovery Center for aesthetic reasons.

Figure 1: Core Sample fossil and information

Figure 2: Monitor depicting the Florida coastline at a Core Sample kiosk

Tree Island

The Tree Island kiosk is located in the Water section of the EcoDiscovery Center. Tree Island shares an exhibit case with an exhibit on a related topic, videos detailing the Loxahatchee Impoundment Landscape Assessment (LILA). The LILA exhibit was not produced as part of the *Water's Journey* project. The shared exhibit case is free-standing with touchscreen monitors placed at waist-height of an adult. The Tree Island interaction models the relationship between water level and organisms that inhabit tree islands in the Everglades. The kiosk depicts an island that is surrounded by various depths of water depending on the changing seasons. As the water levels rise and fall, different species of plants and animals inhabit the island depending on their requirements. The amount of water present can vary between flood and drought, but is connected to seasonal functions. Visitors can use a slider on the touch screen kiosk to manipulate the water level or watch as the water level changes on its own. By selecting on an exclamation point icon on the image of the island, visitors receive more information about a species on the island; the information about the species changes as the water level changes.

Human Encroachment

The Human Encroachment kiosk is located in the EcoDiscovery Center between the Prehistoric Florida and the Otters at Play areas of the EcoDiscovery Center. This exhibit is a free-standing touchscreen monitor and is vertically mounted approximately four feet off the floor. The kiosk contains initial background information on the development of Florida, a map-based model of the relationship of human development and animal populations, and visualizations of animals within an augmented reality environment. Visitors can add or remove human habitation to the map of Florida by rubbing or tapping the screen. As the amount of human habitation changes, the population of three animal species (bears, deer, and panthers) changes as shown on a bar graph beside the map (Figure 3). A button at the bottom of the screen allows visitors to toggle between the map and the visualization of the deer, bear, and panther in the live otter habitat environment. The background of the environment changes depending on the amount of human habitation depicted on the map. When less human development is depicted, the animated animals are shown in an augmented reality version of the otter habitat (Figure 4). Touching an animal triggers a pop-up with information on how the animal's population is impacted by development.

Figure 3: Human Encroachment interactive map

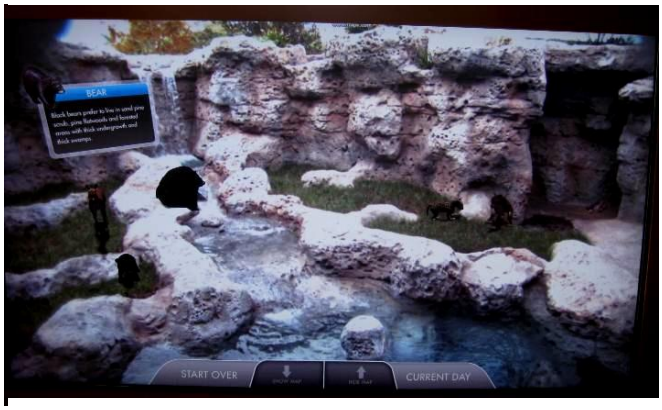


Figure 4: Human Encroachment augmented reality with animals and pop-up

Hydrologic Cycle

The Hydrologic Cycle kiosk is one of three *Water's Journey* exhibits at the Florida Table, a large projected map of Florida located in the Water area of the EcoDiscovery Center (Figure 5). The Hydrologic Cycle

exhibit consists of one horizontally mounted touchscreen and a wall-mounted monitor. Visitors' interactions at the touchscreen control the images that appear on the monitor. The touchscreen depicts the hydrologic cycle as a closed circle with a water molecule on it. As visitors touch and drag the molecule around the circle, stages of the hydrologic cycle are pictured on a box in the center of the circle with a few sentences about the stage and Florida-specific information (Figure 6). A corresponding image is displayed on the wall monitor and related sounds. More information about each stage is available by touching a "learn more" button in the box.

Figure 5: The Florida Table. From left to right along the rail, the Hydrologic Cycle, Wet and Dry Seasons, and Sheet Water Flow.

Figure 6: The runoff stage of the Hydrologic Cycle touchscreen

Wet and Dry Seasons

The Wet and Dry Seasons kiosk is one of three *Water's Journey* exhibits at the Florida Table, a large projected map of Florida located in the Water area of the EcoDiscovery Center. The Wet and Dry Seasons exhibit consists of one horizontally mounted touchscreen and the Florida Table. Visitors' interactions at the touchscreen are linked to the images that appear on the Florida Table. The touchscreen depicts a map of Florida at the top and a model of the earth and sun at the bottom (Figure 7). As visitors touch and drag the earth around the sun, the seasons change. This change is depicted on an information bar across the center of the screen, showing average temperature and rainfall in each month. Other month-specific information is displayed in a box next to the map. A button on the right-hand side allows visitors to toggle to a larger map of Florida with dots on it, red dots for the dry season and blue dots for the wet season. A button near the bottom of the screen allows visitors to toggle back and forth between the wet and dry versions of the map. Touching a dot activates a pop-up with additional information on the season, including interactive polls. A cumulative tally of all visitor responses is displayed on the Florida Table.

Figure 7: The Wet and Dry Season touchscreen

Sheet Water Flow

The Sheet Water Flow kiosk is one of three *Water's Journey* exhibits at the Florida Table, a large projected map of Florida located in the Water area of the EcoDiscovery Center. The Sheet Water Flow exhibit consists of one horizontally mounted touchscreen and the Florida Table. Visitors' interactions at the touchscreen are linked to the images that appear on the Florida Table. Using the touch screen, visitors can explore five time periods and the flow of surface water in Florida. Water flow is depicted by blue arrows moving across the surface of the land (Figure 8). By selecting on an exclamation point icon on the image of Florida, visitors can get additional information about the time period. A game is also included on the touchscreen, allowing visitors to manipulate the flow of water across the same image of Florida by placing roads, canals, and cities on the map. As items are placed or removed, the water flow changes. The water flow is periodically modeled on the Florida Table using blue arrows to depict the direction of the water.

Figure 8: Sheet Water Flow touchscreen

Hurricanes: Storm and House

The Hurricanes kiosks are located in the Storm Center area of the EcoDiscovery Center and share a free-standing exhibit consisting of two touchscreen monitors and a central TV screen (Figure 9). On the TV, footage of a newscaster warns of an approaching hurricane and offers advice about hurricane preparation. The touchscreens face opposite directions, so that players are on either side of the exhibit as they play. Small stools are usually available in front of the touchscreens so visitors can sit as they play. One touchscreen focuses on building a house and buying materials in preparation for a hurricane (Figure 10). At the end of the simulation, visitors find how their house fared against a hurricane. The other touchscreen allows visitors to manipulate the factors that contribute to a hurricane, including water temperature, location, size, and intensity. After setting up their hurricane, visitors watch an animation of a house in a hurricane and find out the power of the storm they created. The exhibit was designed to allow two players, one at each touchscreen to

Figure 9: The Hurricanes exhibit showing the House touchscreen (left), the TV (center), and the back of the Storm touchscreen (right)

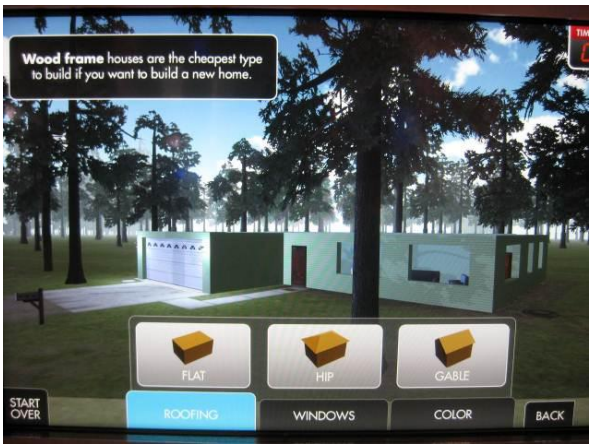


Figure 10: House interactive at the Hurricanes exhibit

play against each other; alternatively the exhibit also works as two independent experiences.

Invasive Species

The Invasive Species kiosk is a wall-mounted touchscreen located on the second floor of the EcoDiscovery Center, with large observing windows looking down into the live otter habitat below. The interactive features three species, the Melaleuca Tree, Water Hyacinth, and Burmese Python. For each species, visitors can choose one of three strategies to control the species - manual removal, a biological control agent, or a chemical method (Figure 11). Once a control method is selected, the screen transitions to a game-play mode where visitors deploy the strategy. The game-play mode uses augmented reality with the invasive species and control mechanisms appearing as animated visuals within a camera view of the otter habitat.

Figure 11: Water Hyacinth interactive at the Invasive Species exhibit

Evaluation Design and Methods

The summative evaluation was designed to better understand how the *Water's Journey* kiosks were contextualized within the sub-sections of the EcoDiscovery Center and to document the impacts of the kiosks on visitors in the target age-range (10 to 16 years old) who were visiting with a family group (i.e. not a school or camp group). Two studies, each using a combination of methods, were undertaken during the course of the summative evaluation. Table 1 summarizes these studies.

Table 1: Summary of the Water's Journey Summative Evaluation Studies

Contextual Study	Kiosk-Based Study
Study of the *Water's Journey* kiosks within sub-sections of the EcoDiscovery Center	Focused study of the experience, usage, and impacts of the *Water's Journey* kiosks
Conducted with visitors aged 8 to 18 years old	Conducted with visitors aged 8 to 18 years old and teen MODS volunteers.
Observations (i.e. timing and tracking) and interviews	Observations and interviews/focus groups

Interviews with the members of the project team also were conducted to provide context to the evaluation results. All evaluation instruments were developed with the input and feedback of key project staff at both E2i/UCF and MODS. The instruments were piloted and revised by ILI staff, with the revisions shared with the project team. The final instruments and related protocols were submitted to

the IRB at UCF for approval. Below is a description of each study, the methods used, the sample, and analysis procedures.

Contextual Study

The first study planned and executed was a contextual study designed to 1) understand how the *Water's Journey* kiosks were being used within two sub-sections of the EcoDiscovery Center and 2) the impacts of the kiosks. Because the study focused on sub-sections of the larger EcoDiscovery Center, it was not an evaluation of the EcoDiscovery Center or the visitor experience within the EcoDiscovery Center as a whole. The sub-sections identified for data collection for the *Water's Journey* summative evaluation were 1) Otters at Play, Prehistoric Florida, and Water grouped together and 2) Storm Center. This study used a combination of visitor observation (timing and tracking) and structured interviews. See Appendix 1 for the detailed observation and interview protocols used in the contextual study.

Sampling and Recruitment: The non-probability sampling procedure Availability Sampling was used, whereby visitors will be selected from the target population on the basis of their availability, convenience, or self-selection. Using this method, museum visitors who appeared to be between 8 and 16 years old were selected by a researcher stationed near the entrance of the space.[3] This visitor became the "target" visitor for the observation (which was uncued) and the primary respondent for the interview. As the target visitor left the space, the data collector approached an adult in their group for permission to interview the target visitor. After explaining the purpose of the research, the voluntary nature of participation, obtaining consent from an adult with the child and assent from the child, and allowing visitors to ask questions about the study, the data collector began the interview. If permission was not obtained or if the visitor left the gallery without being interviewed, the observation of the visitor was retained, resulting in an observation without a matched interview.[4] On occasion, a child who had not been observed but who was in the same visiting group with the target was also interviewed, resulting in interviews that were not matched with an observation. See Appendix 1 for the detailed sampling and recruitment protocol used in the contextual study.

Observations: Researchers observed visitor interactions in two sub-sections of the EcoDiscovery Center where *Water's Journey* kiosks were installed. The observational method used was timing and tracking; a visitor was selected and unobtrusively followed throughout the sub-section, creating a description visitor usage and experience in the area and at all exhibits in the space. Measures used at the sub-section level included the time spent in the space and path taken through the space. Exhibit-based measures included stay time and engagement level at each exhibit a visitor stopped at, types of social interaction (child-to-child, child-to-adult, and child-to-staff) at each exhibit. Data collectors also made detailed observations of behaviors at all *Water's Journey* kiosks, including types of interactions with the kiosks, the content of social interactions, and any difficulties encountered while using the exhibit. Based on the data collector's observations, demographics of the visitor (i.e. sex and approximate age) were also recorded.

Interviews: Researchers conducted post-experience interviews with visitors who were observed in the exhibition space, with the goal of creating matched pairs of observations and interviews. The interviews

[3] The decision to expand the age range of visitors included in the study was made on the basis of the limited number of individuals aged 10 to 16 visiting with family groups.

[4] Although the primary focus of the study was children visiting in family groups, children visiting in school groups were also observed (n=6). These children were not interviewed due to issues of permission from the schools and parents.

included open-ended questions and Likert-style rating questions on visitor's attitudes, understanding, and knowledge gain resulting from visiting the sub-section of the EcoDiscovery Center and the *Water's Journey* kiosks specifically. Demographic questions were also asked, including age, grade in school, zip code, and group size and make-up. After being interviewed, the target visitor and other children in their group were given a MODS pencil as a thank you gift for participating in the interview.

Otters at Play, Prehistoric Florida, and Water Sub-Section Sample: A total of 50 visitors were tracked through the subsection of the EcoDiscovery Center that included Otters at Play, Prehistoric Florida, and Water; of these, 21 were interviewed. The sample was evenly split between males and females (Table 2). The average age of the target visitor for the observations and interviews was 11.9 years old (SD=2.5) and the average grade in school was 5th (SD=2.3). The majority of those interviewed (80%) lived in Florida, while the remaining lived in Colorado, Connecticut, New York, and Pennsylvania. The average group size was 4.4 people, and included relatively equal numbers of adults and children. Observations and interviews in this sub-section were completed on February 10-12 and 19-20, 2012 by Kara Hershorin, Karla Kitalong, and Susan Foutz. Ms. Hershorin and Ms. Foutz were ILI researchers, and Dr. Kitalong of the Michigan Technological University, was the researcher who supervised the front-end and formative evaluation of *Water's Journey*.

Table 2: Otters at Play, Prehistoric Florida, and Water Sub-Section Sample, Target Visitor Demographics

Sample Description	
Gender of Target (n=49)	
Male	49%
Female	51%
Mean Age of Target (n=48)	11.9 years
Mean Grade of Target (n=20)	5th grade
Live in Florida? (n=20)	80%
Mean Group Size (n=23)	4.4 people
Mean number of adults in group	2.1 adults
Mean number of children in group	2.3 children

Note: The target's history of visitation to MODS was not asked in the contextual study.

Storm Center Sub-Section Sample: A total of 31 visitors were tracked through the Storm Center sub-section of the EcoDiscovery Center; of these, 14 were interviewed. An additional 4 visitors who were not tracked were also interviewed as they exited Storm Center. The sample included more males than females (57% versus 43%) (Table 3). The average age of the target visitor for the observations and interviews was 10.7 years old (SD=1.9) and the average grade in school was 6th (SD=1.8). All of those interviewed (100%) lived in Florida. The average group size was 4.2 people, and included slightly more children than adults. Observations and interviews in the Storm Center were completed on February 18-20, 2012 by Susan Foutz.

Table 3: Storm Center Sub-Section Sample, Target Visitor Demographics

Sample Description	
Gender (n=35)	
Male	57%
Female	43%
Mean Age of Participant (n=35)	10.7 years
Mean Grade of Target (n=20)	6th grade
Live in Florida? (n=16)	100%
Mean Group Size (n=14)	4.2 people
Mean number of adults in group	1.9 adults
Mean number of children in group	2.4 children

Note: The target's history of visitation to MODS was not asked in the contextual study.

All data from the contextual study were entered into SPSS for analysis. Quantitative data from the interviews and observations were analyzed using descriptive and inferential statistics as appropriate. Standard measures for timing and tracking, including sweep rate index and percent of diligent visitors, were calculated. Qualitative data from the interviews were reviewed for emergent trends, coded into categories, and then quantified.

Kiosk-Based Study

The contextual study revealed that the pattern of usage of the *Water's Journey* kiosks was relatively low in terms of the data needed for the study design (See Findings). The visitation pattern observed within the space fit with the expectations of the project team. The *Water's Journey* exhibits were not intended to be landmark or iconic exhibits within the larger space but rather to provide depth and breadth to the experience, supporting the themes of the EcoDiscovery Center. However, the visitation pattern was problematic for the original evaluation design. Using the un-cued method the sample size at each *Water's Journey* kiosk was too low to perform the required analysis. As a result, ILI researchers determined that time constraints and the relatively low numbers of visitors in the target age range called for a change in methods. Switching to a cued observation method allowed for a larger sample than would occur through natural usage. Moving from un-cued observations and interviews to cued observations and interviews was used to focus visitors' attention specifically on the *Water's Journey* kiosks.

Two audiences were included in the kiosk-based study, visitors in the target age range (8 to 16 years old) and teen-aged volunteers at MODS. Cued observations and interviews were undertaken with museum visitors, and a modified focus group format was used to collect data from teen volunteers. See Appendix 2 for the observation, interview, and focus group protocols used in the kiosk-based study.

Visitor Sampling and Recruitment: The non-probability sampling procedure Availability Sampling was used, whereby visitors were selected from the target population on the basis of their availability, convenience, or self-selection. Using this method, family groups who appeared to have a child between 8 and 16 years old were selected by a researcher stationed near the *Water's Journey* kiosk being studied. The data collector approached an adult in the group, explained the purpose of the research and the voluntary nature of participation. After obtaining consent from an adult and assent from the child, and allowing visitors to ask questions about the study, the data collector proceeded with the interview

and observation. If permission was not obtained, the data collector encouraged the family to enjoy the museum.

Visitor Observations: The data collector directed visitors to the selected *Water's Journey* kiosk or set of related kiosks.[5] Visitors were asked to interact with the kiosk as they naturally would while the data collector stood within 1 to 3 feet taking notes. Parents and other group members were encouraged to participate in exploring the kiosk as well. The researcher selected one visitor between 8 and 16 years old to be the "target" for the observation; all observations were made based on the interactions and behaviors of the "target" visitor. Measures recorded by the data collector included stay time at the exhibit, types social interaction (child-to-child, child-to-adult, and child-to-staff) at each exhibit, content of social interaction, types of interactions with the exhibit, and any difficulties encountered while using the exhibit.

Visitor Interviews: Researchers conducted interviews with the target visitor who was observed at the *Water's Journey* kiosk and any other children in the study age range who also interacted with the kiosk. The interviews included open-ended questions and Likert-style rating questions on visitor's attitudes, understanding, and knowledge gain resulting from visiting *Water's Journey* kiosks specifically. Two rating questions were asked both before and after visitors' interaction with the kiosks, creating a pre-post for those items; the majority of the interview was conducted post-interaction with the kiosk. Demographic questions were also asked, including age, grade in school, zip code, and group size and make-up, and prior visitation to MODS. After being interviewed, the children in the group were given a MODS pencil as a thank you gift for participating in the interview.

Visitor Sample: A total of 99 cued observations and 126 interviews were conducted with visitors for the kiosk-based study (See Table 4). These observations and interviews included two individual kiosks (i.e. Human Encroachment and Invasive Species) and three related groups of kiosks (i.e. Core Samples, Florida Table, and Hurricanes). Due to time constraints on data collection and in consultation with the project's PI, visitor data was not collected on the Tree Island kiosk. Males and females were equally represented in the sample, and the majority (93%) were from Florida (Table 5). The average age of the visitors who participated in the interviews was 11.8 years old (SD=2.1) and the average grade in school was 6th (SD=2.1). Nearly three-quarters (73%) of those interviewed had been to MODS before and 52% had visited within the last 18 months. The average group size was 4 people, and included slightly more children than adults. Observations and interviews for the kiosk-based study were completed on March 10-12, March 15-17, and May 25-27, 2012 by Susan Foutz and Kara Hershorin.

[5] The following closely related kiosks were grouped together for the kiosk-based study: the kiosks grouped around the Florida Table (Hydrologic Cycle, Wet & Dry Seasons, Sheet Water Flow); the Core Sample kiosks (Land and Water); the Hurricanes kiosks (Storm and House). Visitors were strongly encouraged to interact at all kiosks in the group before being interviewed.

Table 4: Visitor Sample for the Kiosk-Based Study

Water's Journey Kiosk	Number of Observations	Number of Interviews
Core Samples (2 kiosks)	20	22
Florida Table (3 kiosks)	20	27
Human Encroachment	20	31
Hurricanes (2 kiosks)	22	26
Invasive Species	17	20
Study Total	**99**	**126**

Note: Tree Island was not included in the visitor portion of the kiosk-based study.

Table 5: Sample Demographics for Visitors in the Kiosk-Based Study*

Sample Description	
Gender (n=125)	
Male	50%
Female	50%
Live in Florida? (n=122)	93%
Mean Age of Participant (n=126)	11.8 years
Mean Grade of Target (n=125)	6th grade
Prior Visitation to MODS (n=124)	
Last visit was within the past 18 months	52%
Last visit was more than 18 months ago	21%
First visit to MODS	27%
Mean Group Size (n=95)	4.0 people
Mean number of adults in group	1.7 adults
Mean number of children in group	2.3 children

* Based on the interview demographics.

Teen Volunteer Sampling and Recruitment: Teens who were volunteers at MODS at the time of the kiosk-based study were eligible to participate in the study. Ciara Bostick, the MODS staff member responsible for scheduling teen volunteers, contacted teens who were scheduled to be on-site at MODS on a day the ILI researchers would be present. After explaining the nature of the focus group, the staff member asked the teen volunteer if they would be willing to arrive an hour before their shift starts to participate in the focus group. Teens who expressed an interest were sent a permission slip attached to a letter to their parents explaining the purpose of the study, the nature of the focus group, the voluntary nature of participation, that the focus group will be audio recorded, and with contact information for Museum and ILI staff. Only teens who returned a completed permission slip were able to participate in the focus group. See Appendix 3 for a copy of the permission slip and letter to parents.

Teen Volunteer Focus Groups: Focus groups were held before MODS opened on days teen volunteers were able to speak with ILI researchers. The focus groups began with introductions and an orientation to the focus group. The ILI staff member asked teens questions to provide background information (their age, how long they have volunteered at MODS, and their motivations for volunteering). The researcher then pointed out two or more kiosks or groups of related kiosks for the teens to interact with. Teens were then given 10 to 20 minutes to interact with the selected kiosks on their own or in pairs. As teens

interacted with the kiosks, the research was on-hand to answer questions, observe teen behaviors at the kiosks, and give time notices (i.e. "2 minutes left"). After teens interacted with the kiosks, the group reassembled for a conversation about the kiosks with a focus on appeal, impact, usability, intended audience, and recommendations for improvement (See Appendix 2 for the focus group protocol). The focus groups were audio recorded with permission of the teens and then transcribed in full for analysis.

Teen Volunteer Sample: A total of five focus groups were completed for the study with a total of 14 teens. The teen in the focus groups had been volunteers for MODS for anywhere from one week to two years at the time of the study. General reasons for volunteering included preparation for college applications and to accrue service hours for high school graduation; however, at least three teens had more than enough hours to fulfill the graduation requirement and continued to volunteer. Many teens had specific reasons for volunteering at MODS including an interest in a science-related career, knowing other teen volunteers, and a life-long love of the museum. The following list details the make-up of each focus group:

- Focus Group One: Four males; two were in 9th grade and were 15 years old, and two were in 10th grade and 16 years old. Conducted on March 10, 2012 by Susan Foutz.
- Focus Group Two: Two females; one was homeschooled and in 9th grade, the other was in 10th grade at a public school. Conducted on March 11, 2012 by Susan Foutz.
- Focus Group Three: A total of five teens, three males and two females. Four of the teens were 16 years old and in 10th grade; one teen was 15 years old and in 9th grade. Conducted on March 12, 2012 by Susan Foutz.
- Focus Group Four: Group Four: Two brothers, a 15 year old boy in 9th grade, and a 16 year old boy in 10th grade. Conducted on May 26, 2012 by Kara Hershorin.
- Focus Group Five: One 9th grade boy age 15. Conducted on May 27, 2012 by Kara Hershorin.

All data from the visitor sample of the kiosk-based study were entered into SPSS for analysis. The focus groups were transcribed in full by Verbal Ink, a professional transcription service. Quantitative data from the interviews and observations were analyzed using descriptive and inferential statistics as appropriate. Qualitative data from the interviews were reviewed for emergent trends, coded into categories, and then quantified. The focus group transcripts were reviewed for emergent trends.

Interviews with the Project Team

Interviews with members of the *Water's Journey* project team were conducted to inform the fields of informal science education and science museums by providing context to the evaluation results. These interviews focused on the goals and purpose of the project as it was originally conceived; the design process for the kiosks; the degree to which the team felt the project met its initial goals; and the impact of the project on the museum, the team, and the fields of informal science education and science museums (See Appendix 4 for the interview protocol).

A total of five individuals were interviewed from the project team, two with E2i/UCF and three with MODS. These individuals were identified as essential project personnel by the grant's PI and were recruited via email message by Susan Foutz. All participants understood that the purpose of the interviews was to add context to the evaluation findings and that quotations (identified by institutional affiliation only) would be used in the final evaluation report. Phone interviews were conducted by Susan Foutz on July 9-10, 2012; team members had not yet received the summative evaluation results at the time of the interviews. The interviews lasted approximately one hour each. Ms. Foutz took detailed notes throughout the interview, which served as the basis of the thematic analysis of the interviews.

Findings

The findings for the summative evaluation of *Water's Journey* are presented below organized into five overarching areas:

1) The project concept, purpose, and goals, drawing on interviews with the project team;

2) The *Water's Journey* exhibits contextualized within the MODS exhibition spaces, drawing on the contextual study with visitors;

3) The visitor experience at the individual kiosks that comprise the *Water's Journey* exhibits, drawing on the kiosk-based study with visitors and teen volunteers; and

4) The impact of the *Water's Journey* exhibits on the target audience, drawing on the kiosk-based study with visitors and teen volunteers and interviews with the project team.

5) The impact of the *Water's Journey* exhibits on the MODS' visitor experience and the fields of science centers and informal science education, drawing on the interviews with the project team and focus groups with teen volunteers.

Project Team's Reflections on the Project Concept, Purpose, and Goals

The members of the project team were asked to reflect on the concept, purpose, and goals of the *Water's Journey* project in one-on-one interviews with a member of the evaluation team. These conversations drew on team members' recollections of early stages of the project as seen through the lenses of a completed project.

The original concept for the *Water's Journey* project was multifaceted. The project was developed to incorporate technology into the museum that would be as appealing as the technology teens have access to in other aspects of their lives. However, the team felt strongly that the project would not be a case of including technology for the sake of technology:

> *I was very motivated through these exhibits and others in the new wing to help people understand the role of water and the role of the everglades in Florida and what is the science behind it, why should we care, and what do we need to do about it. I was concerned about raising awareness, where does our fresh water come from, and how does it all work? You hear from people, "Why should I care about the everglades. It is just a swamp." No. It filters all the water in Florida. So this was one way to work on those messages with a university partner, in a sophisticated way… It is not supposed to be about the computer or about technology-- it is there to support other information. (MODS staff member)*

Technology would be a vehicle to convey locally-based environmental messages in a way that would increase their relevance for teens. "I want a way to make the museum experience more relevant to the young adults that are our future," a UCF/E2i team member said. For members of both the MODS team and the UCF/E2i team, mixed or augmented reality was critical to the exhibit concept. For example, a museum team member said the project concept included "the notion of creating the new exhibit method of augmented reality and using that as a tool to deliver the messages in the EcoDiscovery Center…we want to deliver something that would be on par with what they use all the time, and use something just as cool to get the notions across."

For visitors, this experience would result in a museum-appropriate, visitor-friendly way "to understand complex ecology topics." The hope of the project team was that visitors would have a better understanding of the local issues facing Florida in terms of water's importance and the role of human development. In the long term, the inclusion of locally important topics could have community impacts, as seen in the following quotations:

> *The way I feel about the role of the museum is not to teach them facts about science, but to understand how things work, because that leads to the necessity of people to think about their lives and how they vote on community issues. (MODS staff member)*

> *One of my visions was sitting in a city council meeting in Fort Lauderdale ten years from when we started this [project] and some city council proposal was coming up for discussion. A high schooler would stand up and say, "I have gone to the museum many times, and have you seen that you can't add one more road or one more canal?" [For them to challenge] an official that didn't have their facts together. (UCF/E2i staff member)*

National Science Foundation funding was critical to achieving this vision. The grant funding supported the museum-university collaboration in a way that would not have been possible without the grant. "It wasn't going to happen any other way, and I can't see another source for funding the work that the UCF folks did," said a MODS team member. The project was an opportunity for the museum team to push the boundaries of their experience with collaboration, learning research, and emerging technology. Members of the museum staff also felt that partnering with the university and receiving NSF funding enhanced their organizational credibility.

The exhibit development process was described by all members of the project team as very collaborative. Regular phone meetings, in-person meetings, and remote product sharing were used to determine the content and format for the individual exhibit kiosks. A UCF/E2i staff member was pleased about the ability of the UCF/E2i team to stay flexible and open to the changes that are part-and-parcel of designing any exhibit: "When the museum came to us with the layout change [for the Hurricanes exhibit], I was like 'Great!' This is a natural part of the iteration that happens in a project like this. If we locked it in before, we would be stifling our partner."

For the fields of science centers and informal science education, the project team members thought that *Water's Journey* would have multiple benefits. It would push the boundaries of mixed or augmented reality and serve as a proof-of-concept: "If the augmented reality could work here then it could work all over the country, at other museums, [and be] a new method of interacting with exhibits in hands-on museums," reflected a MODS staff member. Team members also felt the project was a way to explore the personalization of the museum-going experience. For example, a UCF/E2i staff member thought including data-driven simulations supported the personalization of the exhibits: "The idea of being able to play with data is interesting. And more than that, I will play with the data differently than someone else will [based on my personal experience and knowledge]. So that brings a customizable experience, because everyone's unique individual brain brings something different to the experience." What the team would learn about creating unique, technology-driven exhibits would be a benefit to the fields of science museum and informal science education.

Water's Journey in the Context of the MODS Exhibition Areas

The contextual summative evaluation study for the *Water's Journey* project was conducted on the first floor of the EcoDiscovery Center in the following sub-sections: Otters at Play, Prehistoric Florida, Water, and Storm Center. These sub-sections and the Everglades Airboat Adventure comprise the permanent exhibitions on the first floor of the EcoDiscovery Center. Drawing on the data reported below, it is

possible to estimate the average time spent on the first floor of the EcoDiscovery Center for visitors in the target age range (8 to 16 years old) on the days data were collected. The estimated per-visit stay time on the first floor of the EcoDiscovery Center for visitors in the target age range is 22 minutes.[6] This estimate is for one visit to the first floor of EcoDiscovery Center for target-age group visitors during holidays. This estimate does not take into account multiple visits in one day, which is an important factor since data collectors observed visitors returning to the first floor of the EcoDiscovery Center throughout their time spent at the museum. It is also important to note that while 36% of target-age group visitors were observed entering the Everglades Airboat Adventure by the data collectors, MODS staff members' observations indicate that the vast majority of visitors to the EcoDiscovery Center enter the Everglades Airboat Adventure at some point during their museum stay. This experience, from entering the queuing area which is content rich, to participating in the introduction and the ride, takes a full 20 minutes.

Visitor Observations in the Otters at Play, Prehistoric Florida, and Water Sub-Section

Visitors in the target age range were observed in the Otters at Play, Prehistoric Florida, and Water sub-section of the EcoDiscovery Center to understand their behavior in the space in general, with a focus on the use of the *Water's Journey* kiosks within the context of the space. The findings are organized below by the path visitors took though the sub-section, stay time in the space and at specific exhibits, the number of stops, engagement with exhibits, and social interactions.

Path Analysis

Researchers recorded the path taken by target-age group visitors in order to determine how visitors move through the Otters at Play, Prehistoric Florida, and Water sub-section of the EcoDiscovery Center. The wide, open design staircase to the second floor of the EcoDiscovery Center is located in the center of the entrance to the new wing; half of the visitors entered this sub-section by the Storm Center (left side of the staircase) and the other half accessed the exhibition by the Florida Table (right side of the staircase). Those entering near the Storm Center tended to follow a clockwise path leading up towards the Giant Megalodon and over towards the Otter habitat. Visitors entering near the Florida Table typically followed a counter-clockwise path. There were visitors that followed no coherent path and bounced back and forth between exhibit elements.

Two major exhibit elements seemed to draw target-age group visitors' attention: Giant Megalodon and the otter habitat (See the section below on the number of stops per exhibit and attraction power). Researchers also observed that 36% of visitors visited the Everglades Airboat Adventure during the visit to the EcoDiscovery Center that was observed by data collectors.

[6] This was calculated by adding together 1) the median stay time for the Otters at Play, Prehistoric Florida, and Water sub-section (9 minutes), 2) the median stay time for the Storm Center sub-section (6 minutes), and 3) the mean length of the Everglades Airboat Adventure experience (7 minutes; assuming that each of the 18 visitors observed entering the Everglades Airboat Adventure spent 20 minutes and the remaining 32 spent no time at the Everglades Airboat Adventure during that visit).

Stay Time

Time spent by those observed in the target age-range at the Otters at Play, Prehistoric Florida, and Water sub-section ranged from 1 minute up to 23 minutes, with a median time of 9 minutes (Table 6). These findings are a reflection of the visitation patterns of target age-group visitors during the data collection period (which occurred primarily during holidays) and may not be reflective of visitation during non-holidays. Additionally, these findings do not take into account the interaction between this sub-section and other sub-sections of the EcoDiscovery Center or the rest of the museum. Anecdotally, data collectors observed family groups re-visiting this sub-section throughout their museum stay. If this trend is common then likely the average time spent of 9 minutes represents only one of multiple visits to the Otters at Play, Prehistoric Florida, and Water sub-section during the group's stay. If this is the case, the overall time spent in this sub-section for each target-age group visitor is likely higher than 9 minutes. It is also important to note that families with children younger than the target age-group (which was 8 to 16 years old) may spend more time in the space; however, younger children were not included in this study. Therefore, this data cannot be used to draw conclusion visitation habits of visitors in general.

One way to examine visitors' behaviors is to analyze how they responded to different types of exhibits. Out of the 50 total exhibit elements in this sub-section, researchers identified 25 components (objects, displays, live animals, and interactives), 18 interpretive text panels, and 7 kiosks designed by the University of Central Florida as part of the *Water's Journey* project. Researchers analyzed the patterns of use among these elements. When considering the *Water's Journey* kiosks in this sub-section as a group, the typical visitor spends little time at the *Water's Journey* kiosks. The median total time per visitor spent at all seven *Water's Journey* kiosks was 33 seconds. This can be compared to a median of 2 minutes, 57 seconds spent at the non-*Water's Journey* interactive components per visitor. Gender, age or day of week did not affect stay time in the exhibition as a whole. These factors also did not affect stay time at the various element types.

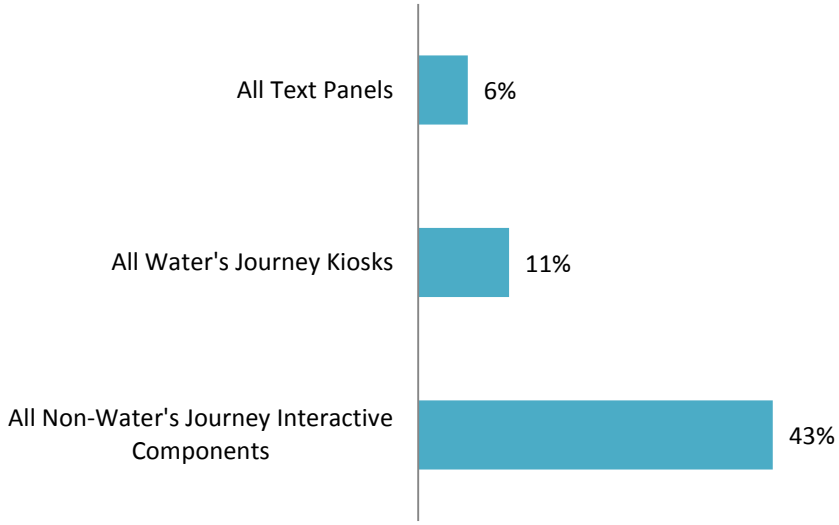
Table 6: Stay Time of Target Age-Group Visitors in the Otters at Play, Prehistoric Florida, and Water Sub-Section*

Element Type	n	Mean	Median	St. Dev.	Min	Max
Overall Exhibition	50	9 min 57 sec	9 min	5 min 21 sec	1 min	23 min
All Non-*Water's Journey* Interactive Components	50	4 min 2 sec	2 min 57 sec	2 min 59 sec	20 sec	9 min 50 sec
All *Water's Journey* Kiosks	26	1 min 13 sec	33 sec	1 min 39 sec	2 sec	7 min 22 sec
All Text Panels	7	1 min 12 sec	30 sec	1 min 51 sec	10 sec	5 min 22 sec

*The Everglades Airboat Adventure was not included in this sub-section; therefore, it is not included in this data.
Note: During data collection, the Core Sample: Land was not operating; thus, not available to visitors.

In proportion to the total time spent in the Otters at Play, Prehistoric Florida, and Water sub-section, target age-group visitors on average spend 11% of their total time visiting *Water's Journey* Kiosks (Figure 12). Visitors spend the most time at 3-dimensional objects, live animals, and interactives (not including the *Water's Journey* kiosks). Anecdotally, researchers observed that the rest of visitors' time (40%) was spent walking and glancing.

Figure 12: Percentage of Time Spent at Exhibit Types by Target Age-Group Visitors



Two metrics measure thorough use of an exhibition space: the Sweep Rate Index (SRI) and Diligent Visitor Index (%DV). The sweep rate index is calculated by dividing the exhibition's square footage by the average total time spent. Lower sweep rates indicate that visitors spent more time in an exhibition. The Diligent Visitor Index (%DV) measures the percentage of visitors who stop at more than half of the exhibit elements. Higher percentages of diligent visitors mean that more people were paying attention to more components, and fewer exhibit elements were being ignored, skipped, or missed. Based on data from numerous exhibitions, the average SRI is 432 and the average %DV is 26.[7]

As shown in Table 7, the Otters at Play, Prehistoric Florida, and Water sub-section had a Sweep Rate Index of 1000, higher than the typical museum exhibition, indicating that target age-group visitors to this sub-section spent a relatively a shorter duration of time per square foot of exhibition floor space. The Otters at Play, Prehistoric Florida, and Water sub-section's low %DV of 0% indicates that no target age-group visitor stopped at more than 50% of all elements. Even when text panels are removed from this calculation, the %DV is still 0%. These statistics show that visitors in the target age group spent a relatively short period of time in the exhibition on this particular visit and were only engaged with a small proportion of the exhibit elements during that visit.[8]

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[7] Serrell, B. (1998). Paying Attention: Visitors and Museum Exhibitions. [Professional Practice Series (Adams, R., Ed.)]. Washington, D.C.: American Association of Museums.

[8] Note that these findings do not take into account 1) the interaction between this sub-section and other sub-sections of the EcoDiscovery Center and/or the remainder of the museum, 2) repeated visits to sub-sections throughout the course of a family's museum stay, or 3) families with children younger than the target age-group (which was 8 to 16 years old). Therefore, this data cannot be used to draw conclusion on the visitation habits of visitors in general.

Table 7: Otters at Play, Prehistoric Florida, and Water Sub-Section Summary for Target Age-Group Visitors *

Measure	
Average time spent	9 min
Sweep Rate Index	1000
% Diligent Visitors	0
Square Feet	9,000
# Elements	50

*The Everglades Airboat Adventure was not included in this sub-section; therefore, it is not included in this data.

By way of further contextualization, researchers have studied visitors' use of similar exhibitions in several museums across the country. At *Swamp: Wonders of Our Wetlands* at the Chicago Zoological Society's Brookfield Zoo, the SRI computed for visitors was 804 with a %DV of 0% (Serrell, 1998). In the *Science in American Life*, a temporary exhibition that explored how science and technology have been the most profound agents of change in American life, visitors spent an average of 8 minutes, for an SRI of 750 and calculated %DV of 0% (Serrell, 1998). Key differences here are that both of these exhibitions are larger in scale (over 10,000 square feet) than the Otters at Play, Prehistoric Florida, and Water sub-section, and *Science in American Life* had fewer elements.

Number of Stops

In the Otters at Play, Prehistoric Florida, and Water sub-section, the number of elements visited per target age-group visitor ranged from 1 to 14 with a median of 4 elements. All visitors stopped at least one non-*Water's Journey* interactive component. Slightly more than half (52%) of the sample visited at least one of the 6 available *Water's Journey* kiosks,[9] and 14% stopped at least one of the interpretive text panels. As may be expected, the number of exhibits stopped at is significantly correlated with total time spent in the exhibition (Spearman's rho= 0.617, p=0.000); the longer visitors spent in the Otters at Play, Prehistoric Florida, and Water sub-section, the more elements they visited.

In analyzing the use of the seven *Water's Journey* kiosks in this sub-section, the number of exhibits visited per target age-group visitor ranged from 0 to 3, with a median of 1 stop at a *Water's Journey* Kiosk (Table 8).

[9] During data collection, Core Sample: Land was not operating; thus, not available to visitors.

Table 8: Number of Elements Target Age-Group Visitors Stopped at in the Otters at Play, Prehistoric Florida, and Water Sub-Section (n=50)

Element Type	Mean	Median	St. Dev.	Min	Max
Overall Exhibit	5	4	3.10	1	14
All Non-*Water's Journey* Interactive Components	4.02	3	2.57	1	10
All *Water's Journey* Kiosks	0.72	1	0.83	0	3
All Text Panels	0.26	0	0.83	0	5

Individual exhibits in the Otters at Play, Prehistoric Florida, and Water sub-section can be described in terms of their "attraction power" or the percent of visitors who stop at the exhibit element. Exhibits with higher percentages attract more visitors, regardless of how long the visitor stays. Table 9 shows the attraction power for the most-visited exhibit elements with the *Water's Journey* kiosks highlighted.

Table 9: Top Ten Exhibit Elements in terms of Attraction Power for Target Age-Group Visitors (n=50)*

Exhibit Element	n	% of visitors who stopped
Otter Habitat	42	84%
Giant Megalodon	22	44%
Big Animals! Big Portions! Scale	19	38%
Do a few drops make a difference?	14	28%
Otter pelt	13	26%
Pollution Spinning Out of Control	13	26%
Core Sample: Water	12	24%
Danger! Sea level changing! Ice Block	12	24%
Gator Country Game	10	20%
Human Encroachment	10	20%

*The Everglades Airboat Adventure was not included in this sub-section; therefore, it is not included in this data.
Note: During data collection, Core Sample: Land was not operating; thus, not available to visitors.

Of the *Water's Journey* kiosks, the Core Sample: Water interactive was the most popular with Target Age-Group Visitors. Roughly, one quarter of target age-group visitors stopped at this kiosk. Human Encroachment was the second most visited *Water's Journey* kiosk, with 21% of visitors stopping. This was followed by the Hydrologic Cycle (12%) and Tree Island (8%). Only two visitors were observed stopping at the Wet & Dry Season and Sheet Water Flow kiosks.

Holding power refers to the amount of time visitors spend examining an exhibit. Table 10 shows where target age-group visitors spent the most time with the *Water's Journey* kiosks highlighted.[10] Live animals

[10] Only those elements with three or more recorded visitor stops were included in this analysis.

and computer interactives seem to hold visitors attention. Of the *Water's Journey* kiosks, the Hydrologic Cycle has a high holding power. Visitors spend on average 53 seconds at this interactive.

Table 10: Top Ten Exhibit Elements in terms of Holding Power for Target Age-Group Visitors *

Exhibit Element	n	Mean	Median	St. Dev.	Min	Max
Otter Habitat	40	2 min	1 min 38 sec	1 min 40 sec	5 sec	5 min 59 sec
Predator Tracker kiosk	3	1 min 45 sec	26 sec	1 min 34 sec	6 sec	4 min 43 sec
Prehistoric Quiz	8	1 min 39 sec	1 min 23 sec	1 min 13 sec	20 sec	3 min 49 sec
Animated Florida	8	1 min 26 sec	1 min 15 sec	1 min 9 sec	8 sec	3 min 26 sec
Gator Country Game	10	1 min 12 sec	1 min 13 sec	46 sec	10 sec	2 min 30 sec
FIU Scientist Movie	3	1 min 9 sec	1 min 15 sec	1 min 3 sec	3 sec	2 min 9 sec
Water: A Limited Resource	5	1 min 6 sec	25 sec	1 min 31 sec	9 sec	3 min 45 sec
Tree Island Video	3	1 min 5 sec	54 sec	51 sec	20 sec	2 min
Hydrologic Cycle	6	53 sec	47 sec	42 sec	15 sec	2 min 8 sec
Giant Megalodon	21	46 sec	36 sec	35 sec	5 sec	2 min 26 sec

*The Everglades Airboat Adventure was not included in this sub-section; therefore, it is not included in this data.
Note: During data collection, Core Sample: Land was not operating; thus, not available to visitors.

Engagement with Interactive Experiences or Materials

Although the amount of time spent, and number of stops at exhibit elements can be a useful indicator of visitors' use of a gallery, it often inadequately reflects the quality of the visitors' experience. Thus, researchers used a quality ranking scale developed to assess the quality of interactions that visitors have at specific exhibition elements (excluding interpretive text panels). The following scale was used to determine the target visitor's level of engagement with a particular element: 1=Minimal/Glance, 2=Cursory/Superficial, 3=Moderate, and 4=Extensive (See Appendix 1 for a detailed description of the engagement scale).

Using this scale, the mean exhibit engagement score was 2.11 or Cursory/Superficial for target age-group visitors. *Water's Journey* kiosks elicit similar engagement levels to other elements in the Otters at Play, Prehistoric Florida, and Water sub-section (Table 11). There is no significant median difference between engagement levels at Water's Journey kiosks and components (Wilcoxon Signed Ranks, Z=-6.19, p=0.536); although we might expect visitors to have a different kind of interaction with the *Water's Journey* kiosks, this was not the case.

Table 11: Average Engagement by Element Type in Otters at Play, Prehistoric Florida, and Water Sub-Section for Target Age-Group Visitors (n=50)

Elements	Mean	Median	St. Dev.	Min	Max
Overall Exhibit	2.11	2	0.73	1	4
Non-*Water's Journey* Interactive Components	2.16	2	0.82	1	4
Water's Journey Kiosks	2.13	2	0.74	1	3.5

Using the same engagement scale to look at each exhibit reveals that only two exhibits in Otters at Play, Prehistoric Florida, and Water sub-section had engagement scores above 2.5, the Prehistoric Quiz and Water: A Limited Resource (Table 12).[11] Of the Water's Journey exhibits, the Hydrologic Cycle had the highest mean engagement score (mean=2.33) and the third highest score overall. Core Sample: Water and Tree Island were also among the top ten exhibits with the highest engagement scores in the sub-section.

Table 12: Top Ten Exhibit Elements in terms of Engagement for Target Age-Group Visitors *

Element Type	n	Mean	Median	St. Dev.	Min	Max
Prehistoric Quiz	8	2.63	2.00	1.188	1	4
Water: A Limited Resource	5	2.60	3.00	1.517	1	4
Hydrologic Cycle	6	2.33	2.50	0.816	1	3
Danger! Sea level changing! Ice Block	11	2.27	2.00	1.348	1	4
Otter Habitat	39	2.26	2.00	1.044	1	4
Animated Florida	8	2.13	2.00	1.246	1	4
Gator Country Game	10	2.10	2.00	0.994	1	4
Core Sample: Water	10	2.10	2.00	0.876	1	4
Tree Island	4	2.00	2.00	0.816	1	3
Big Animals! Big Portions! Scale	19	1.89	2.00	0.751	1	3

*Only those elements with three or more recorded visitor stops were included in this analysis. The Everglades Airboat Adventure was not included in this sub-section; therefore, it is not included in this data.

[11] Only those elements with three or more recorded visitor stops were included in this analysis.

Social Interactions

Data collectors recorded instances where an individual was overheard talking to a member of their group about a particular aspect of an experience, was collaborating with someone else to use an interpretive space or material, or was pointing out something to another visitor. Of all the unique visitor stops, a social interaction occurred at over half. Overall, target age-group visitors appear to be sharing information in the Otters at Play, Prehistoric Florida, and Water sub-section (Table 13). A little over half of the social interactions occurred between the target visitor and an adult in the visiting group. Other interactions occurred between two children. There were no examples of staff interactions observed during this study.

There is a relationship between time spent in the Otters at Play, Prehistoric Florida, and Water sub-section and the number of social interactions. The longer a target age-group visitor spends in the gallery, the more likely social interactions are to occur (Spearman's rho=0.467, p = 0.004). No significant difference emerged when comparing social interactions between gender, day of the week, or age.

Table 13: Frequency of Target Age-Group Visitors' Social Interactions in Otters at Play, Prehistoric Florida, and Water Sub-Section

Social Interaction	n	Percent
Social interaction occurred	112	52%
Target and adult interaction	62	55%
Target and child interaction	50	45%
No social interaction	105	48%

Target age-group visitors engaged in social interactions at the *Water's Journey* kiosks, but at somewhat lower rates. Just over one-third of target age-group visitors had a social interaction while visiting a *Water's Journey* kiosk (Table 14).

Table 14: Frequency of Target Age-Group Visitors' Social Interactions at *Water's Journey* Kiosks in the Otters at Play, Prehistoric Florida, and Water Sub-Section

Social Interaction	n	Percent
Social interaction occurred	13	39%
Target and adult interaction	5	46%
Target and child interaction	6	55%
No social interaction	20	61%

When looking at the social interactions at the individual exhibits, many elements in the Otters at Play, Prehistoric Florida, and Water sub-section were successful in creating social interaction. The saber tooth jaw was most likely to create social interaction; all target age-group visitors who stopped at the element

had a social interaction (Table 15).[12] Overall, twelve exhibits in the Otters at Play, Prehistoric Florida, and Water sub-section encouraged social interactions for 50% or more of those who visited.

Table 15: Top Twelve Exhibit Elements in terms of Target Age-Group Visitors' Social Interaction*

Exhibit Element	Number who stopped	% of those who stopped who had a social interaction
Saber tooth jaw	7	100%
Dig Pit	4	75%
Giant Mastodon	3	67%
Predator Tracker kiosk	3	67%
Otter Habitat	42	57%
Otter Pelt	13	54%
Big Animals! Big Portions! Scale	19	53%
Do a Few Drops Make a Difference?	14	50%
Danger! Sea Level Changing! Ice Block	12	50%
Gator Country Game	10	50%
Hydrologic Cycle	6	50%
Tree Island	4	50%

*The Everglades Airboat Adventure was not included in this sub-section; therefore, it is not included in this data.

Summary of Otters at Play, Prehistoric Florida, and Water Sub-Section Observations

The observations of visitors in the Otters at Play, Prehistoric Florida, and Water sub-section revealed that the *Water's Journey* kiosks were not heavily used by children in the target age range who visited in family groups. However, this finding was not limited to the *Water's Journey* kiosks alone; the Diligent Visitor Index (%DV=0%) indicates that the exhibit elements in the gallery were not heavily used. In interpreting the attraction power analysis of the various exhibit elements, it appears that the iconic exhibits in the gallery—the river otters and the giant megalodon—are indeed drawing visitors through the gallery and are successfully attracting their attention. The river otters also have the highest holding power of any exhibit element in the gallery. The power of "attractive, landmark objects" has been

[12] Only those elements with three or more recorded visitor stops were included in this analysis.

supported previous visitor studies.[13] It is important to note that two *Water's Journey* kiosks were in the top ten exhibits in terms of attraction power (Core Sample: Water and Human Encroachment) and the Hydrologic Cycle kiosk was among the top ten exhibits in terms of holding power.

When considering engagement with the exhibits themselves, the *Water's Journey* kiosks had levels of engagement comparable to other exhibit elements. Three *Water's Journey* kiosks (Hydrologic Cycle, Core Sample: Water, and Tree Island) had engagement ratings in the top ten of all exhibit elements in the sub-section. However, in terms of social interaction at particular exhibits, the *Water's Journey* kiosks had slightly lower rates of social engagement as compared to other interactive exhibits in the sub-section. This finding is not surprising, however, as the majority of the *Water's Journey* touchscreens in the Otters at Play, Prehistoric Florida, and Water sub-section are of a size that suggests a one person interaction. However, two of the *Water's Journey* kiosks (Hydrologic Cycle and Tree Island) were in the top twelve exhibit elements in terms of social interaction.

The implications of the Otters at Play, Prehistoric Florida, and Water sub-section observations for this study dictated a change in methods. Because of the relatively low attraction power of the *Water's Journey* kiosks, a cued visitor study was required to gather data specific to visitor usage of these kiosks and kiosk impact. This was due to the logistical and time constraints of collecting data in a naturalistic (i.e. un-cued) manner.

Visitor Observations of the Storm Center Sub-Section

Target age-group Visitors were observed in the Storm Center sub-section of the EcoDiscovery Center to understand their behavior in the sub-section in general, with a focus on the use of the *Water's Journey* kiosks within the context of the space. The findings are organized below by the path visitors took though the sub-section, stay time in the sub-section and at specific exhibits, the number of stops, engagement with exhibits, and social interactions.

Path Analysis

Researchers recorded the path taken by target age-group visitors through the Storm Center sub-section in order to determine how visitors move through the Storm Center. The majority of target age-group visitors (61%) entered Storm Center from Go Green, while the rest (39%) entered from the central area of the EcoDiscovery Center. Most visitors entered through one entrance and exited through the other (81%); a few entered and exited through the same passage(19%). As a result, the most common combination was to enter from Go Green and exit toward the other EcoDiscovery Center exhibits (17 of 31 visitors). The second most common was to enter from the central EcoDiscovery Center and exit at Go Green (8 of 31 visitors).

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[13] Bitgood, S., Hines, J., Hamberger, W., & Ford, W. (1992). Visitor circulation through a changing exhibits gallery. In A. Benefield, S. Bitgood, & H. Shettel (Eds.), *Visitor Studies: Theory, Research, and Practice, Vol. 4*. (pp. 102–114). Jacksonville, AL: Center for Social Design.

Parsons, M., & Loomis, R. (1973). *Visitor Traffic Patterns: Then and Now*. Washington, DC: Office of Museum Programs, Smithsonian Institution.

Weiss, R., & Boutourline, S. (1963). The communication value of exhibits. *Museum News* (Nov.): 23–27.

Visitors' paths while in Storm Center were categorized into "Systematic" and "Unsystematic." A systematic path through the area appeared to be linear, orderly, or methodical. An unsystematic path through the area seemed to follow no coherent path. This is not to imply that the visitor taking an "unsystematic" path did not have a reason for doing so, only that to the researcher (or outside observer) the path appeared to be arbitrary or random. Using this method 74% of target age-group visitors followed a systematic path and 26% followed an unsystematic path. Visitors taking either type of path could revisit an exhibit multiple times. The tracking data were analyzed to determine the number of visitors who visited two or more exhibits multiple times during their time in Storm Center; 52% revisited two or more exhibits during their path through the sub-section.

Stay Time

Time spent at the Storm Center ranged from 1 minute up to 22 minutes, with a median time of 6 minutes (Table 16).). It is important to note that these findings are a reflection of the visitation patterns for of target age-group visitors during the data collection period (which occurred primarily during holidays) and may not be reflective of visitation during non-holidays. Additionally, these findings do not take into account the interaction between this sub-section and other sub-sections of the EcoDiscovery Center or the rest of the museum. Anecdotally, data collectors observed family groups re-visiting this sub-section throughout their museum stay. If this trend is common then likely the median time spent of 6 minutes represents only one of multiple visits to the Storm Center sub-section during the group's stay. If this is the case, the overall time spent in this sub-section for each visitor is likely higher than 9 minutes. It is also important to note that families with children younger than the target age-group (which was 8 to 16 years old) may spend more time in the space; however, younger children were not included in this study. Therefore, this data cannot be used to draw conclusion visitation habits of visitors in general.

Another way to examine visitors' behaviors is to analyze how they responded to different types of exhibits. Out of the 21 total exhibit elements in Storm Center, researchers identified 10 components (objects, displays, and interactives), 9 interpretive text panels, and 2 kiosks designed by UCF as part of the *Water's Journey* project.[14] Researchers analyzed the patterns of use among these elements. When considering the *Water's Journey* kiosks in the Storm Center as a group, the typical target age-group visitor spent 2 minutes, 22 seconds (median time) at the *Water's Journey* kiosks. This can be compared to a median of 4 minutes, 20 seconds spent at all interactive components per visitor. Gender, age or day of week did not affect stay time in the sub-section as a whole. These factors also did not affect stay time at the various element types.

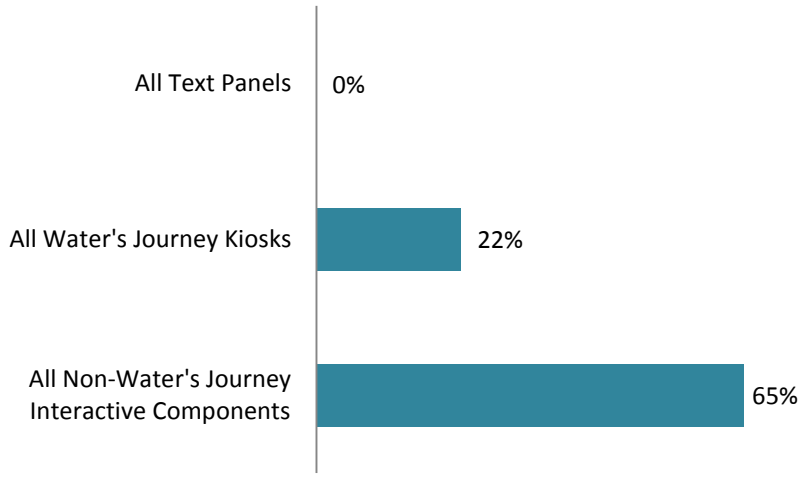
[14] Interpretive text panels were excluded from the analysis of Storm Center. Only one visitor was observed reading a text panel, which occurred while they were interacting with the Plasma Ball. Therefore, the time spent was included in their time for that exhibit.

Table 16: Stay Time for Target Age-Group Visitors in the Storm Center Sub-Section

Element Type	n	Mean	Median	St. Dev.	Min	Max
Overall Exhibition	30	7 min 10 sec	6 min	4 min 44 sec	1 min	22 min
All Non-*Water's Journey* Interactive Components	31	4 min 44 sec	4 min 20 sec	3 min 16 sec	20 sec	16 min 31 sec
All *Water's Journey* Kiosks	9	2 min 17 sec	2 min 22 sec	1 min 30 sec	5 sec	4 min 32 sec

In proportion to the total time spent in Storm Center, target age-group visitors on average spend 22% of their total time in the sub-section visiting *Water's Journey* Kiosks (Figure 13). Visitors spend the most time at 3-dimensional objects and interactives (not including the *Water's Journey* kiosks). Anecdotally, researchers observed that the rest of visitors' time (13% total) was spent walking, glancing, and waiting to use popular exhibits.

Figure 13: Percentage of Time Spent at Exhibit Types for Target Age-Group Visitors



Two metrics measure thorough use of an exhibition: the Sweep Rate Index (SRI) and Diligent Visitor Index (%DV). The sweep rate index is calculated by dividing the exhibition's square footage by the average total time spent. Lower sweep rates indicate that visitors spent more time in an exhibition. The Diligent Visitor Index (%DV) measures the percentage of visitors who stop at more than half of the exhibit elements. Higher percentages of diligent visitors mean that more people were paying attention to more components, and fewer exhibit elements were being ignored, skipped, or missed. Based on data from numerous exhibitions, the average SRI is 432 and the average %DV is 26 (Serrell 1998).

As shown in Table 17, the Storm Center had a SRI of 533, indicating that target age-group visitors' time spent was only slightly less than would be expected in the average exhibition. The Storm Center low %DV of 0% indicates that no visitor stopped at more than 50% of all elements. However, when text panels are removed from this calculation, the %DV is 39%.

Table 17: Storm Center Sub-Section Summary for Target Age-Group Visitors

Measure	
Average time spent	6 min
Sweep Rate Index	533
% Diligent Visitors	0%*
Square Feet	3,200
# Elements	21

*%DV is 39% when text panels are removed from the calculation.

Number of Stops

In the Storm Center sub-section, the number of elements visited per target age-group visitor ranged from 1 to 9 with a median of 5 elements (Table 18). All target age-group visitors stopped at least one interactive component. More than a quarter (29%) of the sample visited at least one of the *Water's Journey* kiosks. Only one visitor was observed reading a text panel. As may be expected, the number of exhibits stopped at is significantly correlated with total time spent in the exhibition (Spearman's rho=0.815, p<.000); the longer visitors spent in the Storm Center, the more elements they visited.

Table 18: Number of Elements Visitors Stop at in the Storm Center Sub-Section for Target Age-Group Visitors

Element Type	Mean	Median	St. Dev.	Min	Max
Overall Exhibit	5.10	5	1.94	1	9
All Non-*Water's Journey* Interactive Components	4.77	5	1.78	1	8
All *Water's Journey* Kiosks	0.29	0	0.46	0	1

Individual exhibits in the Storm Center can be described in terms of their "attraction power" or the percent of visitors who stop at the exhibit element. Exhibits with higher percentages attract more visitors, regardless of how long the visitor stays. Table 19 shows the attraction power for the most-visited exhibit elements.

Table 19: Top Five Exhibit Elements in terms of Attraction Power for Target Age-Group Visitors (n=31)

Exhibit Element	n	Percent
Cloud Rings	26	84%
Plasma Ball/ The Lightning State	25	81%
Hurricane Force Winds	24	77%
Focused Destruction: Tornado	18	58%
Storm Center 7 Weather Station	18	58%

Of the two *Water's Journey* kiosks, Hurricanes: Storm was visited by 19% of those observed and Hurricanes: House was visited by 10% of the visitors to Storm Center. It is important to note that one reason relatively few visitors to Storm Center experienced a *Water's Journey* kiosk was that the exhibits were often in use by other visitors. This was in part due to the high holding power for the *Water's Journey* Kiosks (See Table 20 below).

Holding power refers to the amount of time visitors spend examining an exhibit. Table 20 shows where target age-group visitors spent the most time.[15] Tell Your Hurricane Story had the most holding power, with visitors spending on average 2 minutes and 37 seconds. However, most of those observed recording videos at Tell Your Hurricane Story were not telling hurricane stories and were instead talking about other topics. Both of the *Water's Journey* kiosks had average stay times of over 2 minutes.

Table 20: Top Five Exhibit Elements in terms of Holding Power for Target Age-Group Visitors (n=31)

Exhibit Element	n	Mean	Median	St. Dev.	Min	Max
Tell Your Hurricane Story	4	2 min 37 sec	19 sec	4 min 44 sec	6 sec	9 min 43 sec
Hurricanes: Storm	6	2 min 19 sec	2 min 21 sec	1 min 43 sec	5 sec	4 min 32 sec
Hurricanes: House	3	2 min 15 sec	2 min 22 sec	1 min 16 sec	56 sec	3 min 27 sec
Storm Center 7 Weather Station	18	1 min 48 sec	1 min 20 sec	1 min 16 sec	5 sec	4 min
Hurricane Force Winds	23	1 min 15 sec	1 min 11 sec	31 sec	S9 sec	2 min 16 sec

Engagement with Interactive Experiences or Materials

Although the amount of time spent and number of stops at exhibit elements can be a useful indicator of visitors' use of an exhibition space, it often inadequately reflects the quality of the visitors' experience. Thus, researchers used a quality ranking scale developed to assess the quality of interactions that visitors have at specific exhibition elements (excluding interpretive text panels). The following scale was

[15] Only those elements with three or more recorded visitor stops were included in this analysis.

used to determine the target visitor's level of engagement with a particular element: 1=Minimal/Glance, 2=Cursory/Superficial, 3=Moderate, and 4=Extensive (see Appendix 1 for a detailed description of the engagement scale).

Water's Journey kiosks elicit similar engagement levels to other elements in the EcoDiscovery Center (Table 21). There is no significant median difference between engagement levels at *Water's Journey* kiosks and components (Wilcoxon Signed Ranks, Z=-.352, p=0.725). Although we might expect visitors to have a different kind of interaction with the *Water's Journey* kiosks, this was not the case.

Table 21: Average Engagement by Element Type in Storm Center Sub-Section for Target Age-Group Visitors

Elements	Mean	Median	St. Dev.	Min	Max
Overall Exhibit	2.70	2.6	0.49	2	3.75
Non-*Water's Journey* Interactive Components	2.70	2.8	0.51	2	4
Water's Journey Kiosks	2.78	3	1.20	1	4

When considering each exhibit individually, however, the Water's Journey kiosks in Storm Center are among those with the highest engagement levels (Table 22).[16] Hurricanes: House had the highest engagement level of all Storm Center exhibits with a mean of 3.7; Hurricanes: Storm had the sixth highest overall engagement score with a mean of 2.3.

Table 22: Top Six Exhibit Elements in terms of Engagement of Target Age-Group Visitors (n=31)

Exhibit Element	n	Mean	Median	St. Dev.	Min	Max
Hurricanes: House	3	3.7	4	.58	3	4
Hurricane Force Winds	24	3.5	4	.66	2	4
Storm Center 7 Weather Station	18	3.2	3.5	1.0	1	4
Cloud Rings	26	2.9	3	.91	1	4
Plasma Ball/The Lightening State	25	2.8	3	.89	1	4
Hurricanes: Storm	6	2.3	2.5	1.2	1	4

[16] Only those elements with three or more recorded visitor stops were included in this analysis.

Social Interactions

Data collectors recorded instances where an individual was overheard talking to a member of their group about a particular aspect of an experience, was collaborating with someone else to use an interpretive space or material, or was pointing out something to another visitor. Of all the unique visitor stops, a social interaction occurred at more than three-fourths (78%) of all stops (Table 23). The most common type of social interaction observed was between the target visitor and another child (i.e. under 18 years old); 66% of all stops with a social interaction included this type of interaction.

There is a relationship between time spent at the Storm Center and the number of social interactions. The longer visitors spend in the sub-section, the more likely social interactions are to occur (Spearman's rho=0.737, p<.000). No significant difference emerged when comparing social interactions between gender, day of the week, or age.

Table 23: Frequency of Target Age-Group Visitors' Social Interactions in Storm Center Sub-Section *

Social Interaction	N	Percent
Social interaction occurred	123	78%
Target and child interaction	81	66%
Target and adult interaction	75	61%
Target and staff member	5	4%
No social interaction	34	22%

* Multiple types of social interactions observed per stop; percentages within "social interaction occurred" total more than 100%.

When looking at the social interactions at the individual exhibits, many elements in the Storm Center were successful in creating social interaction. At two exhibits, Hurricane Force Winds and Hurricanes: House, every target age-group visitor who stopped was observed to have a social interaction (Table 24).[17] At the other *Water's Journey* Kiosk, Hurricanes: Storm, 67% of those who stopped had a social interaction. In fact, at all interactive components in the Storm Center, 50% or more of those who stopped had a social interaction with another visitor.

[17] Only those elements with three or more recorded visitor stops were included in this analysis.

Table 24: Top Five Exhibit Elements in terms of Target Age-Group Visitors' Social Interaction (n=31)

Exhibit Element	Number who stopped	% of those who stopped who had a social interaction
Hurricane Force Winds	24	100%
Hurricanes: House	3	100%
Magic Planet	10	90%
Cloud Rings	26	88%
Storm Center 7 Weather Station	18	78%

Summary of Storm Center Sub-Section Observations

The observations of target age-group visitors in the Storm Center sub-section revealed that the exhibit elements were in generally heavily used and supported social interactions. In this context, the *Water's Journey* kiosks were relatively heavily used by children in the target age range who visited in family groups. The Hurricanes interactives were typically busy and had higher holding power than all other exhibits in the area, with the exception of the Tell Your Hurricane Story kiosk. Visitors who stopped at either the Storm or House kiosk spent on average more than 2 minutes at the exhibit in an area where the median stay time was 6 minutes. The Hurricanes kiosks had engagement rates similar to the other exhibit elements in Storm Center, with both kiosks among the top six in terms of visitor engagement. The Storm Center exhibits in general were successful at supporting social interactions between visitors, and Hurricanes: House interactive was particularly successful, with 100% of visitors who engaged with the exhibit having a social interaction.

Target Age-Group Visitor Interviews in the Otters at Play, Prehistoric Florida, and Water Sub-Section and Storm Center Sub-Section

Target age-group visitors who were interviewed after being observed in the EcoDiscovery Center were asked two open-ended questions about the sub-sections they were observed in: 1) what "the most interesting part" of the space was for them and 2) to complete the sentence, "I never realized that…" when thinking about everything they saw in the sub-section.[18] The total number of target age-group visitors interviewed in each sub-section was relatively small: 21 for the Otters at Play, Prehistoric Florida, and Water sub-section and 14 for the Storm Center sub-section.

For the Otters at Play, Prehistoric Florida, and Water sub-section, the exhibit that was most frequently mentioned as "most interesting" was the otters, named by 56% (n=10) of those interviewed. Visitors in the target age-rage either thought the otters were "cute" or liked watching the otters play. For example, a 12 year old boy liked the otters because of "how they played in the water, how they attacked each

[18] Visitors who stopped at *Water's Journey* kiosks also were asked questions related to those specific exhibits. However, this data was not analyzed due to the extremely small sample size at each kiosk.

other." The second most frequently mentioned exhibit was the megalodon, named by 39% (n=7). Visitors were interested in its size and that it was interactive; one 11 year old girl liked that you could "go inside shark mouth, go inside [to play]." The other exhibits in Otters at Play, Prehistoric Florida, and Water sub-section were named by two or less individuals.

When asked what they had never realized, target age-group visitors to the Otters at Play, Prehistoric Florida, and Water sub-section reported new learning relative to the overall size of a species (35%, n=7) or other physical features of a species (25%, n=5). Typically, these visitors were referring to the megalodon or the otters when referring to learning something about a species' physical characteristics. For example, a 16 year old male never realized "that otters were that big. I was expecting them to be the size of a cat." Two target age-group visitors reported learning something about the behavior of species in the center, like the 13 year old boy who learned that "megalodons ate so much. It said that it ate 18 times [its] weight every day." Other visitors reported learning that the MODS expansion itself existed or which individual exhibits it contained (23%, n=5).

For the Storm Center sub-section, the exhibit that was most frequently mentioned as "most interesting" was the wind tunnel that simulated a hurricane, named by 55% (n=10) of those interviewed. For many target age-group visitors, their reason for finding this exhibit interesting was that it was fun ("It made your hair all funny"), experiential ("cool to actually feel it"), and realistic ("simulates what a small hurricane is like"). The second most frequently mentioned exhibit was the cloud exhibit which created rings, named by 17% (n=3). Target age-group visitors were generally interested in the look of the rings and the interactive nature of the exhibit. The other exhibits in Storm Center were named by two or less individuals.

When asked what they had never realized, the most common new learning was about the strength or force of hurricane winds (47%, n=7). For example, a 16 year old male never knew that "hurricanes have winds that can be that strong." Other areas of new learning were less frequently mentioned. Two visitors reported learning about how a tornado forms ("tornadoes need hot air."). Two visitors reported learning which individual exhibits Storm Center contained. Additionally, two visitors learned about the damage a hurricane or hail could do ("hurricanes were so dangerous [and that] the wind can do so much damage"; "hail could be that destructive").

Target age-group visitors who were interviewed after being observed in these spaces also were asked to rate statements on the intended impacts for the *Water's Journey* exhibits. Although these sub-sections and the non-*Water's Journey* exhibits were not specifically designed to support the same impacts as *Water's Journey*, the statements were analyzed at the sub-section level to provide possible insights into the impacts for the sub-section.[19]

When looking at the statements in order of highest to lowest mean rating, the order of statements is virtually identical across the two sub-sections. Statements focused on the personal relevance of science were the highest rated in both sub-sections. The statement *Helped me to feel more confident about my ability to understand science* was the rated highest by Storm Center visitors (mean=4.7 out of 5); this statement was tied with *Helped me to make connections between science and my everyday life* as the

[19] The statements were not originally intended to be used to make a determination about the sub-section; the original study design was to compare the ratings of visitors who had used *Water's Journey* exhibits with those who had not. However, the relatively low usage rates for the *Water's Journey* exhibits made collecting the sample size needed for this comparison unfeasible.

highest rated statement for the Otters at Play, Prehistoric Florida, and Water sub-section (mean=4.0 for both statements) (Table 25). Similarly, *Helped me to think about the connection between the past and the present* was the lowest rated statement for Storm Center (mean=2.8) and the second lowest for the Otters at Play, Prehistoric Florida, and Water sub-section (mean=3.2). The consistently lower rating of this statement makes sense in that the past-present connection was not emphasized in Storm Center and was not made explicit in many of the exhibits in the Otters at Play, Prehistoric Florida, and Water sub-section.

Table 25: Impact Ratings of Target Age-Group Visitors for the EcoDiscovery Center Sub-Sections Included in the Evaluation*

Impact Statements: *Visiting this area of the museum…*	**Storm Center Sub-Section (n=17)**		**Otters at Play, Prehistoric Florida, and Water Sub-Section (n=21)**	
	Mean	**SD**	**Mean**	**SD**
Helped me to feel more confident about my ability to understand science.	4.7	.606	4.0	1.284
Helped me to make connections between science and my everyday life.	4.2	1.091	4.0	1.244
Helped me to think about how water impacts the environment.	4.2	.903	3.8	1.411
Helped me to think about changes in the environment that happen over time.	4.1	.857	3.3	1.528
Made me more interested in [the Everglades/Florida's Environment] than I was before.**	4.0	.500	3.1	1.179
Helped me to think about the connection between the past and the present.	2.8	1.348	3.2	1.300

* Scale: 1=Not at all to 5=Very much. Based on the visitor interviews from the contextual study.
** Different phrasing for each area; "the Everglades" was used for the Otters at Play, Prehistoric Florida, and Water sub-section statement and "Florida's environment" for the Storm Center sub-section statement.

There were statistically significant differences in how target age-group visitors to the sub-sections rated one of the six statements; *Made me more interested in [the Everglades/Florida's Environment] than I was before* was rated significantly higher for Storm Center sub-section than for the Otters at Play, Prehistoric Florida, and Water sub-section (Mann-Whitney U=96.500, Z=-2.619, $p<.05$). However, this difference could have resulted from the different wordings of the statement used in each sub-section. There were no significant differences in ratings between males and females or on the basis of visitors' age.

Summary of Target Age-Group Visitor Interviews at the Otters at Play, Prehistoric Florida, and Water Sub-Section and Storm Center Sub-Section

The target age-group visitor interviews conducted in the Otters at Play, Prehistoric Florida, and Water sub-section and Storm Center sub-sections supported the observation findings. In the Otters at Play, Prehistoric Florida, and Water sub-section, visitors named the otters and the giant megalodon as "most interesting" and were likely to learn something new about the size, physical features, and behaviors of

these species. Visitors also gained an awareness of the MODS expansion in general or the exhibits it contained. In the Storm Center, the majority of visitors named Hurricane Force Winds as "most interesting," calling it fun and realistic. Considering that many of the exhibits in Storm Center are focused on hurricanes, and that Hurricane Force Winds was top of mind for many visitors, it is not surprising that much of the new learning supported by the sub-section was related to the strength, force, or damaging effects of hurricanes. The interview data also indicate that these exhibition areas support an understanding of science and the relevance of science for youth in the target age range.

Water's Journey: Analysis of the Individual Kiosks

In order to better understand the visitor experience at the individual kiosks or groups of related kiosks designed as part of the *Water's Journey* project, the summative evaluation included data from two groups: target age-group visitors to the museum and teen volunteers. Museum visitors in the target age range were observed as they interacted with a *Water's Journey* kiosk and then interviewed about their experience at the kiosk (See Appendix 2 for the observation and interview protocols). In small groups, teen volunteers were invited to interact with a sub-set of kiosks and were asked to give their impressions of each kiosk (See Appendix 2 for the focus group protocol). The results in this section are organized by kiosk and include the findings from visitors and teen volunteers. For descriptions and pictures of the individual kiosks please refer to the Description of the *Water's Journey* Exhibits section.

Human Encroachment

Visitors

A total of 20 visitors were observed at the Human Encroachment kiosk. The average time spent was 4 minutes 15 seconds (SD=2 minutes 25 seconds), with a range of between 1 minute 17 seconds (minimum) and 9 minutes 16 seconds (maximum).

- Three-quarters (75%) of observed visitors manipulated variables (either added or removed humans) to see how the mammal population in Florida (panther, deer, bear) changed. Of these, over half (65%) selected the "add humans" button and successfully added humans, while about half (55%) removed humans from the Florida map. Conversely, 25% of all observed visitors manipulated no variables; these visitors typically saw the map of Florida but were not able to manipulate the variables.
- The kiosk also allowed visitors to view virtual animals and learn more about them by touching an animal. Animal renderings were superimposed on live footage of the Otter Habitat or on a stock image of a highway. Just under one-third (30%, n=6) of observed visitors navigated away from the Florida map to view one of these animal screens. Animal facts were accessed by 6 of the 20 visitors, with an average of 2.8 facts selected per person. Three of the 6 visitors accessed an animal fact while still on the Florida map screen.
- A total of 60% (n=12) of the observed visitors experienced usability issues at this kiosk. Visitors had the most trouble figuring out how to add/remove humans. While struggling with this issue, visitors tried tapping the "add humans" and "remove humans" buttons or dragging the bar graphs highlighting the mammal and human populations. Lack of screen sensitivity was also a problem and occurred throughout the interactive. Two visitors had trouble pressing the next button on the home screen (which often caused the computer to skip the instruction text), one visitor could not access any animal facts despite repeatedly tapping various animals, and a few visitors could not get the screen to recognize their touch overall.
- Almost all (90%, n=18) of those observed collaborated with someone else while at the kiosk; 6 collaborated with an adult/parent, 10 with a peer/sibling and 2 with a family group (adults and

children). These social interactions included manipulating variables as a group, reading content out loud, and setting goals together. During parent-child interactions, adults served as facilitators and explained how to work the interactive or provided insight into how adding/removing humans affects the mammal population in Florida. Conversation related mostly to how manipulating variables changes outcomes. Goal setting behaviors often included groups asking "What if?" questions exemplified in these conversations:

> *What happens if we add as many humans as we can? (Adult)*
> *Look [child points out the changing mammal bar graph] (Female, 8)*
> *Once they are gone, I don't think they ever come back. (Adult)*
>
> *Let's see what happens when you remove all humans. (Male, 11)*
> *Annihilated the cougar. (Adult)*
> *Look at the deer. (Female, 10)*
> *Look at the population. Oh my god! (Male, 11)*

At this kiosk, a total of 29 visitors responded to the interview question "What was the main idea of the exhibit?" The majority (69%, n=20) summarized the main idea as humans affect and play a role in Florida's changing environment. For example, a 13-year-old boy thought the main idea of the kiosk was to "show how human population affects animal population. As humans grow, populate the land, drain everglades, animals die out." Just over half (52%, n=15) discussed the changing populations of animals and humans. Five visitors gave a very general response saying the main idea was to learn about Florida's environment and the animals that live there.

When asked "What was the most interesting part of the exhibit for you?", almost everyone interviewed (83%, n=25) found adding or removing humans to be the most interesting part of the exhibit. When thinking about why adding or removing humans was most interesting, visitors focused on learning about the changing animal and human populations, with typical responses including:

> *Seeing how some of the animals would disappear when humans came around, inhabited [the area]. (Female, 11)*
>
> *How people have grown so much in Florida and how much animal population[s] declined. (Male, 13)*

Teen Volunteers

Focus groups one and two provided feedback on the Human Encroachment kiosk.

Main idea

When asked about the main idea of the kiosk, most teens discussed the changing human and mammal population in Florida, emphasizing that with human encroachment, animals will disappear:

> *I guess it's trying to show how if we keep on like taking away their land they're going to keep on decreasing and then they're going to be endangered species.*
>
> *I think it just shows like how our interactions in Florida like reduce animal habitat and covers that. And it just shows pretty much how we impact their population.*

A few teens indicated that at the Human Encroachment kiosk visitors might be inclined to ask "What if?" questions to discover learning messages:

> *To show like people what would happen if they populated this part of land where the panthers roam and the bears roam. What would happen to them? Like what would happen if we populate most of Florida? What would happen to the animals?*

> *Why are the bears increasing? And add more humans and panthers and deer are decreasing and panthers are increasing. What's going on? Some people might not know these certain things and some people might. And then so kind of they learn it.*

One participant thought the main message was to show "the difference between humans and animals, like how the animals are more inner state and we're outer state." After interacting with the Human Encroachment kiosk, some teens still had questions about what exactly the interactive was intended to illustrate. A conversation ensued where the group theorized on why the bears increased and the cougars decreased.

Reactions to the Kiosk

Teen volunteers were not overly impressed with the Human Encroachment kiosk. Some found the interactive to be "boring" and the least interesting of the sub-set of kiosks with which they interacted. Participants did not view Human Encroachment as a "game," but more "like a graph that shows you the information." This is in keeping with the approach of the *Water's Journey* team members who refer to the exhibit as a "learning simulation."

When asked about what they liked best, a few enjoyed seeing the virtual animals in a natural habitat and two teens mentioned learning about the main message:

> *I guess just to like inform people that we have to watch the animals.*

> *I think honestly, interactive is always good and that you can like press the button. You can like control the human population to know that animals are dying because of us.*

Teens made suggestions for what they thought could be improved. Most found the lack of screen sensitivity to be a major issue. The touchscreen was unresponsive at times, which made for a frustrating experience:

> *It was glitchy, it was slow. I wasn't really interested in it.*

> *I think the touch screen was better if you used it more because I mean after you're doing this and it's not working, you get frustrated and just leave.*

> *Touch screen doesn't work.*

None of the teens successfully navigated to an animal screen. Most were unaware that option even existed, although a few tried pressing the "Hide Map" button, but were unable to get this feature to work. During the discussion, researchers showed participants the animal screens and asked them to provide feedback. A few teens found the virtual animals to be unrealistic. However, one teen pointed out that these characters might be appropriate for children, "It gives them an idea so they'll think, 'Okay'."

Most of the teen volunteers participating in the focus group were not inclined to recommend Human Encroachment to a friend. They felt the location near the otter habitat would make it difficult to hold visitors' attention. This is in keeping with the findings from the Otters at Play, Prehistoric Florida, and

Water sub-section observations, where the otter habitat was shown to be an iconic exhibit within the space.

Age appropriateness

Responses for target age group ranged from young children to teenagers for the Human Encroachment kiosk. However, most felt that the interactive was geared toward older children, "because they'll understand like how they're affecting the environment and how they can make a better future probably." The physical design of the kiosk also factored into one participant's response: "Height wise, I don't think [it is designed for] little kids because they can't reach it. And the first page has some reading."

Core Samples

Visitors

Eighteen unique visitors were observed at the Core Sample kiosks. Thirteen visitors were observed at Core Sample: Land, 3 visitors at Core Sample: Water, and 2 visitors interacted with both kiosks. Visitor behavior did not vary between kiosks, thus researchers examined the Core Sample kiosks overall, analyzing 20 total observations. The average time spent at a Core Sample kiosk was 3 minutes 45 seconds (SD=1 minute 30 seconds), with a range of between 58 seconds (minimum) and 5 minutes 34 seconds (maximum).

- The average number of specimens accessed while interacting with a Core Sample kiosk was 19, with a median of 20. The number of specimens ranged from 5 to 34. More than half (55%, n=11) of those observed read information or talked about animal or plant facts displayed on at the kiosk.
- Three-quarters (75%, n=14) of observed visitors looked at the screen displaying the changing shoreline of the state of Florida. Typically, visitors pointed to the Florida screen and used the roller-ball to see how the shape of Florida changes.
- None of the visitors observed at Core Sample: Land looked at the "hero screen," which projected a life-sized rendered image of prehistoric animals. This may be due to the fact that during observation, the hero screen played a looping video and was not connected to visitor actions. However, there is no evidence that the pop-up indicating a specimen was displayed on the "hero screen" was useful in directing visitors to look at the screen.
- Only one visitor experienced a usability issue with the Core Sample kiosks. An 11-year-old boy tried tapping the Florida screen, mistaking it for a touchscreen. Later during his experience, he made the connection that the fossil screen and Florida screen were connected and used the roller ball to change the shoreline of Florida.
- The majority (60%, n=12) of observed visitors collaborated with someone else while at the kiosk; 2 collaborated with an adult/parent and 10 with a peer/sibling. This included reading the content out loud and deciding together what to look at. Members of the group not in control of the roller-ball would often point at a specimen, the timeline, or the Florida screen to help guide the exhibit experience. For peer or sibling groups, it was typical (n=8) for children to take turns operating the roller-ball.
- Conversation included comparing the size of prehistoric specimens to the size of a human: "That's what it would look like compared to us [points to human]." Observed visitors often asked questions about specimens or created a game where they guessed the type of animal based upon the fossil of its ancestor. Three visitor groups discussed the Florida screen, and two groups talked about the concept of time changing:

How big Florida was 12,000 years ago. How much land is being taken up. This is what it looks like today.

This is present day and time goes down.

A 12-year-old girl made a personal connection between the fossils she encountered at Core Sample: Water with the television show, *SpongeBob SquarePants* and the movie, *Ice Age*.

At the Core Sample kiosks, a total of 22 visitors responded to the interview question "What was the main idea of the exhibit?" The majority (68%, n=15) indicated that the exhibit was about prehistoric animals. Typical responses include:

Tell[ing] more about Florida's history and past and the animals. Know more about animals existing a long time ago. (Male, 12)

Telling you about prehistoric stuff and a long time ago things used to be here. Artifacts. (Female, 10)

Compare everything about animals today and prehistoric Florida animals. (Male, 12)

Half (50%, n=11) specifically mentioned Florida's history and animals. Nine visitors (41%) indicated change over time was a main idea including the concepts of adaptation and evolution, with four discussing how Florida's shoreline changed over time: "How the shape of Florida changes, how big, small it was with water," and "Florida continues to shrink as time continues." Others described learning about fossils or generally mentioned animals, plants, or the environment.

Twenty-two visitors responded to the question: "What was the most interesting part of the exhibit for you?" About half (55%, n=12) found the animals or fossils to be the most interesting aspect of the Core Sample kiosks. The following represents a range of responses:

Fossils, I didn't know much about those animals. I did recognize some of them. (Male, 12)

How it shows different fossils and where they are found and different animals and plants. (Female, 14)

Learn about parts of animals from ancestors of animals. (Female, 12)

Visitors were also interested in the scale and timing of environmental change (36%, n=8). This included exploring the timeline of Florida fossils as well as learning about Florida's changing shoreline:

How many millions of years you can go back and see how many animals. (Male, 11)

Seeing how Florida was actually bigger and got smaller because of environment and extinction. 11,000 years ago it started to get bigger, that is when it was biggest. (Female, 16)

Three visitors enjoyed the user-controlled experience: "Being able to find it yourself, you can be creative and go practically wherever you want. You don't have to go to things, if you don't want." Three visitors were impressed with the size of prehistoric specimens.

Teen Volunteers

Researchers conducted three focus groups with teen volunteers at the Core Sample kiosks (groups two, four, and five gave feedback on these kiosks). Teens were asked to interact with at least one of the kiosks: Core Sample: Land or Core Sample: Water.

Main idea

All focus group participants described the main idea of the kiosks as learning about prehistoric animals and fossils. The majority specifically mentioned Florida's history. Representative responses include:

> *To show people like fossils to see what's in fossils looks like, fossils of animals like pieces of them, pieces of like pottery and you know, to show them what was back then.*
>
> *Give off information about Florida and its fossils, back – like, the ancestor animals. It showed when the fossil came and it showed how the deeper you go, the older the fossils are.*
>
> *It helps to like get the information through and like concepts that the earth's been around for such a long time and that organisms and like animals have been here for like most of that time and just the actual like exhibits like it passes on the idea that it's like it just gives us like the background, like the history of like animals here.*

Teens found the Core Sample kiosks to be "perfectly placed" within the context of the EcoDiscovery wing. The information presented in the Core Sample: Land and Core Sample: Water kiosks, respectively, is compatible with their location near the Giant Megalodon and the Saber-toothed cat.

Reactions to the Kiosk

Teens enjoyed exploring the history of Florida through the Core Sample kiosks. Many found the content to be informative and interesting. They enjoyed learning facts about specimens:

> *The facts, like I was surprised that there's like 20 different kind of buffalo. I was like wow, I just know buffalos.*
>
> *The information about all the different like prehistoric animals was really cool.*

Some mentioned that the kiosks successfully conveyed the concept of size. This was accomplished through facts, the visual comparison between the size of prehistoric specimen and the human, as well as the projections on the hero screen.

Core Samples was a user-controlled, interactive experience for teens. Over half of the focus group participants liked this aspect of the kiosks. One teen explained how "like move the ball and roll all around the screen made it really cool because it actually was like an archeological experience and you actually got to explore. I think it was – it's something that not everybody gets, so it's like a unique experience."

Teens also commented on the concept of "timespan." They enjoyed scrolling up and down to view fossils from different time periods and also the changing shoreline of Florida. This simulated "going back in time."

Minor suggestions for improvement incorporated ideas to enhance the visitors' experience at Core Samples. Some recommended incorporating a scavenger game to provide a purpose-driven experience that would help scaffold learning. One group did not notice the connection between the fossil screen and the Florida screen. They suggested adding an interpretive label to help inform visitors. One teen

thought that young visitors would prefer for all fossils to include a rendered image of the animal/plant, similar to the hero images.

Teens indicated they would recommend these exhibits to friends. When describing Core Samples to potential visitors, one teen said:

> *There's these two exhibits that are really informative and it's fun to play around with, especially when you get to learn a lot more than you probably already knew. So I think you should check these out. And it's really interesting and really fun to do.*

Age appropriateness

When asked about the target audience for these kiosks, all participants felt the Core Samples were intended for middle school, high school, and adult visitors and less appropriate for younger visitors:

> *Fifth grade and older. The amount of words they put in to – elementary schoolers can't really keep up with the words and they'll get distracted very easily and walk away.*
>
> *I think its targets [are] pretty much all age groups except like really, really small children because it gives you like an insight on animals' facts and everything. And like the information attracts more to like teenagers like us because I mean we want to learn more, so it was really cool.*
>
> *Later elementary school to high school because there's a lot of facts and little kids don't really have a long attention span, so they wouldn't be able to like sit here and like look through each one.*

Invasive Species

Visitors

A total of 17 visitors were observed at the Invasive Species kiosk. The average time spent was 5 minutes 28 seconds (SD=2 minutes 37 seconds), with a range of between 1 minute 41 seconds (minimum) and 11 minutes (maximum).

- Overall, visitors demonstrated thorough use of the exhibit. The majority (71%, n=12) of observed visitors explored all three invasive species: python, hyacinth, and Melaleuca. Three visitors (18%) explored two of the three invasive species and two visitors (12%) only selected one species. After choosing a species to explore, visitors on average selected 2 methods of control for that species. Invasive Species included 9 total scenarios to investigate (three control methods per species); observed visitors typically explored 5 out of 9 scenarios.
- All observed visitors (100%) selected the python as an invasive species to explore. This was often the first selection made by visitors. Most visitors (10 out of 17) first read about Burmese pythons and then selected a control method.
    - The most common Burmese python game activity was "manual" removal. The majority (71%, n=12) selected this method of control. All visitors were able to remove at least one python from the otter habitat, catching between 1 and 3 snakes.
    - Just over half (58%, n=10) selected "biological" as a method of controlling pythons. Visitors tended to move the thermometer, testing different temperatures.
    - About one-third (35%, n=6) selected "chemical" as a method of controlling pythons. The interactive notified visitors that there is no current chemical method to eradicate Burmese pythons.
- The majority (82%, n=14) explored the water hyacinth at this kiosk.

    - About half (47%, n=8) selected "manual" as a method of controlling hyacinth. A computer error occurred and visitors were presented with the instructions for manually removing Melaleuca trees as opposed to water hyacinth. Actual game play was correct and expected visitors to remove water hyacinth by dragging plants out of the water. Although provided with incorrect instructions, 5 visitors were eventually able to remove water hyacinths.
    - The majority (65%, n=11) of observed visitors selected "biological" as a method of controlling water hyacinths. Most of these visitors were able to release parasites into the water; however 4 visitors were not able to add parasites.
    - Over half (59%, n=10) selected "chemical" as a method of controlling water hyacinths. During observation, a computer glitch caused the game to malfunction and the instructions for chemically eradicating Melaleuca trees appeared. The game that followed these instructions was the chemical eradication of Melaleuca trees. Visitors did not seem to notice the error.
- Over three-quarters (77%, n=13) of observed visitors selected the invasive Melaleuca tree to explore.
    - Nine observed visitors (53%) selected "manual" as a method of controlling the Melaleuca tree. Only one visitor had trouble raising and lowering the excavator's arm and was not successfully able to knock down a tree.
    - Just under half (41%, n=7) selected "biological" as a method of controlling the Melaleuca tree. All 7 visitors released snout beetles onto the trees. However, visitors struggled with dragging and placing the sapling. This appeared to be due to both screen sensitivity and lack of understanding the mechanism for placing the sapling.
    - Most (59%, n=10) selected "chemical" as a method of controlling the Melaleuca tree. Nine of the 10 visitors who selected "chemical" played the game. One visitor decided to exit after reading the instruction screen for chemical removal by pressing the "start over" button located in the bottom left-hand corner of the screen. While playing, visitors moved the target to a tree and sent a helicopter to spray.
- Visitors frequently repeated activities within the interactive. Eight of the 17 visitors (47%) played at least one of the games twice. The most often replayed games were Hyacinth: Biological Control and Pythons: Manual Control. Five visitors repeated the Hyacinth: Biological Control activity. Four visitors played the Pythons: Manual Control game multiple times, increasing the number of snakes captured each game.
- About half (53%, n=8) of the visitors observed read a fact about invasive species control methods after playing the games. A 12-year-old female was observed reading out loud a fact explaining that Florida does not stay cold long enough to eradicate Burmese pythons biologically.
- Fifty-three percent (n=9) of visitors experienced a usability issue at the Invasive Species kiosk. All experienced issues with the sensitivity of the touch screen. Six visitors specifically had trouble moving the camera, a feature that appeared in each game throughout the interactive. Three visitors experienced difficulties sliding the thermometer to change temperature during the Pythons: Biological Control activity.
- A total of 41% (n=7) of those observed collaborated with someone else while at the kiosk; 3 collaborated with an adult/parent and 4 with a peer/sibling. This included reading the content out loud, problem solving, and cooperative game play. During conversation, visitor groups strategized, tested a hypothesis, or problem solved. For example a 10-year-old boy and his 10-year-old friend discovered the objective of removing hyacinth biologically: "They are spreading. It's an infection." "Are we trying to infect?" "We are trying to kill these plants. They are

invasive." A 10-year-old boy and his mother were playing the game when the mom said, "Not the best method. It kills everything!"

At this kiosk, a total of 20 visitor responses were recorded in answer to the interview question "What was the main idea of the exhibit?" The majority (55%, n=11) indicated that the exhibit was about removing invasive species. Typical responses in this category included:

Getting rid of invasive species. (Male, 10)

To get rid of invasive species, have to be careful about measures you take because could end up hurting environment more than helping. (Female, 12)

Learn about what methods are useful to get rid of species and what's not. (Female, 11)

Nine visitors focused on learning about invasive species and how dangerous they can be, as explained by this 11-year-old boy: "Tell people about threats [invasive species] to Florida and how they can be dangerous." Five visitors thought the main idea of the kiosk was to teach people about the environment in general.

Twenty visitors responded to the question: "What was the most interesting part of the exhibit for you?" Visitors were evenly divided in their responses. Half (50%, n=10) found specific elements of the game play to be the most interesting aspect. This included catching the pythons, knocking down Melaleuca trees, "killing everything, and destroying stuff." The other half (50%, n=10) found the content to be the most interesting. Learning about invasive species was new to some visitors. The following represents a range of responses:

How they told you not to put chemicals straight on it [flowers] because it would get all other things in environment sick and the water would become contaminated. (Female, 12)

Learning how the population [of invasive species] grows and stuff. (Male, 11)

Python, what temperature is needed to kill a python. (Male, 15)

Teen Volunteers

Focus groups four and five were invited to interact with and discuss their reactions to the Invasive Species kiosk.

Main idea

Focus group participants believed that Invasive Species kiosk successfully communicated its main messages. Teens perceived the main message to be that invasive species are negatively impacting the environment and that it is important and difficult to remove non-native species. Representative responses include:

To show how like our environment around us is actually being impacted by things people brought in, it's like either pets or to make anything look better.

I think that it really got the point across that invasive species obviously don't belong here and how they are hurting the environment because of our actions and how it's our responsibility to take them out of our environment because if not, like soon the species will be completely taken

over and we'll have pythons running around everywhere. So it really – that really like has a strong impact.

To let people know that chemicals –the results of chemicals and the human environmental interaction of the plants and animals in the environment.

Reactions to the Kiosk

Teens found the Invasive Species kiosk to be fun, interactive, and informative. "It's a very interactive machine that allows you to be more informed and more knowledgeable about what happens to non-native species. And it's fun and it's very interesting to use." Teens liked learning information about invasive species and gained new knowledge after interacting with the kiosk. Two brothers in focus group four recognized that the interactive simulates how difficult it is to remove invasive species in real life:

It's frustrating because you play the games and you're like wow; this is actually kind of hard…

Like we were trying our best, but we felt like we still weren't doing enough.

I think it was just the simulation of real life.

The Invasive Species kiosk encouraged teamwork and teens worked together during play. The interactive challenged teens and one participant suggested that while trying to manually remove pythons, visitors could "make a team, you know, like organize ourselves to like win the game." Observational and conversational evidence supported the teens' tendency to play the games over and over again.

Overall, teen volunteers would recommend this exhibit to visitors. However, everyone had issues with the screen sensitivity. Teens specifically had trouble adjusting the camera view:

The touch screen was a little faulty sometimes.

Yeah, it was calibration, like the camera view on the bottom, it was a little hard to move around.

Sensitivity. It's hard to move the things. Cause I kept trying to move the camera and it moved the temperature instead.

One participant found the location to be a major issue. Located on the second floor near the travelling exhibition space and the otter habitat viewing window, Invasive Species is set apart from the rest of the exhibition hall. "Not many people come over here…It's something that gives off a lot of information and they should see it, but all these things over here, that's distracting them from that."

Age appropriateness

Teen participants thought that Invasive Species was intended for all audiences. The interactive nature, entertaining games, information presented, and ease of use make the exhibit appealing to all age groups. When asked how the kiosk would be received by teenagers, a participant said:

I think it may have been targeted specifically for teens because the information, once again, it also just that it's a game, like an interactive game that could attract a lot of teens. And also I noticed how when you finish playing, it'll always like tell you like something that you like kind of notice, but it'd be like oh, like for the chemicals, like chemicals aren't the most effective because they also contaminate the water and kill other species. And then it's like could you think of any other solution that'd be more effective. So that actually gets you thinking and like trying to actually like get involved and help. So that was pretty cool.

In order to make the exhibit even more appealing to teens, volunteers suggested rotating different facts and incorporating humor into the script.

Hurricanes

Visitors

A total of 20 unique visitors were observed at the Hurricanes kiosks. Eight of these visitors were observed at the Storm kiosk, 8 were observed at the House kiosk, and 4 visitors were observed at both Hurricane kiosks. There are 12 total observations for each Hurricane kiosk. Because objectives and game play of the two kiosks were different, the observation data from each kiosk were analyzed independently; however, all interview responses were analyzed together.

Observed Behavior at the Storm Kiosk

The average time spent at the Storm kiosk was 4 minutes 5 seconds (SD=1 minute 56 seconds), with a range of between 2 minutes 12 seconds (minimum) and 7 minutes 44 seconds (maximum).

- The vast majority (83%, n=10) of observed visitors read at least some of the content or instructional screens during the game. Typically, visitors were observed reading about storm variables (i.e. speed, intensity, and size) and/or about the hurricane aftermath.
- Almost all of the visitors observed (92%, n=11) manipulated storm variables. Visitors tried different combinations, adjusting seasons, temperature, speed, intensity, and size before creating their storm. Five were observed playing the game more than once during their interactions at the kiosk. A 9-year-old girl completed the interactive 5 times.
- Three-quarters (75%, n=9) of visitors experienced a usability issue at the Storm kiosk. All 9 encountered issues getting to the water temperature screen. After selecting a season using the slider bar, visitors were either unaware or were unable to successfully engage the temperature selection screen. Researchers observed two visitors repeatedly tapping the ocean, but the screen was not sensitive enough to engage the water temperature screen. In addition, a computer glitch occurred for one observed visitor, with the temperature, two-player option, and season slider appearing simultaneously on one screen.
- More than half (67%, n=8) of those observed collaborated with someone else while at the kiosk; 5 collaborated with an adult/parent, 2 with a peer/sibling, and 1 as part of a family group. In parent-child dyads, the child was more likely to control the touch-screen than the parent. Parents read the content out loud, helped with instructions, and discussed topics with children. When interacting with other children at the Storm kiosk, researchers observed children taking turns manipulating variables or playing the game. Conversations centered on what was happening in the interactive. While two 16-year-olds were playing at the Storm kiosk, one boy said, “There goes the house!” Both teens then read out loud about the hurricane aftermath.
- Only two observed visitors selected the two-player option during game play. In both cases, the computer waited for player 2 and then defaulted to one-player mode. As a result, no visitors were observed using the Storm kiosk in the two-player mode.

Observed Behavior at the House Kiosk

The average time spent at the House kiosk was 4 minutes 59 seconds (SD=2 minutes 40 seconds), with a range of between 2 minutes 2 seconds (minimum) and 8 minutes 57 seconds (maximum).

- Over half (58%, n=7) of observed visitors read at least some of the content or instructional screens during the game. Of these 7 visitors, 4 read the instructions regarding moving debris and purchasing storm prep items, 3 read information before selecting housing materials, and 1 visitor thoroughly read the hurricane aftermath screen.
- All of the visitors observed (n=12) manipulated variables to build a house. Most completely customized their house, selecting a location, architectural frame, roofing, windows, and a color. The vast majority (83%, n=10) also purchased storm prep items. Popularly purchased items included gas, batteries, water, and tape. Due to the design of the interactive, visitors had the most time to buy these items before they sold out. The 2 observed visitors who did not purchase items, attempted to buy supplies, but faced usability issues.
- It was common for visitors to play the game multiple times. Two visitors played the interactive 3 times and 5 visitors played the game twice.
- About two-thirds (67%, n=8) of visitors experienced a usability issue while interacting with the House kiosk. Most (n=5) initially tried tapping storm prep items instead of dragging them from the inventory to the house. Three of these visitors eventually figured out to drag items, however, often not until the second or third time playing the game. Two visitors were not successful in moving debris from the yard. In both cases, visitors tried dragging debris "off" the screen as opposed to in the garage. One 15-year old girl tried twice to manipulate the house during the storm and was unsuccessful both times.
- Three-quarters (n=9) of those observed collaborated with someone else while at the kiosk; 3 collaborated with an adult/parent, 4 with a peer/sibling, 1 as part of a family group, and 1 with a MODS staff member or volunteer. This included reading the content out loud, taking turns, and deciding what selections to make. Conversations involved asking questions and discussing decisions. One 11-year-old boy asked his mother "What if I try rural? Will it be easier to break or not?" Two teenage girls discussed the results of their decisions, "Look at my roof- it flew away. Complete roof failure."
- Under half (42%, n=5) of the observed visitors selected the two-player option during game play. Many times the Storm kiosk was unoccupied and the computer system defaulted to one-player mode. Only two visitors successfully engaged a second player. A 12-year-old boy played against his sister. After the storm hit, he threw his fists in the air and exclaimed "I won!"

<u>Interview Data from both Hurricane Kiosks</u>

At the Storm and House kiosks, a total of 25 visitor responses were recorded in answer to the interview question "What was the main idea of the exhibit?" The majority (64%, n=16) indicated that the exhibits were about preparing for a hurricane. For example, a 15-year-old girl responded, "Prepare for hurricanes, have proper things, proper house with proper windows and roof. People should be more prepared for hurricanes and be better prepared for damage. Normal houses are not usually as prepared." Nine visitors (36%) thought the main idea was to show how much damage hurricanes can cause. Five visitors (20%) specifically mentioned how a hurricane forms and the factors that affect storm creation and strength. Others (20%, n=5) mentioned general responses about hurricanes, science, or weather. Representative responses include:

> *The process, how hurricanes are formed. (Female, 15)*
>
> *Prepare for hurricane season, what causes hurricanes and how to protect against them. (Male, 16)*
>
> *About winds. Some winds can destroy cars, buildings and can blow down trees and a house. Can wipe out mobile homes. (Male, 10)*

Hurricane can be very damaging. (Female, 16)

When asked "What was the most interesting part of the exhibit for you?," 26 visitor responses were recorded. A vast majority (77%, n=20) of interviewed visitors found manipulating variables to be the most interesting part of the exhibit. Of these 20 visitors, 11 specifically mentioned building the storm, 5 mentioned selecting building materials for the house, and 4 found purchasing supplies for the house to be the most interesting. Just over one-third of visitors (35%, n=9) enjoyed seeing the hurricane damage the house. A 9-year-old girl responded, "Because it looked cool, how the houses are getting all messed up and bunch of stuff gets damaged." A few (n=5) expressed interest in knowledge gained, as shown through the following examples:

Learn how much people really have to do to prepare. There is a lot of stuff you have to do. Pick right type of material for house, so it's sturdy, so survives a hurricane. (Male, 11)

Making hurricane. Now I know how big and fast a hurricane can be. (Female, 9)

Teen Volunteers

Researchers conducted three focus groups with teen volunteers at the Hurricane kiosks (groups three, four, and five gave feedback on these kiosks). On May 26th and 27th the Storm computer was down and not functioning. The two-player mode was not working for groups four and five as a result of the Storm kiosk not functioning; the two-player mode also did not work for group three despite repeated attempts by the teens to engage this function.

Main idea

Teens viewed the main message of the Hurricane kiosks as two related ideas. All teens believed the main idea behind the House interactive was to teach visitors how to prepare for a hurricane:

Show you how to be prepared for a hurricane.

Safety. Yeah, like how to keep you safe during a hurricane.

I think the game teaches you how to be more prepared for when a hurricane hits.

Focus group participants who interacted with the Storm kiosk believed the main idea was to show how hurricanes form and how destructive they can be.

What the ingredients for a hurricane are. How the storm forms.

What time of the month you know, to prepare for certain types of hurricanes and how fast they move, the storms are and destructive.

A few teens found the concepts especially meaningful to Floridians. Hurricanes are a real threat and many Florida natives have witnessed a storm's destruction. Thus, these main messages were appropriate and applicable to their lives. When asked if the exhibits do a good job conveying the main message, one teen replied "it was a really good concept and good idea and really helps to get the point through."

Reactions to the Kiosk

In general, teens liked the Hurricane kiosks and found the hands-on experience to be fun. A few enjoyed learning how dangerous hurricanes can be and how one can be prepared to help minimize damage. The majority of teens recognized that these interactives simulate a real life experience. There was also a

sense that teens would be naturally inclined to play the game over and over again, testing a variety of factors and outcomes.

Although the majority of participants found the kiosks to be "pretty solid," a few provided minor suggestions for improvement. Suggestions included fixing the Hurricane computer and providing a functioning two-player mode. Two teens wanted to see greater flexibility in selecting or manipulating choices on both the House and Storm side:

> *I kept trying to get the storm up to a Category 5 and I couldn't get it there.*
>
> *Like inside the game, like more choices so you have a wider variety of choices to like choose from. But apart from that, everything was really good.*

One participant suggested incorporating custom feedback regarding the strength of a visitor's house:

> *After, they could tell you how to improve. They could've told you how to improve from what you had.*

The two-player mode was appealing to many of the participants. Teens feel that enabling this feature will promote social interactions, encourage visitors to spend longer, and help reinforce concepts.

> *Because it's fun because you can do the two players and it's a little competition and see who can make a better hurricane and who can make a better house.*
>
> *It'd also get kids to spend more time there because you would switch up stations. And then overall, it would give you like a better like understanding of both sides and like the impact that's like the different categories of hurricanes have on each house.*
>
> *But that competition adds another level of fun that more kids are interested in.*

Age appropriateness

When asked about the target audience for these kiosks, teen participants were evenly divided between the following age groups: everyone, elementary, and "middle school and up." The interactive nature and relevant subject matter made the exhibits appealing to all age groups. The minimal amount of reading necessary to operate the computers indicated to some that this was appropriate for elementary-aged children. Others felt that middle school served as the target audience because this is an age when you can begin to contribute to hurricane preparations:

> *Middle schoolers because that's when we start living like I can actually do something in my house to help my family and my house.*

Hydrologic Cycle: Florida Table

Visitors

A total of 19 visitors were observed at the Hydrologic Cycle kiosk. The average time spent was 1 minute 44 seconds (SD=49 seconds), with a range of between 20 seconds (minimum) and 3 minutes 20 seconds (maximum).

- The vast majority (95%) of observed visitors read at least some of the content contained in the informational windows in the center of the screen. Nearly two-thirds (63%) of visitors accessed additional information on at least one of the cycle's stages by clicking on the "more" information button. The most commonly accesses additional information was about

transpiration (n=10), followed by run-off (n=8), condensation (=6), precipitation (n=6), and evaporation (n=5).

- A total of 68% (n=13) of the visitors observed looked at the wall-mounted monitor sometime during their interaction with the kiosk. Typically, a sound (rushing water, thunder, rain) would draw their attention to this monitor.
- There were no usability issues noted at this kiosk.
- Nearly half (47%, n=9) of those observed collaborated with someone else while at the kiosk; 7 collaborated with an adult/parent and 2 with a peer/sibling. This included reading the content out loud and deciding together what to look at. In parent-child dyads, the child was more likely to control the touchscreen than the parent. Conversation included the visitor recalling that they had studied the topic in school and brief observations on what was occurring during each stage in the cycle.

At this kiosk, a total of 23 visitor responses were recorded in answer to the interview question, "What was the main idea of the exhibit?" The majority (78%, n=18) indicated that the exhibit was about the water cycle, with some giving more specific information about the cycle or its stages. For example, an 11-year-old boy thought the main idea of the kiosk was "to teach you about evaporation, condensation, transpiration, rain, and run-off." Five visitors indicated that the exhibit was about "how the water cycle works," two thought it was about the weather and two thought the main idea was to encourage caring for the environment. Of the 10 visitors who thought the Hydrologic Cycle kiosk was the most interesting part of the Florida Table, 6 cited the cycle itself or the content as the most interesting aspect, two indicated they learned something new, two liked the visuals at the kiosk, and one visitor indicated it was interesting because she had learned about it in school.

Teen Volunteers

Focus groups 1 and 3 discussed their reactions to the Hydrologic Cycle kiosk, part of the Florida Water Table display.

Main idea

Teens successfully identified the main message of the Hydrologic Cycle – the "water cycle." Two participants referenced the continuous movement of water in Florida:

> *Show the different parts of the water cycle in Florida.*
>
> *I guess just how the water, you know, evaporates, condensates and just the cycle, really. And it shows like the beach for Florida, and you can see how it happens.*

Reactions to Kiosks

Teens found the Hydrologic Cycle to be least interesting of the Florida Table kiosks. "Honestly, I wasn't thrilled about it. I mean this one was probably like one of my least favorite ones of the group because it's simplistic but it does teach you." When asked what they liked best about the Hydrologic Cycle, teens mentioned the television and the interactive nature of the kiosk. Everyone noticed that the computer was connected to a mounted television. Teens thought this improved the exhibit experience:

> *I like the TVs and the sounds so like you could hear the rain or if it's sunny like it is now.*
>
> *It made it interactive. I think anything that makes it interactive would make it a lot easier for kids to understand and enjoy.*

Participants were disappointed with the simplistic nature of the Hydrologic Cycle kiosk and felt that the interactive would not capture visitors' attention.

> *It kind of needs more like things to do.*
>
> *You can see the whole thing in like maybe a minute.*

There was also a sense that the kiosk might involve too much reading. Teens did not think visitors would take the time to read all of the presented information. Some felt that visitors would need a pre-existing interest in the hydrologic cycle to find the information interesting.

Age appropriateness

Based on the amount of reading, teens felt that the Hydrologic Cycle kiosk was intended for middle school or high school aged visitors. However, the lack of new information on the water cycle might make it better suited for a younger audience: "Most teens already know this from science [class]." Teens also mentioned that little kids would enjoy the interactive by dragging the water molecule around in circles.

Wet & Dry Seasons: Florida Table

Visitors

A total of 19 visitors were observed at the Wet & Dry Seasons kiosk. The average time spent was 1 minute 26 seconds (SD=1 minute 22 seconds), with a range of between 30 seconds (minimum) and 5 minutes 11 seconds (maximum).

- The vast majority (90%) of observed visitors read at least some of the content contained on the first screen of the kiosk, which displayed information about the earth's rotation, average temperature, and rainfall in each month. Nearly all visitors (95%) used the circular slider on the first screen to manipulate the earth and seasons.
- The wet season facts or poll questions, displayed by pushing "buttons" on a map of Florida, were accessed by 10 of the 19 visitors observed, with an average of 2.4 buttons pushed per person. The dry season facts or polls were accessed by 9 of the 19 visitors, with an average of 1.9 buttons pushed per person.
- Nearly two-thirds (63%, n=12) of all visitors observed at this kiosk experienced usability issues. The most common usability issue was lack of sensitivity of the touchscreen, with 10 visitors experiencing this issue; this typically occurred with the "buttons" at the top of the screens that displayed the wet and dry season facts and polls. Three visitors had the interactive crash during use, typically when it was transitioning from the first screen to the wet/dry season screens.
- More than half (53%, n=10) of those observed collaborated with someone else while at the kiosk; 7 collaborated with an adult/parent and 10 with a peer/sibling. This included reading the content out loud and deciding together what to look at. Conversation included the visitors noticing that the temperature and rain fall averages varied by month or commenting on the specific of one month: "Whoa, that's hot!" or "10 inches of rain!" Groups would also collaborate on answering the polling questions.

At this kiosk, a total of 22 visitor responses were recorded in answer to the interview question, "What was the main idea of the exhibit?" A variety of responses were given including:

- The causes of seasonal changes and the types of seasons Florida experiences (n=12 visitors). A typical reply in this category was given by a fifteen-year-old who responded the exhibit was

about "the rotation of the earth and the causes of the different seasons, the dry season and wet season."

- The effects of seasonal changes on the environment and people (n=8). For example, an 11-year-old boy responded that the kiosk was about the "seasons and how it will affect the environment. Starts fires and overflows the lakes."
- The need for environmental protection or care (n=3). For example, an 11-year-old boy replied that the kiosk "show[ed] people about Florida's environment and how careful you have to be with it."
- The seasonal variations in temperature (n=3).

Of the four visitors who thought the Wet & Dry Seasons was the most interesting part of the Florida Table, two indicated that it was interesting because they learned something new, one remarked on how it emphasized caring for the earth, and one did not give a reason for their preference of the kiosk.

Teen Volunteers

Group 1 and 3 discussed their reactions to the Wet & Dry Seasons kiosk, part of the Florida Water Table display.

Main idea

Teen volunteers participating in the focus group thought the Wet & Dry Seasons kiosk was about the changing seasons in Florida: wet and dry seasons. Teens discussed Florida's distinct wet and dry seasons, and one participant mentioned actions that can be taken to help the environment during the dry season.

Reactions to Kiosks

Participants most liked the activity found on the first screen of the kiosk which allows visitors to drag the earth around the sun, displaying information about average temperature and rainfall in each month. Teens recommended that other visitors "definitely look at the temperature to see - Florida doesn't change much in temperature, and you can see all the different amounts of rain each year." They enjoyed learning new information from this screen:

> *It was pretty cool how it showed the current temperature and then you could change it and show like to rotate the Earth around the sun and show how it worked around the Earth.*
>
> *All the way around through the year you see the temperature and everything. It's something I didn't know.*

Teens were not as impressed with the activities related to the map of Florida and the Florida Table. While exploring the wet and dry seasons on the map of Florida, many experienced technical glitches that impeded the visitor experience. Lack of screen sensitivity caused most of these issues.

> *The touch screen was kind of bad because you've got to like touch it like three or four times for it to know.*
>
> *You have to push really hard sometimes to get it to work.*
>
> *It's a little glitchy.*

As a result of this lack of sensitivity, teens had difficulty activating some of the season facts on the Florida map. Additionally, not everyone noticed that the Wet & Dry Season kiosk projected onto the physical 10-foot-by-10-foot Florida Table and that user actions were tied to the animations that appear on the Florida Table. One participant suggested making a stronger connection between the facts or polls and the physical location on the map of Florida. Currently, "some of the ideas don't really connect because I thought it'd be more [tied to the] location" of the button.

One participant found the activities connected to the Florida map to be entertaining: "I like the little descriptions and that it asks you questions. So you can get into it more than if it was just showing you it. There were things I didn't know about Florida that it showed us, and it was cool."

Age appropriateness

Teens viewed the Wet & Dry Season kiosk as most appropriate for middle school, high school, or adult visitors. They described this exhibit as "it wasn't really like a very interactive game," and "it's all reading, really." Thus, participants felt it was less appropriate for little kids and will not capture a child's attention. One teen felt that even teens would not be interested in the Wet & Dry Season kiosk: "I would say older people because teens aren't really interested."

Sheet Water Flow: Florida Table

Visitors

A total of 20 visitors were observed at the Sheet Water Flow kiosk. The average time spent was 3 minute 26 seconds (SD=1 minute 29 seconds), with a range of between 47 seconds (minimum) and 7 minutes 10 seconds (maximum).

- The vast majority (90%) of observed visitors read at least some of the content contained in the informational screens that preceded the game. Of these, 5 touched at least one "!" button to access additional information on these screens. Three visitors were observed going back and forth between two informational screens or between the informational screens and the game to compare the water flow.
- All of the visitors observed (100%) played the game at this kiosk. Four were observed restarting the game during their interactions at the kiosk. The most common game activity was the placing of cities.
- Thirty percent (n=6) of visitors experienced a usability issue at the Sheet Water Flow kiosk. Four experienced issues with the sensitivity of the touch screen and two never determined that the arrows in the upper left corner were used to control the building of roads/canals. Instead the repeatedly touched the building equipment with no results.
- More than half (60%, n=12) of those observed collaborated with someone else while at the kiosk; 6 collaborated with an adult/parent and 6 with a peer/sibling. This included reading the content out loud and deciding together what to look at or what to build. In parent-child dyads, the child was more likely to touch control the touchscreen than the parent. A total of 7 visitor groups had conversations about the water flow, with 6 of the 7 conversations occurring during game play. For example, an 11-year-old girl and her 10 year-old friend hypothesized: "If you put cities all over right here, what would happen? [adds cities] Oh, see how it goes here?" A 10-year-old boy and his mother were playing the game when the mom said, "Look at how the water is affecting it…you are making a mess with all these cities."

At this kiosk, a total of 21 visitor responses were recorded in answer to the interview question, "What was the main idea of the exhibit?" The majority (62%, n=13) indicated that the exhibit was about the

relationship between the environment or water flow and man-made structures. Typical responses in this category included:

> *[You] make up your own system, how canals effect how the water can get out. (Female, 11)*
>
> *How man-made objects could affect Florida so badly. (Female, 10)*
>
> *How the waterways work. The new-made stuff—it is getting in the way of the water. (Male, 18)*
>
> *How Florida started off, and we started building roads and cities. And the water went around them. (Female, 17)*

Five visitors focused only on man-made structures, and two only on water flow. One visitor thought the main idea of the kiosk was about the water cycle. Of the 16 visitors who thought the Sheet Water Flow kiosk was the most interesting part of the Florida Table, 8 thought it was interesting because of the impacts on the environment, 6 were interested in the personalized or choice-related aspects of the kiosk, and 3 specifically liked controlling the water flow.

Teen Volunteers

Group 1 and 3 discussed their reactions to the Sheet Water Flow kiosk, part of the Florida Water Table display.

Main idea

The majority of teens described the main message of the Sheet Water Flow kiosk as how water moves across the surface:

> *Water flow and how it goes and other things affect it.*
>
> *Showing where all the water's from, like where it actually goes around the cities.*

Three participants specifically mentioned human interaction and effect on water flow.

> *This was just like how we can help like fix the flow of water.*
>
> *How interactions will determine output. How interactions will stop the water flow.*
>
> *And the history of development from changing water flow over time.*

Reactions to Kiosks

There were mixed feelings about the Sheet Water Flow kiosk. When asked what they liked most about the exhibit, the majority mentioned gameplay where visitors select a man-made object and add it to the map to see how it affects Florida's water flow. Teens found the game to be interactive and "cool." One participant described the game as similar to the construction and management simulation video game Roller Coaster Tycoon.

Although teens enjoyed certain aspects of the interactive, overall, they felt Sheet Water Flow could be improved. Many found the game to be confusing and suggested that designers incorporate better instructions or explanations to describe the simulation of water flow. Typical responses include:

> *And the thing about it is it's not really clear at first. You know, you can read of course but some people might not typically find that it's about water flow.*

I don't think it's a good game really. It's hard to do. Like, if you just come out of nowhere without instructions, you won't know what to do.

It was confusing stuff.

Teens also faced difficulties with the touch-screen during gameplay. "It seemed cool but it was very glitchy, and I couldn't make the things move where I wanted them to."

Most teens were not likely to recommend this exhibit to a friend. One participant found the Sheet Water Flow kiosk lacking compared with the rest of the museum: "I've got to say compared to the rest of the museum, this is not the greatest to look at." The exhibit did not seem to hold teens' attention.

Age appropriateness

When asked about the target audience for Water Sheet Flow, 3 teen participants felt this kiosk was most appropriate for middle school aged visitors. One teen thought it was intended for adults, and another thought it was designed for everyone.

Tree Island

Teen Volunteers[20]

Focus groups one and two were invited to interact with the Tree Island kiosk and discuss their reactions.

Main idea

All teen focus group participants believed the main idea behind the Tree Island kiosk was to show wet and dry seasons and how the changing water level affects animals. Representative responses include:

The dry and wet seasons and how they affect all the animals.

I think it talked about like the tide. The low tide, the high tide and pretty much how it affects all the animals that are living around there. Because like when there is this tide all the animals live, when there's this tide like none of the land animals are alive.

If the water goes up, some animals disappear and some animals stay. The trees, some get bigger once the water goes up and then sometimes they get smaller once the water goes down.

Teens did not make an Everglades connection at the Tree Island kiosk. "I didn't think they were actually trying to show different islands." Although they understood the main message, participants did not realize that the kiosk was illustrating wetland tree islands located in the Florida Everglades.

Reactions to the Kiosk

In general, teens had a positive reaction to the Tree Island kiosk. They found the interactive nature of the kiosk to be entertaining and the content to be interesting.

The sound makes it like fun you know, because then you feel like you're active and doing something.

[20] Due to constraints on the evaluation, visitors were not observed or interviewed at the Tree Island kiosk.

I like the way it showed the water level you know, with all the animals surviving, like what animals would survive with what certain water level.

I also like how the animals, you can touch and you see which ones they are. But I wish they had more information about them.

Suggestions for improvement related to the design of the interactive. The continuous movement of the wet/dry slider bar made it difficult to read facts and the interactive a little hard to use. A few teens were confused by this feature, as expressed by one participant: "I think it's a little confusing with this because it goes up and I'm like wait, I pressed it right here. Why is it going up to that point? Why is it going up here when I pressed it right here?"

Teens also felt that the animal facts could be improved. One participant suggested making a stronger connection between the facts presented and the associated animal by incorporating animation. This teen had trouble locating some animals, in particular the "snail kite." Another teen wanted more information about each animal.

Although teens enjoyed their Tree Island experience, they felt that the exhibit was not as likely to hold visitors' attention in the museum's Eco Discovery wing. Visitors would "probably look at it for a little bit and then they'd go somewhere else."

Age appropriateness

When asked about the target audience for the kiosk, teen participants found Tree Island appropriate for all age groups including little kids, "high schoolers," and adults. The interactive design would be good for little kids and the content is appropriate for older visitors.

Intended Audiences for the *Water's Journey* Kiosks

Teen volunteers who participated in the focus groups felt the exhibit designers were somewhat successful in designing exhibits intended for teenagers. While the content seemed age-appropriate, teen volunteers felt that exhibits could be even more appealing to teens. They suggested incorporating more games, enhancing the physical design of exhibits in order to draw visitors' attention, and improving the touch screens. Representative responses include:

A game makes it interesting and fun at the same time. And then to make it relevant to teens I would think that maybe you should talk about how we you know, impact everything and what we can do to help make it better. I guess just stuff like that. Maybe green tips like how we can help the planet maybe.

I think sound effects can help too. When you hear the sound effects coming from over that side of the museum I would probably go over and see what it's about.

Teens like touch screens if they work. If a touch screen doesn't work it's like 'nah.'

Summary of the Individual Kiosks Study

As a whole, the *Water's Journey* kiosks successfully engaged visitors who were cued to interact with a kiosk. Although individual exhibits displayed some usability issues, in general visitors were able to operate the interfaces. For kiosks that included gameplay elements, visitors were able to manipulate the variables to achieve individualized outcomes. However, usability issues at times prevented visitors from accessing deeper layers of content (like the pop-ups at Wet and Dry Seasons) or engaging in the full

capabilities of the simulations (like the two-player mode at the Hurricanes or the augmented reality scenes at Human Encroachment). Observations demonstrated that many of the kiosks (such as Invasive Species, Sheet Water Flow, and Hurricanes) supported repeated interactions, with visitors playing the same game/scenario multiple times. Interview data supported these findings, indicating that visitors enjoyed the interactive elements of the exhibits and found controlling the outcomes appealing. The *Water's Journey* kiosks also supported social interaction between adults and youth and between peers. At many of the kiosks, the social interactions went beyond conversations on how to operate the exhibit, and included goal setting, hypothesizing, observations of results, and problem-solving.

The *Water's Journey* kiosks were also successful in conveying information and environmental messages. Both visitors in the target age range and teen volunteers were able to articulate the main messages of the kiosks. For exhibits with a strong human-impact message, visitors understood the implications of human development for the environment as part of the main message. Teen volunteers generally felt the exhibits were suited for teens and/or a variety of ages, and found the exhibits appealing, fun, and interactive. To enhance the visitor experience, they suggested resolving usability issues with the touch screens and incorporating more games into the interactives.

Water's Journey: Impact Analysis

The interviews with visitors and the focus groups with teen volunteers included questions that were designed to address the three high-level impacts of the *Water's Journey* project. Additionally, pre-post interest and knowledge measures were used with visitors to determine if interacting at the kiosks produced a change in visitors' self-reported interest and knowledge of Florida's environment. Reported below are the results of the analysis of the interest and knowledge measures for visitors and the findings related to each project impact.

Interest and Knowledge Ratings

Before interacting with a kiosk (or group of kiosks) for the cued observations, visitors were asked to rate their *interest* in learning about and *knowledge* of Florida's environment. A five-point scale was used with the following statements:

- How interested are you in learning about Florida's environment? (1=Not at all interested, 5=Very interested)
- How much do you know about Florida's environment? (1=Nothing, 5=A lot)

After the visitor had interacted with the kiosk(s), he or she was asked to rate both statements again, creating a matched pair of ratings for each statement.

When looking at the *interest* ratings overall, i.e. combining data for all kiosks, there was a significant difference pre-to-post in how visitors' rated their interest in learning more about Florida's environment (t-test; $t(125)=-5.401$, $p<.005$). Before visiting a *Water's Journey* kiosk, visitors' rated their interest an average of 4.0 on a five-point scale; after interacting with the kiosk, their interest rating increased to a mean of 4.3 (Table 26). This change in rating can be attributed to the visitors' interactions with the kiosk and any social interactions they had while at the kiosk.

When examining the relationship between independent variables and visitors' *interest* ratings, significant differences were found in the change of ratings pre-to-post for sex. Female visitors were more likely than male visitors to rate their interest in learning more about Florida's environment higher

after their interaction with the kiosk (t-test; $t(122)=-2.591$, $p<.05$). Visitors' age and school type (elementary, middle, high) did not affect how interest was rated pre-to-post.

A secondary level of analysis was performed to determine if differences in *interest* ratings pre-to-post were occurring at each kiosks or groups of related kiosks[21]. As seen in Table 26, visitors had significantly higher *interest* ratings after their interaction at three of the five exhibits, Human Encroachment, the Florida Table, and Hurricanes. However, interactions at Core Samples and Invasive Species did not appear to have an effect on visitors' interest in learning more about Florida's environment.

Table 26: Visitors' Interest Ratings, Pre-Post Comparison*

Kiosk	n	Mean Interest Rating		Significant Difference Pre-to-Post?
		Pre-Interaction	Post-Interaction	
Overall	126	4.0	4.3	Yes (t=-5.401; p<.005)
Hurricanes**	26	4.3	4.7	Yes (Z=-2.460; p<.05)
Human Encroachment	31	4.2	4.6	Yes (Z=-2.309; p<.05)
Florida Table**	27	3.9	4.3	Yes (Z=-2.495; p<.05)
Core Samples**	22	3.8	4.0	No
Invasive Species	20	3.7	4.0	No

*Scale: 1=Not at all interested, 5=Very interested. Based on visitor interviews in the kiosks-based study.
**Groups of two or more *Water's Journey* kiosks.

When looking at the *knowledge* ratings overall, i.e. combining data for all kiosks, there was a significant difference pre-to-post in how visitors' rated their knowledge of Florida's environment (t-test; $t(125)=-6.841$, $p<.005$). Before visiting a *Water's Journey* kiosk, visitors' rated their knowledge an average of 3.3 on a five-point scale; after interacting with the kiosk, their knowledge rating increased to a mean of 3.8 (Table 27). This change in rating can be attributed to the visitors' interactions with the kiosk and any social interactions they had while at the kiosk.

When examining the relationship between independent variables and visitors' *knowledge* ratings, no significant difference were found in the change of ratings pre-to-post. Visitors' sex, age, and school type (elementary, middle, high) did not affect how they rated their knowledge of Florida's environment pre-to-post.

A secondary level of analysis was performed to determine if differences in *knowledge* ratings pre-to-post were occurring at each kiosks or groups of related kiosks. As seen in Table 27, visitors had significantly higher *knowledge* ratings after their interaction at three of the five kiosks, Human

[21] The Florida Table, Core Samples, and Hurricanes were grouped kiosks; visitors' had the option of interacting with all kiosks in the group. The majority of visitors in the Florida Table sample interacted with all three kiosks (18 of 20). At Hurricanes 3 of 22 visitors interacted with both kiosks. At Core Samples 2 of 18 visitors interacted at both kiosks.

Encroachment, the Florida Table, and Hurricanes. However, interactions at Core Samples and Invasive Species did not appear to have an effect on visitors' knowledge of Florida's environment.

Table 27: Visitors' Knowledge Ratings, Pre-Post Comparison*

Kiosk	n	Mean Knowledge Rating		Significant Difference Pre-to-Post?
		Pre-Interaction	Post-Interaction	
Overall	126	3.3	3.8	Yes (t=-6.841; p<.005)
Hurricanes**	26	3.4	4.0	Yes (Z=-2.893; p<.005)
Human Encroachment	31	3.6	4.0	Yes (Z=-2.828; p<.005)
Florida Table**	27	2.9	3.7	Yes (Z=-4.065; p<.005)
Invasive Species	20	3.7	3.8	No
Core Samples**	22	3.0	3.4	No

*Scale: 1=Nothing, 5=A lot. Based on visitor interviews in the kiosks-based study.
**Groups of two or more *Water's Journey* kiosks.

Impact 1: Adolescents will develop a greater awareness of how water impacts the environment, from the local to the global.

The kiosks employ water in a variety of ways in displaying its environmental impact. Core Samples uses water as a context for the changing Florida environment, displaying how the coastline of Florida has changed overtime to be more or less under water; the type of fossils displayed are related to this environment. Human Encroachment uses water in a tangential way, displaying animals in an augmented reality environment that includes water. The Florida Table kiosks each have a strong focus on water. Sheet Water Flow focused on the changing flow of water over time and manipulation of water flow. Wet & Dry Seasons kiosk displays the average rainfall in each month and includes information on how rainfall variations impact the natural and human-build environment. The Hydrologic Cycle kiosk is focused on the cycle of water and human impact on the cycle. In the Hurricanes kiosks, the Storm interactive includes the manipulation of water temperature to affects the formation of hurricanes and the results screens of the kiosk show the impact of flooding and rainfall as a result of the storm. The Invasive Species kiosk presents facts the impact of invasives on water quality, and the augmented reality interactions include the role of water in mitigation.

Visitors

In order to explore issues of water's impact on the environment, visitors were asked to rate the degree to which the *Water's Journey* kiosk(s) they had interacted with included information on "the role of water in Florida's environment." Using a scale from 1 to 4 (where 1=Not at all and 4=A lot), 17% indicated the kiosk included "a lot" (or 4 out of 4) of information on the role of water in Florida's

environment (Table 28). The mean rating across all kiosks was 2.3 out of 4. There were no differences in ratings based on the age of the visitor or the sex (i.e. male vs. female) of the visitor.

Table 28: Visitors' Ratings for the Amount of Information on the Role of Water in Florida's Environment (n=122)*

Rating Category	n	% of Visitors
Not at all	48	39%
A little	16	13%
Quite a bit	37	30%
A lot	21	17%

*Based on visitor interviews from the kiosks-based study.

When the ratings are analyzed to compare the kiosks to each other, there are significant differences in how visitors rated the amount of information on the role of water in Florida's environment at each kiosk (Kruskal Wallis test: X^2=37.458, p<.005; Table 29). The Florida Table kiosks were perceived by visitors to contain the most information about the role of water in the environment (mean=3.4); Human Encroachment was perceived to have the least amount of information on the role of water (mean=1.7).

These differences in ratings are not surprising given that the Florida Table kiosks were the most water-focused of all the *Water's Journey* kiosks. Water was a contextual factor or backdrop at some of the other kiosks like Human Encroachment and Hurricanes; at the Florida Table, water direction, movement, and cycles were at the core of the simulations. It is somewhat surprising that the Invasive Species kiosk was not seen as water-focused by visitors. Two of the invasive species highlighted, the Melaleuca tree and the water hyacinths, are problematic because of their impacts on water quality. This finding may indicate a need to more prominently discuss the role of water quality at the Invasive Species kiosk.

Table 29: Kiosk Comparison Visitors' Ratings for the Amount of Information on the Role of Water in Florida's Environment at the Kiosk*

Kiosk	n	Mean Rating	St. Dev.
Overall	122	2.3	1.154
Florida Table**	27	3.4	.844
Hurricanes**	25	2.2	.987
Core Samples**	22	2.1	1.082
Invasive Species	17	1.8	1.033
Human Encroachment	31	1.7	.945

*Scale: 1=Not at all, 4=A lot. Based on visitor interviews from the kiosks-based study.
**Groups of two or more *Water's Journey* kiosks.

Visitors who indicated the topic was included "A little," "Quite a Bit," or "A Lot!" were asked an open-ended question: "What do you remember from the exhibit that was about the role of water in Florida's

environment?" Visitor responses were analyzed across all interviews (n=74) and coded into emergent categories (Table 30). The most common response given by visitors referred to the impacts humans have on water or water has on humans; 41% of visitors mentioned this interrelationship between water and humans in Florida's environment. This category was most often mentioned by visitors who had interacted with the Florida Table, Human Encroachment, or Hurricanes kiosks. For example, at Human Encroachment and the Florida Table, children mentioned the early use of dredgers in Florida. Others focused on how humans use water like the fifteen year old who responded, "Canals helped the agriculture in Florida." Some visitors made connections between human use of water and environmental impacts. An eighteen year old male said that "New things get built and waterways go in a different direction—animals don't have enough water to live in."

Table 30: Visitors' Responses for how the Role of Water in Florida's Environment was Incorporated into the Kiosks (n=74)*

Category	n	% of Visitors**	Kiosks Where the Category Occurred Most Often
Human impact on water/Water's impact on humans	30	41%	Florida Table, Human Encroachment, Hurricanes
Water and changes over time	16	22%	Core Samples, Florida Table, Hurricanes
Connection between water and the environment and/or animals	15	20%	Core Samples, Florida Table, Human Encroachment, Invasive Species
Water flow and cycles	11	15%	Florida Table
The role of water in weather formation	3	4%	Florida Table
Other	3	4%	n/a
I don't know/I don't remember	11	15%	n/a

*Based on visitor interviews from the kiosks-based study.
** Multiple responses allowed; total may exceed 100%.

Another 22% of visitors highlighted the relationship between water and change over time; this could be long-term, geologic change or seasonal change. Some youth noticed that hurricanes were dependent on seasonal changes in water temperature; for example, a thirteen year old girl said that the "temperature of water can affect hurricane, [making it] stronger or weaker." Others who had visited the Core Samples kiosks described the changing Florida coastlines: "land expanded and shrunk, [from] glaciers melting and shrinking size of Florida," responded a fourteen year old.

One-fifth (20%) of those visitors who answered this question made a connection between water and the environment generally or animals specifically. A thirteen year old boy said that "as there is more water, animals thrive" in response to interacting with the Human Encroachment kiosk. As mentioned above, other youth made connections between the environment or animals needs for water and human impacts on water flow or amount.

Additional analyses were performed on the categories with a sufficient number of responses. One area of significance was found; visitors in elementary school were much less likely than middle school or high school-aged visitors to mention the connection between water and changes over time ($X^2(2,n=74)=10.531$, $p<.005$). No other significant differences were found based on grade or sex.

Teen Volunteers

Teen focus group participants were asked to think broadly across the kiosks they interacted with in order to determine how *Water's Journey* exhibits work together to meet the intended goals. Many of the exhibits got teens thinking about water and how it impacts the environment. Teens made connections between water and the environment at all of the exhibits (Tree Island, the Hurricanes kiosks, Invasive Species, Core Samples, and all three Florida Table kiosks). Various responses include:

> *It's people learning how like the water affects the intensity of the hurricane.*
>
> *All three of the invasive species...revolve around water.*
>
> *The water flow one where you had to like mess with where water was actually going and how we changed it and how that affected water flow.*
>
> *In the core species I did, it all revolved around water animals, so that also shows like the great impact of water on our environment, especially how Florida was pretty much non-existent in the past; it was all water. So that was good.*

Those who interacted with Human Encroachment found the message regarding water to be weak. Members from both focus groups discussed how little this exhibit focused on water impacting the environment. One teen felt that Human Encroachment had "no water message" and another participant thought it "was more geared to animals." Others thought the Hydrologic Cycle and Core Samples least addressed the topic of water impacting the environment:

> *The water cycle didn't really talk about impact. It just showed like water cycles going up and down and coming back.*
>
> *[Core Samples] doesn't really talk about the water, it just says about the creatures that used to be in it. Doesn't really have an impact on Florida that much, other than the amount of land it has.*

In order to help these kiosks to better support that message, teens suggested incorporating an interactive game into the Hydrologic Cycle: "maybe add like a game at the end like see if they can guess what they learned…Like see if they can connect the cycle to what is happening." For the Core Samples kiosks, teens felt that adding interpretive text to "explain how water affected those species, like how water played a role in the extinction" would strengthen the message of water impacting the environment.

Impact 2: Adolescents will gain a clearer concept of the time scales and scope of environmental change.

The kiosks use a variety of time scales in their approach to displaying environmental changes over time. Core Samples uses "deep time" or a geological time scale; this seems to have resonated with visitors. Human Encroachment uses a shorter timespan; the introduction starts in the 1800's and the simulation shows population fluctuations over an accelerated time frame. The Florida Table kiosks use a variety of methods to show time. Sheet Water Flow incorporates snapshots of the flow of surface water in Florida in modern times, and the Wet & Dry Seasons kiosk uses a seasonal time frame. In the Hurricanes kiosks, the Storm interactive uses seasonal changes to describe how water temperature affects the formation of hurricanes. The Invasive Species kiosk presents facts about the year invasive species were introduced

and the rapid rate of invasion, including hypotheses about the spread of the species over time if left unchecked.

Visitors

In order to explore issues of time scale and environmental change, visitors were asked to rate the degree to which the *Water's Journey* kiosk(s) they had interacted with included information on "how Florida's environment changes over time." Using a scale from 1 to 4 (where 1=Not at all and 4=A lot), 28% indicated the kiosk included "a lot" (or 4 out of 4) of information on environmental changes over time (Table 31). The mean rating across all kiosks was 2.7 out of 4.

Table 31: Visitors' Ratings for the Amount of Information on Environmental Changes Over Time at the Kiosk (n=125)*

Rating Category	n	% of Visitors
Not at all	26	21%
A little	21	17%
Quite a bit	43	34%
A lot	35	28%

*Based on visitor interviews from the kiosks-based study.

There was a significant difference in how visitors of different ages rated the amount of information on environmental changes over time. Visitor age was strongly correlated with the ($r(123)=-.275$, $p<.005$); younger children tended to rate the amount of environmental change information higher than older teens did. There were no differences in ratings based on the sex (i.e. male vs. female) of the visitor.

When the ratings are analyzed to compare the kiosks to each other, there are significant differences in how visitors rated the amount of information on environmental changes over time at each kiosk (Kruskal Wallis test: $X^2=17.306$, $p<.005$; Table 32). Human Encroachment was perceived by visitors to contain the most information about environmental change over time (mean=3.1), followed by Core Samples (mean=2.9). Hurricanes and Invasive Species contained the least amount of information on change over time, as reported by the visitors in the study (mean=2.2 for both kiosks). There could be a number of reasons for why visitors perceived Human Encroachment, Core Samples, and the Florida Table were perceived as having more information on environmental change over time:

- Visitors may have perceived these exhibits as having a great emphasis on change over time because they were more explicit in their use of time. All three of the top-rated kiosks had a timeline element.
- The top-rated exhibits also used time in the traditional sense of a straight line or "progression" as opposed to cyclical or seasonal changes. This definition of time may have been implied in the way the question was worded as "changes over time." This wording may have invoked a more narrow view of time for visitors, causing them to rate more highly the kiosks that used a time-line approach.[22]

[22] The Florida Table included kiosks with both a timeline element and a seasonal or cyclical element.

Table 32: Kiosk Comparison Visitors' Ratings for the Amount of Information on Environmental Changes Over Time at the Kiosk*

Kiosk	n	Mean Rating	St. Dev.
Overall	125	2.7	1.094
Human Encroachment	30	3.1	.973
Core Samples**	22	2.9	1.151
Florida Table**	27	2.9	.917
Hurricanes**	26	2.2	1.084
Invasive Species	20	2.2	1.056

*Scale: 1=Not at all, 4=A lot. Based on visitor interviews from the kiosks-based study.
**Groups of two or more *Water's Journey* kiosks.

Visitors who indicated the topic was included "A little," "Quite a Bit," or "A Lot!" were asked an open-ended question: "What do you remember from the exhibit that was about how Florida's environment changes over time?" Visitor responses were analyzed across all interviews (n=96) and coded into emergent categories (Table 33). The most common response given by visitors was that plants and animals change over time, given by 45% of who were asked this question. Again, the specific kiosk the visitor interacted with played a role in the response they gave. For example, at the Core Sample kiosks, visitors tended to focus on the different animals or plants the existed in different time periods, something that was clearly illustrated by the kiosk. For example, a twelve year old girl at Core Sample said, "animals and stuff evolved…the farther back I go there were different animals that I didn't know about and that don't exist now."

Table 33: Visitors' Responses for how the Environment Changes Over Time were Incorporated into the Kiosks (n=96)*

Category	n	% of Visitors**	Kiosks Where the Category Occurred Most Often
Animals and/or plants change	43	45%	Core Samples, Human Encroachment
Human impact/Humans cause environmental change	31	32%	Florida Table, Human Encroachment
Seasonal Changes	18	19%	Florida Table, Hurricanes, Invasive Species
Processes that occurred on a geologic time scale	13	14%	Core Samples
Water flow and cycles	7	7%	Florida Table
Other	10	10%	n/a
I don't know/I don't remember	11	12%	n/a

*Based on visitor interviews from the kiosks-based study.
** Multiple responses allowed; total may exceed 100%.

Another 32% of those interviewed mentioned human impacts causing environmental change over time. For many visitors human impacts were related to the changes seen in plants and animals, and they gave responses that highlighted both categories. This interrelationship was most clearly illustrated at Human Encroachment. Visitors noticed that as time passed human impacts on animals increased. "When human population stacked up, the animal population went down," said an eleven year old girl. A ten year old boy responded that the kiosks "show[s] when we keep on multiplying, animals go away and how they change over time because of that."

Additional analyses were performed on categories with a sufficient number of responses. Based on these analyses, no other significant differences were found based on grade (i.e. elementary, middle, or high school) or sex.

Teen Volunteers

Teen focus group participants were asked to think broadly across the kiosks they interacted with in order to determine how *Water's Journey* exhibits work together to meet the intended goals. Teens found that some of the exhibits succeeded in getting visitors to think about environmental changes and how they happen over periods of time. The Sheet Water Flow kiosk utilized a timeline to show how the natural flow of water changed over time in Florida. Scrolling through time at the Core Samples kiosks allowed visitors to look at each fossil and "see how the species evolved and changed during time." Invasive Species also strongly communicated a message of change over time:

> *It helps us to understand the overall effect over time and try not [to] bring in anymore invasive species…so we can protect the future.*

There were mixed opinions regarding the degree to which the message came out with Human Encroachment and Tree Island. Some teens found the message about change over time evident, while others felt it was weak. Teens had the most trouble making connections at the Hurricanes kiosks and the Hydrologic Cycle, feeling these exhibits weakly communicated environmental change over time.

For teens, a visual depiction of a timeline was extremely helpful in communicating the message of change over time. They suggested that designers incorporate a timeline into some of the other kiosks. In addition, providing more information to explain environmental changes over time would be helpful. Adding interpretation to the changing population of mammals at Human Encroachment and more information about the monthly water temperatures at the Storm kiosk would improve exhibits.

Impact 3: Adolescents' confidence level in their ability to understand the relevance of science will rise as they explore the vast amount of scientific data that has been collected, and answer their own questions about the Florida Everglades' rich and fragile ecosystem, and its importance to their own community.

This impact was operationalized by focusing on the degree to which youth perceived the topics of the kiosks as relevant to their daily lives. Most of the kiosks included information that was related to daily life. The exception is the Core Samples kiosks which are focused on deep time and make no direct connections between ancient life forms and the modern world.

Visitors

In order to explore issues of personal and community relevancy, visitors were asked to rate the degree to which the topic of the *Water's Journey* kiosk(s) they had interacted with was important for them to know about. Using a scale from 1 to 4 (where 1=Not at all and 4=A lot), 66% rated the topic of the kiosk they interacted with as "a lot," or a 4 out of 4 (Table 34). The mean rating across all kiosks was 3.6 out of 4.

Table 34: Visitors' Ratings for the Importance of the Kiosk's Topic (n=126)*

Rating Category	n	% of Visitors
Not at all	1	1%
A little	3	2%
Quite a bit	39	31%
A lot	83	66%

*Based on visitor interviews from the kiosks-based study.

There was a significant difference in how visitors of different ages rated the importance of the topics at the kiosks. Visitor age was strongly correlated with the importance rating ($r(124)=-.221$, $p<.05$); younger children tended to rate the importance of the topic higher than older teens did. There were no differences in ratings based on the sex (i.e. male vs. female) of the visitor.

When the ratings are analyzed to compare the kiosks to each other, there are significant differences in how visitors rated the importance of the topics of each kiosk (Kruskal Wallis test: $X^2=19.668$, $p<.005$; Table 35). Hurricanes and Human Encroachment were the highest rated kiosks in terms of importance (mean=3.9 and 3.8 respectively) and Core samples was the lowest rated (mean=3.2). This difference between kiosks makes sense when the content of the kiosks is compared. The main messages of the Hurricanes kiosks are most closely related to a child's daily life in Florida and include suggestions for action that children can undertake. The Core Samples kiosk, while interesting to youth, is not directly tied to daily life and therefore could be perceived as less relevant.

Table 35: Kiosk Comparison of Visitors' Ratings for the Importance of the Kiosk's Topic*

Kiosk	n	Mean Rating	St. Dev.
Overall	126	3.6	.578
Hurricanes**	26	3.9	.326
Human Encroachment	31	3.8	.425
Florida Table**	27	3.6	.565
Invasive Species	20	3.5	5.13
Core Samples**	22	3.2	.795

*Scale: 1=Not at all, 4=A lot. Based on visitor interviews from the kiosks-based study.
**Groups of two or more *Water's Journey* kiosks.

Visitors who rated the importance of the topic as "a little," "quite a Bit," or "a lot!" were asked an open-ended question: "Why should you know about it?" Visitor responses were analyzed across all interviews (n=122) and coded into emergent categories (Table 36). The most common reason visitors gave as to why the topic of the kiosks was important was that the kiosk contained information about animals or the importance of animals; 30% of visitors gave this response. For example, one twelve year old boy who interacted with Human Encroachment felt the kiosk's message was important because "animals are part of a huge ecosystem. If one thing goes wrong, no animals." Another boy interviewed at the Core Samples focused on the didactic elements of the exhibit, saying the "main reason for the exhibit was to show kids that don't really know about prehistoric animals and species."

Table 36: Visitors' Responses for why the Topic of the Kiosk was Important to "Know About" (n=122)*

Category	n	% of Visitors**	Kiosks Where the Category Occurred Most Often
Animal information related to the kiosk's topic	36	30%	Core Samples, Human Encroachment
Care/protect the environment and/or animals	27	22%	Florida Table, Human Encroachment, Invasive Species
Preparedness	25	21%	Hurricanes
Learning or general exposure to the topic	24	20%	All kiosks
Human Impact/Development	20	16%	Florida Table, Human Encroachment
Florida-related issue	18	15%	Core Samples, Florida Table, Hurricanes
Changes over time (Geologic or Historical Scale)	15	12%	Core Samples
Environmental information related to the kiosk's topic	14	12%	Florida Table, Human Encroachment, Hurricanes, Invasive Species
Invasive species mitigation	8	7%	Invasive Species
Other	4	3%	n/a
I don't know/I don't remember	0	0%	n/a

*Based on visitor interviews from the kiosks-based study.
** Multiple responses allowed; total may exceed 100%.

Another 22% of visitors focused specifically on the kiosk's message of the need to care for animals or protect the environment. For many visitors this was related to the concepts of the importance of animals and human impacts. For example, one thirteen year old boy said, "we have to protect the environment and help raise animal populations" as a reason that the Human Encroachment kiosk was important. A twelve year old boy posed the question about the future decisions waiting for children: "When we grow up, are we going to build wherever or be cautious?" An older teen felt the Florida Table had a similar important message, to "tell other people…[to] know what to do and what not to do."

Other response categories, including "Human Impact/Development" and "Florida-related issue," also supported the intent of this visitor impact through an emphasis on the human dimension of environmental impact and the local/Florida-based nature of the topic. Additional analyses were

performed on categories with a sufficient number of responses. Based on these analyses, no significant differences were found based on grade (i.e. elementary, middle, or high school) or sex.

Teen Volunteers

Teen focus group participants were asked to think broadly across the kiosks they interacted with in order to determine how *Water's Journey* exhibits work together to meet the intended goals. As a whole, teens thought the *Water's Journey* exhibits helped them to better understand connections between science and their personal lives. Teens reported these exhibits to be most relevant to their lives: Human Encroachment, Hydrologic Cycle, Wet & Dry Seasons, Hurricane kiosks, and Invasive Species. These exhibits emphasized human interaction with the environment or made a personal connection to Florida for teens.

> *[Human Encroachment] is pretty much based on what we do. And it impacts what we do on the animals.*
>
> *The otter one [Human Encroachment] I think was the most relevant because it shows how humans and their environment interact. If you start building all these types of you know, construction things, then you know how that's going to affect animals there.*
>
> *I think the water cycle is more relevant because we see rain most in the summer like every day and the ocean is right next to us. I think the rain affects us the most down in Florida.*
>
> *[Invasive Species] shows how chemicals and other things, such as human interaction and nature all impact the environment. I guess you can relate that to yourself in a way because it shows how you adapt to the environment and how you can change in the environment. That changes your life a lot.*

Teens who interacted with the Hurricane kiosks found this exhibit to be the most relevant to their lives. They felt empowered to take action and apply storm preparation techniques when the next hurricane threatens Florida.

Participants had trouble making personal connections at the Core Sample kiosks. Teens viewed this exhibit primarily as a history lesson.

> *It doesn't really show how that can change your life or anything.*
>
> *They were talking about animals that had nothing to do with humans, really. And, there was no real science other than showing adaption and evolution over time. So you couldn't really see anything that had anything to do with your life in there.*

One participant emphasized the unique experience created through the *Water's Journey* kiosks: "I would say that it takes an exhibit [to help me realize the importance of science] because I don't really think about that all the time. I have to definitely come to the museum and then think about like going green and stuff."

Summary of the Impacts of the Water's Journey Kiosks

As a whole, interactions with the *Water's Journey* kiosks increased visitor interest and knowledge about Florida's environment; statistically significant differences in interest and knowledge ratings were found when the data for all the exhibits were combined, and also at three of the five exhibit groups. (Human Encroachment, the Florida Table kiosks, and the Hurricanes kiosks; Tables 26 and 27).

In terms of the three impacts for the project, the project achieved these impacts when viewed as a single unit; however, as seen in Table 37, not all of the exhibits were perceived by visitors to include elements related to the impacts. The Florida Table kiosks (which were three of ten total kiosks created by the *Water's Journey* team), were the only ones perceived by visitors to have included at least a moderate amount of information on the role of water in Florida's environment (where "moderate" would be a 2.5 on the 4-point scale; Table 29). However, when the qualitative responses are included in the analysis, it becomes apparent that visitors were able to discuss the role of water in relation to the exhibit topics, even if they perceived that the role of water was only lightly featured by the exhibit. These qualitative responses also indicate that visitors perceived issues such as human impact, change over time, and the role of water in the environment in the majority of *Water's Journey* exhibits. Similarly, the teen volunteers discussed how water was incorporated into all of the exhibits but found that the message of the environmental impact of water was stronger at some exhibits than others.

Table 37: Kiosk Comparison of the Three Visitor Impacts*

***Water's Journey* Kiosk**	**Impact 1: Role of Water**	**Impact 2: Change Over Time**	**Impact 3: Importance**
Florida Table**	✓	✓	✓
Core Samples**		✓	✓
Human Encroachment		✓	✓
Invasive Species			✓
Hurricanes**			✓

*Based on visitor interviews from the kiosks-based study; where a ✓ means a kiosk was rated a 2.5 or higher on a four-point scale (1=Not at all to 4=A lot).
**Groups of two or more *Water's Journey* kiosks.

Three exhibits or exhibit groups (the Florida Table kiosks, the Core Sample kiosks, and Human Encroachment) achieved the change over time impact at a moderate or higher level when looking at the ratings (where "moderate" would be a 2.5 on the 4-point scale; Tables 37 and 32). Considering the open-ended responses, the same three exhibits were mentioned as highlighting changes over time in animals and plants or as a result of human behavior. The other exhibits were much less likely to be perceived as including change over time messages, and visitors commonly were not able to explain how change over time was incorporated into the exhibit. As discussed previously, this finding may be a result of these kiosks using less explicit examples of time. Teen volunteer data support the hypothesis that visualizations that include timelines help to explicitly support the change over time message.

All *Water's Journey* kiosks were perceived by visitors as important topics to know about, with all of them receiving ratings of 3.2 or higher on this item (Table 37 and 35). Reasons for perceiving a topic as important were, not surprisingly, highly related to the main idea of the individual kiosk, and in turn, the

goals of the project. Information related to caring for animals or the environment was the second most mentioned reason for identifying a kiosk's topic as important.

Project Team's Assessment of the Project and its Impacts

In one-on-one interviews with a member of the evaluation team, members of the *Water's Journey* project team were asked to reflect on the final products of the project as a whole and the project's impacts on the MODS' visitor experience and the fields of science centers and informal science education. The teen volunteers also reflected on the degree to which the Water's Journey exhibits enhance the MODS' mission and visitor experience. The reflections of the project team and the teen volunteers are based on their own understanding of the project's goals, the mission of MODS, and the professional fields of science centers and informal science education.

Reflections on the Final Products

Members of the project team thought that the *Water's Journey* project as a whole met its goals. The team collaboratively developed exhibits on local environmental topics that were appealing to teenaged visitors. "I think it breaks down complicated environmental pieces into easily digestible forms for visitors to understand," replied one MODS staff member. Another commented, "I think they are interactive, that people like to play around with them, and they learn things from them. I like the one where they can track their finger around the seasons—It is very easy to get. It is a hard concept to get across, but it is very easy to get across when you are playing with it." While the kiosks may not have increased the overall number of youth aged 10 to 16 visiting the museum, they do provide engaging, relevant interactions for teens who are visiting.

The team members from the two partner organizations, however, did differ over degree to which the project met the goal of including mixed or augmented reality. Members of the MODS team felt that this portion of the project was not fully realized, while members of the UCF/E2i teem felt mixed or augmented reality was successfully incorporated. These differences in the degree to which mixed or augmented reality were included in the kiosks and the role of the augmentation in conveying the content are illustrated below:

> *I know we didn't really fulfill the augmented reality [goal]. There isn't one that is an AR, we didn't accomplish the goal of augmented reality…Some of the exhibits just weren't designed to be augmented. The only attempt of AR is at the otter habitat…the animals are supposed to roam through the environment but they really just stand there and move a bit when you touch on them. But it is not fooling anyone that they are really in the environment…So maybe [there are] only two that could count as AR. (MODS staff member)*

> *I feel like we used new and emerging technology to enhance what you would feel was a typical exhibit. I'm not sure that was true of all the exhibits, but I think that was true with the MR exhibits….I feel like our augmented reality was really successful. (UCF/E2i staff member)*

> *The ones that are trying to make use of augmented reality, I think, they have effective content, but how much of that really has to do with superimposing the animation over the live footage? [People understand the content,] but I don't think that has much to do with the augmented reality part of it. (MODS staff member)*

In the end, it may be that the teams had different, not completely aligned visions of what mixed or augmented reality is, the capabilities, and how to define success for this project goal. These differences in vision were recognized by members of the project team:

> *I think that what people originally imagined and what was possible was two different things. I think that over time we became more precise and I think that a lot of the stuff that we originally pictured—like you would go to a portal and look through and you would see things moving along that were virtual and things that were real. I don't know if that is because I didn't understand the technology or what…but what is out there that is good. (MODS staff member)*

> *We were always looking at AR as a narrative and not as a pop-up, as it is in the marketing [arena]. We would explain it to people and they were like "You are doing that?," the marketing early adopter things they had seen on TV, and it wasn't until later they would see it was different. (UCF/E2i staff member)*

> *It depends on how you define that and what it is supposed to be. But the whole concept of augmented reality is kind of gimmicky and I don't know how important that is. I think of some of the things [UCF] works on in virtual reality with the military or with disabled people, that is valuable. But in the museum, I don't think it is needed. (MODS staff member)*

Whether the project successfully met its goal of using augmented reality to interpret content is not entirely clear among the project members.

Impacts on the MODS' Visitor Experience

The *Water's Journey* project team felt the kiosks successfully support the mission and goals the museum. An UCF/E2i staff member replied that "The museum's mission or goals are to raise awareness of the environment and the animals…it is really showing the human impact" on the environment. A museum staff member on the team agreed: "I think [water] is an area that we didn't have any kiosks about. So that's what the Everglades are all about, water, and we didn't have anything that represented that. So it has given that piece that was missing in the museum. It added a lot of technology, and new technology that we didn't have before."

Teen volunteers who participated in focus groups also were asked about the value of incorporating *Water's Journey* kiosks into the new EcoDiscovery Center. Most viewed the *Water's Journey* exhibits as an added addition to the museum. The placement of the kiosks seemed fitting:

> *I think especially since the animals are right next to it. So after you go through the animals you can see the lifestyle kind of the animals that are affected by the water cycle. I think it's a good addition. (Teen Volunteer)*

> *I think it's good because it's right next to the Everglades. And people forget that. They think the Everglades are always full of water. But since the water cycle over there by the tree, it shows how it goes down during the dry season and everything. (Teen Volunteer)*

Many of the teens believed the *Water's Journey* kiosks supported the overall goals and mission of the museum. The exhibits reinforced the museums messages about water, the environment, and encouraged green practices. Teens also emphasized how kiosks fit well with the museum's goal of creating personal connections for visitors. This is exemplified in one teen's response:

Because the museum, what I feel like its main goal is it's to like expand the knowledge of like not only like the habitat itself, but also how it affects you and how you affect it. So through these three exhibits, these kiosks, they actually like help us understand more about our habitat and how we can help and how we can protect ourselves. So it definitely fits the goal. (Teen Volunteer)

Considering the goals of the museum and the role of the exhibits in the visitor experience, the teen volunteers and members of the *Water's Journey* project team agreed these goals were met.

Impacts on Fields of Science Centers and Informal Science Education

The impacts the project may have on the fields of science centers and informal science education were somewhat difficult for most members of the project team to articulate. This is likely a result of having just finished the project and needing distance and feedback from these fields to make a meaningful assessment of the impacts.

Individually, members of the *Water's Journey* project team felt they had grown professionally from the project. Learning to collaborate successfully with another team was an area of professional growth for at least one member of the team from each organization. These team members hoped the museum-university partnership would serve as an example to the field for what can be accomplished through partnerships and collaborations. Other members of the team, however, felt that the field already has literature on best-practices for multi-institutional collaboration. From the point of view of these team members, the project built on the existing collaboration literature and is a good example of collaboration, but does not signal a shift in what is already known about collaborations.

The team members did feel that the *Water's Journey* exhibits were successful examples of layering information. Individually, each kiosk has multiple layers of information, allowing visitors to go deeper as they explore; collectively the kiosks work together to layer the environmental messages throughout the EcoDiscovery Center. Multiple members of the project team cited the layering as a point of learning for the wider field:

I think it is a new way of…displaying information where multiple things can interact with one centered thing…when you go to other museums, you see that you push a button and it throws information at you. But this you have to manipulate it and explore the possibilities, so I think this is a different way of looking at exhibits. (MODS staff member)

If you give them little pieces [of a message that] is relevant or intriguing to them or if it strikes a chord or passion for them [they will get the message]. Because a lot of time the content is all at one kiosk and if you don't get it [there], you don't get it. Here it is an overarching theme and they visit across [the kiosks] and then at the end of the day pull out of their memory all the pieces. (MODS staff member)

Members of the team did say that with the summative evaluation findings and through continued conversations and presentations, they would be more able to articulate the impacts of the *Water's Journey* project on the larger field.

Conclusions and Recommendations

Through cued interactions and interviews with visitors aged 8 to 18, findings indicate that the exhibits, when analyzed comprehensively, achieved the three audience impacts for the project. Individually, some exhibits achieved all three impacts while others achieved one or two.

> ***Impact 1: Adolescents will develop a greater awareness of how water impacts the environment, from the local to the global.***
>
> Quantitative ratings indicated that visitors in the target age-range did not perceive the role of water in the environment as a message of all of kiosks; only the Florida Table exhibits were perceived as strongly incorporating the role of water in the environment. However, qualitative data indicated that visitors were able to accurately describe how the topic was incorporated into the remaining *Water's Journey* exhibits.
>
> ***Impact 2: Adolescents will gain a clearer concept of the time scales and scope of environmental change.***
>
> Quantitative ratings indicated that visitors in the target age-range did not perceive the topic of environmental change over time as a message of all kiosks; visitors did not perceive the Hurricanes and Invasive Species exhibits as including a significant amount of information on change over time. Qualitative data indicated that, for these same exhibits, visitors were not able describe how the topic was incorporated into the exhibits. This finding may be a result of the different methods used to interpret time, with the some kiosks using more explicit visualizations or time scales (such as deep time) which are more commonly associated with environmental change.
>
> ***Impact 3: Adolescents' confidence level in their ability to understand the relevance of science will rise as they explore the vast amount of scientific data that has been collected, and answer their own questions about the Florida Everglades' rich and fragile ecosystem, and its importance to their own community.***
>
> Quantitative and qualitative data both support the findings that this impact was achieved at all *Water's Journey* exhibits, with visitors in the target age-range describing the necessity to care for animals and the environment as reasons why the exhibits were relevant. Issues such as human impacts on the environment and the local/Florida-related scope of the topics were also mentioned by a sub-set of visitors.

It is important to note that the above findings were measured through cued interactions and interviews with visitors; when visitors were observed unobtrusively, results indicate that the *Water's Journey* exhibits as a whole were not heavily used and that visitors spent relatively little time at the exhibits. It can be concluded, therefore, that while the kiosks have the potential to achieve their intended impacts, they may not be achieving these impacts under the typical usage conditions of the museum exhibition areas.

Considering the goal of using technologically-based exhibits to engage visitors ages 10 to 16, visitors and teens were successfully able operate the interfaces and repeatedly played through the games or scenarios. The kiosks also supported social interaction between adults and youth and between peers. At many of the kiosks, the social interactions went beyond conversations on how to operate the exhibit, and included goal setting, hypothesizing, observations of results, and problem-solving.

Moving beyond visitor impacts, it is not entirely clear among the project members whether the project successfully met its goal of using augmented reality to interpret content. In any collaborative endeavor, shared vision and understanding is essential to the outcome of the project. This necessity may be exacerbated in projects employing emergent technology where the capabilities of the technology may not be well understood by all members of the team. Just as importantly, the capabilities of emerging technology are constantly evolving throughout the course of the project, which may mean the team has to continually revisit and revise what successful implementation of the technology looks like.

Appendices

Appendix 1 Contextual Study: Observation and Interview Protocol

Overview

This study will use a specific observation method common in visitor studies: Timing and tracking. Timing and tracking is a type of unobtrusive observation where data are collected about how visitors naturally use an exhibition and/or specific components within an exhibition (Yalowitz & Bronnenkant, 2009). In this study, we will track approximately 65 individual visitors (from both school and family groups) in Area 1 and 30 in Area 2. Visitors will not be cued or approached by the data collectors at the beginning of the observation. Visitors will be tracked from the beginning of the exhibition through the entire space to the end of the exhibition. Data collectors trained by ILI staff will record information such as the pathway that the visitor takes through the exhibition, as well as their level of engagement at specific stops and social interactions with each other and with staff members as applicable. The total time spent at the site and in certain areas will be recorded. At the end of the exhibition, the data collector will approach the visitor who was observed for an interview.

Materials Needed

Clipboard

Pencils/pens

Watch or stopwatch

Tracking Maps (to be created after researchers have made a site visit, late January 2012)

Interview instrument

Study Information sheet

Observation sign

Thank You gift (pencils)

Sampling Procedures

Based on the layout of the exhibition, ILI staff will select an appropriate location to select visitors and begin the observation. The nonprobablity sampling procedure Availability Sampling will be used, whereby visitors will be selected from the target population on the basis of their availability, convenience, or self-selection. When the data collector is ready to begin a Timing and Tracking observation (i.e. immediately after a break or after completing an interview), he or she will station themselves at the pre-determined location near the entrance of the exhibition. The next individual who appears to be 8 to 16 years of age and crosses in front of the data collector will be considered the "target" of the observation. The observation is keyed to this target visitor, with engagement scores and social interactions based on the target visitor's interactions with the exhibition. If the group splits up, the data collector will continue to track the target visitor.

Tracking the Target Visitor through the Exhibition

Remaining Unobtrusive

The goal in visitor tracking is to strike a balance between the visitor's comfort level (i.e. not getting to close to them) and the need to collect detailed data on their interactions with the various components of the exhibition. The data collector may want to remain out of the sightlines of the visiting group, so as not to interfere with his/her natural exhibition experience. The data collector may naturally engage with the exhibition themselves, often appearing as if they are taking notes about a specific exhibition

component, and not the visitor. It is not necessary to stay right with the visitor at all times, or watch them at every moment. It is suggested that the data collector keep a comfortable distance between themselves and the visiting group, being as natural as possible.

If the data collector is approached by any visitors and asked any general questions (i.e. the location or restrooms, the museum hours, etc.) the data collector should be as helpful as possible to the visitors; if they do not know the answer to a question, refer the visitor to appropriate museum staff. If the data collector is approached by the target visitor or another of their group and asked any questions about their purpose, the data collector should respond that they are observing how visitors use the exhibition as part of a study. If the visitor would like more information on the study, the data collector can supply them with a study information sheet or answer questions as they are able.

If the data collector "looses" a target visitor in the middle of tracking, they will try to find them again and make note of the amount of time you missed. If the data collector cannot locate the target visitor, they will mark the tracking map "incomplete track," mark any demographic information that they are able, and go back to the entrance to approach the next visitor.

Recording Data

Data collectors will use a modified floor plan of *Water's Journey* to record observational data (to be developed after a site visit by the evaluation team). While the specifics of the observations and the tracking sheet, the following represents a typical Timing and Tracking protocol.

Visitor's Time Spent and Path

Record the time the target visitor enters the exhibition, and later record the time they leave the exhibition. Data collectors will also record "in" and "out" times for the various kiosks to calculate average stay times in those areas, in addition to the overall stay time for the site as a whole. You may either record a "running" time with a stop watch (i.e., start at 0) or use actual time (i.e., start at the time of day the individual enters the site) and ILI staff will calculate the stay times later.

As the visitor moves through the site, the data collector will record the target visitor's pathway through the space. Specifically, the data collector will draw a line corresponding to the visitor's movement throughout the space, with particular attention paid to the visitor's stops at any key exhibits or kiosks (TBD). The data collector will mark the line with directional arrows, to record the direction of the visitor's movement throughout the space. When a visitor makes a stop at a particular kiosk, the data collector will draw the path line to touch that component and place a circle on that spot on the map. The circle reflects the focus of the visitor's attention more so than where his or her feet are planted in the gallery.

Visitor's Engagement with Interactive Experiences or Materials

Each time the visitor stops at one of the components on the map, the data collector will record the quality of engagement with that component. The data collector will not give an engagement score to stops not indicated on the map, but will draw a line to that area to show that the visitor walked or looked intently at something not on the map.

Although the amount of time spent at a component can be a useful indicator of visitors' use of a gallery, it often inadequately reflects the quality of the visitors' experience. What if the visitor spends 5 minutes in front of an exhibition component, but is talking with their partner about what to have for lunch? Therefore, ILI uses a quality ranking scale, developed to assess the quality of interactions that visitors

have with specific exhibition components. Data collectors will use the following scale to determine the target visitor's level of engagement with a particular component.

1= MINIMAL/GLANCE - visitor stops, pauses and/or glances briefly at a component/area, but displays no apparent interest in any particular element or information; if applicable, visitor does not appear to press the audio button for this stop, and does not engage with anyone in relation to it. If applicable, visitor does not approach a kiosk even when it is open and accessible. Visitor only glances at any written materials (panels, labels).

2= CURSORY/SUPERFICIAL - visitor stops, watches or views one or more elements of the component/area with slight interest; if applicable, they appear to push the audio, but walk away quickly. Visitor may read some of a panel/label; and they may engage briefly with another visitor or staff member in relation to the component/area, such as through verbal comments or pointing. If applicable, they may look at a kiosk, but do not engage, or approach it only briefly.

3= MODERATE - visitor stops, watches or views one or more elements of the component/area with apparent interest; appears engaged and focused; presses audio and seems to listen fairly closely; reads part of any panel/label available; visitor may engage in some conversation related to the component/area, or they may point out certain elements. If applicable, visitor enters the space and explores it fairly thoroughly.

4= EXTENSIVE - visitor stops, watches or views elements of the component/area very intently; appears extremely engaged and focused; presses audio and seems to listen intently to it; they may read most or all of a panel/label, engage in a fairly extended conversation with others about the area/component, or point out many aspects of the component/area. If applicable, the visitor enters the space and explores it in depth and with apparent focus and concentration.

Visitor's Social Interactions Related to the Stops

In addition to recording the target visitor's engagement with the components and "stops" on the map, data collectors will record evidence of social interaction as it is relevant to each of these experiences. Of course, this will only be relevant if the visitor being tracked is part of a larger social group or interacts with other groups or staff members during their visit. Specifically, the data collector will record instances where an individual is overheard talking to a member of their group about a particular aspect of an experience, is collaborating with someone else to use an interpretive space or material, or is pointing out something to another visitor. It is important that the conversation is <u>relevant</u> to the exhibit or site. However, if the visitor's comment relates only to wayfinding or logistics (i.e., "When are we eating lunch?" or "Where is the bathroom?"), this should <u>not</u> be recorded as social interaction. Usability issues with the exhibit should be recorded. Following are a few examples:

<u>Do record:</u> "Look at this model over here – isn't that cool?"
"I've never thought about this before."
"Can you figure out how this one works?"

<u>Do not record:</u> "When do you want to get lunch?"
"I'm going to the next section now."
"Are you still on part 1?"

The following codes will be used to record social interaction, and will be written directly next to the relevant space/material on the map:

T → A = Target to adult interaction (target initiates)
A → T = Adult to target interaction (adult initiates)
T → C = Target to child interaction (target initiates)
C → T = Child to target interaction (child initiates)
T → S = Target to staff interaction (target initiates)
S → T = Staff to target interaction (staff initiates)

Crowdedness Level
At the end of the tracking, assess the overall crowdedness level of the site during the visitor's stay. There are four levels as follows:

1 – Empty (there are hardly any other visitors on site; the visitor you are observing is often part of the only group in the space; it is very easy to access all kiosks)
2 – Sparsely visited (there are other visitors around, but the visitor you are observing still has easy access to any kiosks or exhibit components they may wish to look at. They do not have to wait or crowd around areas.)
3 – Moderately crowded (the cell blocks and other areas are relatively crowded; visitor may have some difficulty seeing everything or may have to wait to look at panels, listen to specific audio stops, etc.)
4 – Very crowded (the site is very full; visitors have to pause and wait to look at certain components, listen to audio stops, etc. The crowdedness may impact their ability to explore everything they would like to and to the extent that they might if it were less crowded.)

Transitioning from Tracking to Interviewing
When the target visitor exits the exhibition, the tracking observation is completed. Remember to note the time, so that we can calculate overall stay times for visitors. The last step in tracking is to provide any necessary context about the visitor in the NOTES section. For instance, you might write something like "Dad and daughter, and daughter led most of the interactions/experiences; Dad just followed." Take this section to tell us whatever you think will be important for us to fully understand this visitor's experience at *Water's Journey through the Everglades*. It may be necessary to complete this section after the interview.

As part of the study design we are attempting to collect an interview from each target visitor who is tracked through the exhibition, creating a matched set of observational and interview data. Therefore, at the end of the tracking, the data collector will approach the group that includes the target visitor. The primary goals of this initial interaction with visitors is to introduce ourselves, explain what we are doing, and obtain consent for the target visitor to participate in the interview. For the purposes of this method, data collectors will need to obtain the consent from an adult in the visiting group to interview a person 14 years and younger; the child will also have to give their assent. Therefore, if an adult is with the group, the introduction should be addressed to the adult, as in the following example:

> "Hi! My name is ____ and I am working with the Museum of Discovery and Science. We are talking to visitors as part of a research study to understand and improve visitors' experience at the museum. We are particularly interested in the thoughts of our younger visitors. Would it be ok if I talked to him/her [gesturing to the target visitor] before you leave?
>
> - [If the adult consents, ask the child] Is that ok with you?
> - [If the child assents, continue with script on the interview instrument]
> - [If either consent or assent is not obtained, the data collector can give more information to the visitor on the nature of the study, the time commitment, etc. If consent or assent

is not obtained at that point the data collector lets the group continue.] That's alright. Enjoy your visit to the museum today!"

If the group has no adults present **and** members of the group appear to be 15 or 16 years old, the data collector can approach the group. Because we are only interviewing those 15 and older without the consent of an adult, the data collector must verify the age of the target visitor, as in the following example:

> "Hi! My name is Kara and I am working with the Museum of Discovery and Science. We are talking to visitors as part of a research study to understand and improve visitors' experience at the museum. We are particularly interested in the thoughts of our younger visitors. We are particularly interested in the thoughts of middle and high-schoolers. Would you be willing to talk to me for a couple of minutes?
>
> - [If the child consents] Can I ask how old you are?
> - [If the child indicates they are 15 or 16] Great! I'm only talking to people who are 15 or 16, so that works. [Continue with script on the interview instrument]
> - [If the child indicates they are not 15 or 16] Oh, sorry! I'm only talking to people who are 15 or 16. I hope you enjoy the exhibit.
> - [If consent is not obtained, the data collector can give more information to the visitor on the nature of the study, the time commitment, etc. If consent is not obtained at that point the data collector lets the group continue.] That's alright. Enjoy your visit to the museum today!"

The data collector should to encourage an adult to stay with the participating child, while the rest of the group moves on through the museum. It is not necessary for the entire group to stay with the visitor participating in the interview.

If the visitor says they only have a short period of time, the data collector will assure them this is fine and that they are free to leave whenever they need to. We want to be accommodating and will tailor the interview to suit their needs and limitations. We want to include them in the sample, rather than exclude them (e.g. force them to refuse) because we can't accommodate them.

For this interview, if the target declines to participate, another visitor from the group cannot be substituted. In this case, the data collector should indicate that the target was randomly selected for the interview and that they are the only one who can complete it. If no interview is obtained from the target (either because the target declines, or because the target is 14 or younger and without an adult) the data collector will mark the map "completed track, declined interview," will mark any demographic information that they are able, and go back to the entrance to approach the next visitor.

Facilitating the Interview

Once consent is obtained, the data collector will start the interview, recording all answers as close to verbatim as possible directly on the interview instrument. The data collector will attempt to ask every question as it is worded on the instrument; however, slight re-wordings or explanations may be necessary for some visitors. At the end of the interview, the data collector will thank the visitor and give them a thank you gift.

Study Fact Sheet

Summative Evaluation Study of Water's Journey through the Everglades Observations and Interviews

You have been selected to participate in a study taking place at the Museum of Discovery and Science because entered the exhibit *Water's Journey through the Everglades*. These exhibits were designed by the University of Central Florida's Media Convergence Lab. We are conducting an evaluation study to gather information on the impact of interacting with the exhibit on visitors between the ages of 8 and 16 years old. The museum is required to study the exhibits and collect data about visitors' use of the exhibits as part of the National Science Foundation grant that funded this project. This information will help the museum, the university, and the National Science Foundation determine if the exhibits were successful at meeting their goals.

As part of the study, we are:

1) Observing visitors as they interact with the exhibits, and
2) Interviewing visitors immediately after they interact with the exhibits.

Taking part in this study is completely voluntary and you are free to request not to be observed, not to be interviewed, or to stop an observation or interview at any time. Your participation in the study will be brief—only 15 to 25 minutes total—and the study does not pose any risks to visitors. Your answers will be confidential. No identifying information will be included in any reports resulting from this study. Visitors who participate the interview will receive a small thank you gift such as a pencil in return for their time.

If you have questions about this study or would to speak to someone about it, please contact the director of the evaluation study:

Susan Foutz
Senior Research Associate
Institute for Learning Innovation
foutz@ilinet.org
(410) 956-5144

The Institute for Learning Innovation has partnered with the Museum of Discovery and Science and the University of Central Florida's Media Convergence Lab to conduct this study.

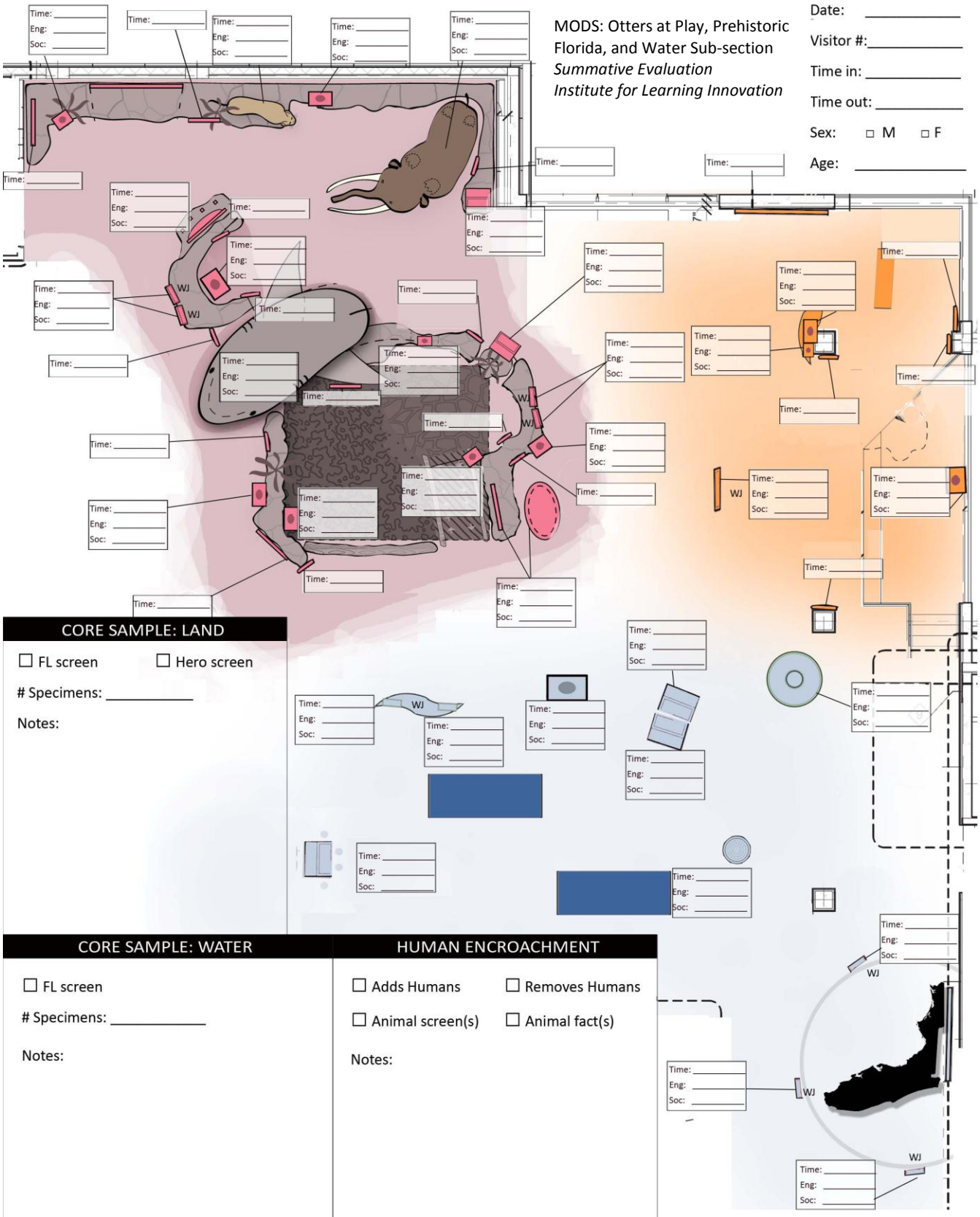
If you would prefer to speak with the lead researcher for this project at the University of Central Florida's Media Convergence Lab, please contact:

Eileen M. Smith
Director
E2I Creative Studio, a Media Convergence Laboratory
Institute for Simulation and Training
University of Central Florida
esmith@ist.ucf.edu
(407) 882-1359

Thank you for your participation and enjoy your visit to the Museum of Discovery and Science!

MODS: Otters at Play, Prehistoric Florida, and Water Sub-section
Summative Evaluation
Institute for Learning Innovation

Date: _____
Visitor #: _____
Time in: _____
Time out: _____
Sex: ☐ M ☐ F
Age: _____



CORE SAMPLE: LAND

☐ FL screen ☐ Hero screen

Specimens: _____

Notes:

CORE SAMPLE: WATER

☐ FL screen

Specimens: _____

Notes:

HUMAN ENCROACHMENT

☐ Adds Humans ☐ Removes Humans

☐ Animal screen(s) ☐ Animal fact(s)

Notes:

TREE ISLAND

☐ Uses Wet/Dry slider

Animals: _____

Notes:

HYDROLOGIC CYCLE

☐ Reads ☐ TV screen

Notes:

WET & DRY SEASON

☐ Reads anything Screen 1

Buttons Wet: _____

Buttons Dry: _____

Notes:

WATER TABLE

☐ Reads background

☐ Plays game

Notes:

Water's Journey
Visitor Exit Interview
(Ages 8 to16)

Interviewer: _____ Visitor #: _____
Date: _____ ☐ Weekday ☐ Weekend Time of day: _____AM/PM

(To parent) Hi! My name is ____ and I am working with the Museum of Discovery and Science. We are talking to visitors as part of a research study to understand and improve visitors' experience at the museum. We are particularly interested in the thoughts of our younger visitors. Would it be ok if I talked to him/her [gesturing to the child]? *(To child)* Will you talk to me about what you thought of the museum? *(If yes from both adult and child)* Great! Before we start, I'd like to let you know that you can leave anytime you need to, this is completely voluntary. I'll ask you questions about the museum and you tell me what you think—your honest thoughts, there are no right or wrong answers. Also I have this sheet for you, if you'd like to learn more about what we are doing or talk to the people in charge of the study *(Hand info sheet to parent)*. Do you have any questions so far? Great, let's begin…

1. First I'm going to ask you to think about everything you might have seen in this area *(Gesture)*—from here back to the wall and windows. What was the most interesting part of this area? *[Probes: Why was that? Can you tell me more about that?]*

2. Now again, thinking about everything you saw in this area *(Gesture)*, please complete the following sentence: I never realized that… *[Probes: Why was that? Can you tell me more about that?]*

3. Now I'd like you to think about what happened for **you today during your visit**. I'm going to read some sentences, and for each sentence I'd like you to rate whether or not that sentence **really happened for you today** on a scale from 1 to 5. 1 is "not at all" and 5 is "very much." *[Read the statement, show them the scale, ask "Did that happen for you?" and circle their answer]*

Statement **Visiting this area of the museum…**	**Not at all**				**Very much**
Made me more interested in the Everglades than I was before.	1	2	3	4	5
Helped me to think about connections between the past and the present.	1	2	3	4	5
Helped me to think about changes in the environment that happen over time.	1	2	3	4	5
Helped me to think about how water impacts the environment.	1	2	3	4	5
Helped me to make connections between science and my everyday life.	1	2	3	4	5
Helped me to feel more confident about my ability to understand	1	2	3	4	5

science.	

4. Now I'm going to ask you a few questions about specific exhibits in this area. *(Ask about each area they visited, referring to the tracking map if needed. For each one, gesture to the area and describe it—DO NOT READ them the title- we don't want to influence their answers. If they did not visit an area leave that section blank.)* The first one is…

The Florida Table: This one had three touchscreen activities with a map of Florida in the middle.

a) What was the main idea of that exhibit? *[What do you think the museum wanted visitors to know after seeing it?]*

b) Do you remember anything about the role of water in Florida's environment from visiting that exhibit?
(Circle One) Yes No Not Sure *(If Yes)* What do you remember? Was this something new that you just learned from the exhibit?

c) Do you remember anything about how Florida's environment changes over time from visiting that exhibit?
(Circle One) Yes No Not Sure *(If Yes)* What do you remember? Was this something new that you just learned from the exhibit?

Tree Island: This one had one touchscreen activity.

a) What was the main idea of that exhibit? *[What do you think the museum wanted visitors to know after seeing it?]*

b) Did you learn anything about the role of water in Florida's environment from visiting that exhibit?
(Circle One) Yes No Not Sure *(If Yes)* What do you remember? Was this something new that you just learned from the exhibit?

c) Did you learn anything about how Florida's environment changes over time from visiting that exhibit?
(Circle One) Yes No Not Sure *(If Yes)* What do you remember? Was this something new that you just learned from the exhibit?

Human Encroachment: This one had one touchscreen activity and was by the Otters.

a) What was the main idea of that exhibit? *[What do you think the museum wanted visitors to know after seeing it?]*

b) Did you learn anything about the role of water in Florida's environment from visiting that exhibit? *(Circle One)* Yes No Not Sure *(If Yes)* What do you remember? Was this something new that you just learned from the exhibit?

c) Did you learn anything about how Florida's environment changes over time from visiting that exhibit?
(Circle One) Yes No Not Sure *(If Yes)* What do you remember? Was this something new that you just learned from the exhibit?

Core Samples/Specimens: This one was on the side of the shark had a trackball and monitors. *[If they went to both, indicate that there were two related stations].*

a) What was the main idea of that exhibit? *[What do you think the museum wanted visitors to know after seeing it?* If they went to both: *What were the differences between the two stations.]*

b) Did you learn anything about the role of water in Florida's environment from visiting that exhibit? *(Circle One)* Yes No Not Sure *(If Yes)* What do you remember? Was this something new that you just learned from the exhibit?

c) Did you learn anything about how Florida's environment changes over time from visiting that exhibit?
(Circle One) Yes No Not Sure *(If Yes)* What do you remember? Was this something new that you just learned from the exhibit?

5. (For everyone) Great! Now let's think about this whole area (Gesture). Do you feel any different about Florida's Environment after visiting this area? *(Circle One)* Yes No Not Sure
Why is that? Tell me more about that?

<u>Now I'd just like to ask a few questions about you.</u>
Are you:
__Male
__Female

How old are you? _____
What grade are you in? _____

What is your zip code? _____

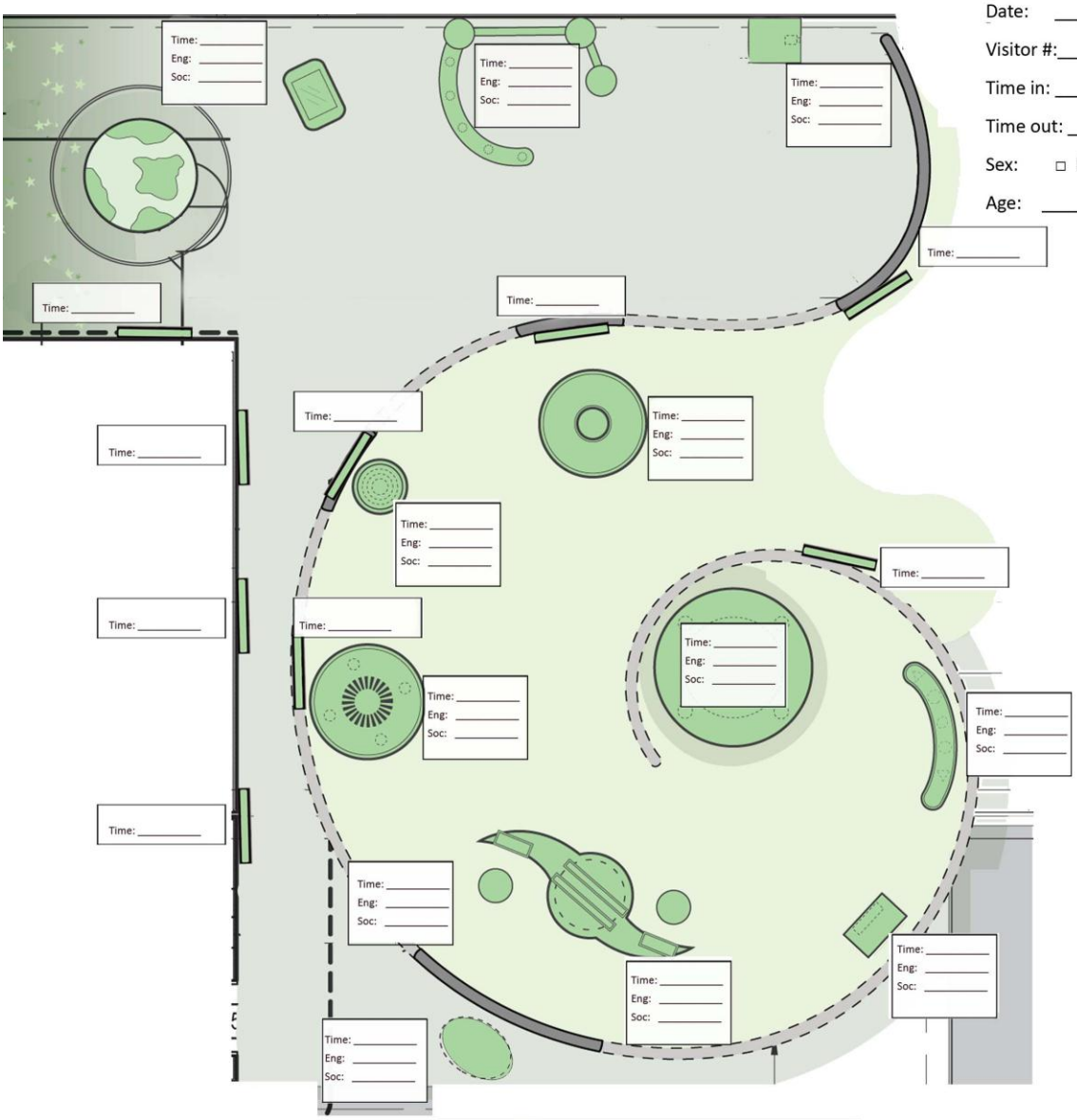
How many people are you visiting the museum with today? (including yourself)

Total: _____

Number of Adults: _____

Number of Children under 18: _____

MODS: Storm Center Sub-section



Date: _____

Visitor #: _____

Time in: _____

Time out: _____

Sex: ☐ M ☐ F

Age: _____

☐ 1 Person at each station

HURRICANE SIDE	HOUSE SIDE
☐ Reads anything ☐ Manipulates Storm	☐ Reads anything ☐ Manipulates House
☐ Usability: _____	☐ Usability: _____

Water's Journey
Visitor Exit Interview
(Ages 8 to16)

Interviewer: _____ Visitor #: _____
Date: _____ ☐ Weekday ☐ Weekend Time of day: _____AM/PM

(*To parent*) Hi! My name is ____ and I am working with the Museum of Discovery and Science. We are talking to visitors as part of a research study to understand and improve visitors' experience at the museum. We are particularly interested in the thoughts of our younger visitors. Would it be ok if I talked to him/her *[gesturing to the child*]? (*To child*) Will you talk to me about what you thought of the museum? *(If yes from both adult and child)* Great! Before we start, I'd like to let you know that you can leave anytime you need to, this is completely voluntary. I'll ask you questions about the museum and you tell me what you think—your honest thoughts, there are no right or wrong answers. Also I have this sheet for you, if you'd like to learn more about what we are doing or talk to the people in charge of the study *(Hand info sheet to parent*). Do you have any questions so far? Great, let's begin…

1. First I'm going to ask you to think about everything you might have seen in this area (*Gesture*)—from here and all around back in there. What was the most interesting part of this area*? [Probes: Why was that? Can you tell me more about that?]*

2. Now again, thinking about everything you saw in this area (Gesture), please complete the following sentence: I never realized that… *[Probes: Why was that? Can you tell me more about that?]*

3. Now I'd like you to think about what happened for you today during your visit. I'm going to read some sentences, and for each sentence I'd like you to rate whether or not that sentence really happened for you today on a scale from 1 to 5. 1 is "not at all" and 5 is "very much." *[Read the statement, show them the scale, ask "Did that happen for you?" and circle their answer]*

Statement **Visiting this area of the museum…**	**Not at all**				**Very much**
Made me more interested in the Everglades than I was before.	1	2	3	4	5
Helped me to think about connections between the past and the present.	1	2	3	4	5
Helped me to think about changes in the environment that happen over time.	1	2	3	4	5
Helped me to think about how water impacts the environment.	1	2	3	4	5
Helped me to make connections between science and my everyday life.	1	2	3	4	5
Helped me to feel more confident about my ability to understand science.	1	2	3	4	5

4. *(If they visited the build a hurricane/house kiosk*) Now I'm going to ask you a few questions about a specific exhibit in this area. It's the one where you can sit down and use a touchscreen on either side of the large TV. (*Gesture*).

   a) What was the main idea of that exhibit? *[What do you think the museum wanted visitors to know after seeing it?]*

   b) Do you remember anything about the role of water in Florida's environment from visiting that exhibit?
   (Circle One) Yes No Not Sure *(If Yes)* What do you remember? Was this something new that you just learned from the exhibit?

   c) Do you remember anything about how Florida's environment changes over time from visiting that exhibit?
   (Circle One) Yes No Not Sure *(If Yes)* What do you remember? Was this something new that you just learned from the exhibit?

5. (*For everyone*) Great! Now let's think about this whole area (*Gesture*). Do you feel any different about Florida's Environment after visiting this area? (*Circle One*) Yes No Not Sure
   Why is that? Tell me more about that?

<u>Now I'd just like to ask a few questions about you.</u>
Are you:
__Male
__Female

How old are you? _____

What grade are you in? _____

What is your zip code? _____

How many people are you visiting the museum with today? (including yourself)
Total: _____
Number of Adults: _____
Number of Children under 18: _____

Appendix 2 Kiosk-Based Study: Observation, Interview and Focus Group Protocol

Observations and Interviews with Museum Visitors

Due to the pattern of usage of the *Water's Journey* kiosks at the Museum of Discovery and Science, the decision has been made to cue visitors to interact with the kiosks. Phase 1 of the summative evaluation with museum visitors (as described in the work plan dated February 3, 2012) used an uncued method where visitors' natural behavior in the gallery and with the kiosks was observed. Using the uncued method it was determined that there would not be a large enough sample size at each *Water's Journey* kiosk to perform the required analysis. Switching to a cued observation method will allow for a larger sample than would occur through natural usage.

For the cued method, data collectors will approach visitors between the ages of 8 and 16 as they enter the gallery using a continuous sampling method as described in the summative evaluation work plan. After explaining the purpose of the research, the voluntary nature of participation, obtaining consent from an adult with the child and assent from the child, and allowing visitors to ask questions about the study, the data collector will direct the visitors to a selected *Water's Journey* kiosk or set of related kiosks. Visitors will be asked to interact with the kiosk as they naturally would while the data collector (an ILI staff member) stands close by to take notes. The data collector will record observations such as stay time, engagement level, types and level of social interaction (with in group, between groups, and between visitors and staff), and any difficulties encountered while using the exhibit.

Once the visitors indicate that they have finished interacting with the kiosk(s), the data collector will proceed to interview the visitor about their experience. Interviews will include open-ended interview questions and Likert-style rating questions in order to measure change in attitude, engagement, and knowledge as a result of the experience. Demographic and psychographic data will be collected during the interviews. See additional attachments for the draft interview instruments.

Water's Journey
Cued Observation

Date: _____
Visitor #:_____

Storm Center

Hurricane Side
Time in: _____
Time out: _____

☐ Reads Anything ☐ Manipulates Storm
☐ Usability: _____
☐ Two player?

House Side
Time in: _____
Time out: _____

☐ Reads Anything ☐ Manipulates House ☐ Buys Anything
☐ Usability: _____
☐ Two player?

Water's Journey
Cued Observation

Date: _____
Visitor #:_____

Core Samples

Land
Time in: _____
Time out: _____

☐ FL Screen ☐ #Specimens: _____
☐ Hero Screen
☐ Usability: _____

Water
Time in: _____
Time out: _____

☐ FL Screen ☐ #Specimens: _____
☐ Usability: _____

Water's Journey
Cued Observation

Date: _____
Visitor #:_____

Human Encroachment
Time in: _____
Time out: _____

☐ Adds Humans ☐ Removes Humans
☐ Animal screen(s) ☐ Animal fact(s): _____
☐ Usability: _____

Tree Island
Time in: _____
Time out: _____

☐ Uses Wet/Dry Slider
☐ # Animals: _____
☐ Usability: _____

Water's Journey
Cued Observation

Date: _____
Visitor #:_____

Florida Table

Water Table Time in: _____ ☐ Reads Background ☐ Plays Game
Time out: _____ ☐ Usability: _____

Wet & Dry Seasons Time in: _____ ☐ Reads anything Screen 1
Time out: _____ ☐ #Buttons Wet: _____ ☐ #Buttons Dry:_____
☐ Usability: _____

Hydrologic Cycle Time in: _____ ☐ Reads ☐ TV Screen
Time out: _____ ☐ Usability: _____

Water's Journey
Cued Observation

Date: _____
Visitor #:_____

Invasive Species (2nd Fl)
Time in: _____
Time out: _____

Pythons: ☐ Biological ☐ Physical ☐ Chemical
Water Hyacinths: ☐ Biological ☐ Physical ☐ Chemical
Tree: ☐ Biological ☐ Physical ☐ Chemical
☐ Usability: _____

Water's Journey
Cued Interview
(Ages 8 to16)

Interviewer: _____ Visitor #: _____
Date: _____ ☐ Weekday ☐ Weekend Time of day: _____AM/PM

(To parent) Hi! My name is ____ and I am working with the Museum of Discovery and Science. We are talking to visitors as part of a research study to understand and improve visitors' experience at the museum. One of the things we are doing is asking visitors to use this exhibit and then talk to us about it. Is that something you would be willing to do? (*If yes from both adult and child*) Great! Before we start, I'd like to let you know that you can leave anytime you need to, this is completely voluntary. Also I have this sheet for you, if you'd like to learn more about what we are doing or talk to the people in charge of the study *(Hand info sheet to parent*). Do you have any questions so far? Great, let's begin…

1. I'm going to ask you to use this exhibit right here, and then we'll talk about it. But before you start, I'd like to ask you to rate two sentences for me. I'll read the sentence and you tell me your rating on a on a scale from 1 to 5. *[Read the statement, show them the scale, and circle their answer]*

	Not at all interested				**Very interested**
How interested are you in learning about Florida's environment?	1	2	3	4	5
	Nothing				**A lot**
How much do you know about Florida's environment?	1	2	3	4	5

Observation: Ok, now I'll ask you to use the exhibit. Please use it for as long as you want and do as much or as little as you'd like. I'm going to stand right here and take a few notes while you are doing that. [Visitor interacts with kiosk].

2. First I'm going to ask you to rate those two sentences again. I'll read the sentence and you tell me your rating on a on a scale from 1 to 5. [*Read the statement, show them the scale, and circle their answer]*

	Not at all interested				**Very interested**
How interested are you in learning about Florida's environment?	1	2	3	4	5
	Nothing				**A lot**
How much do you know about Florida's environment?	1	2	3	4	5

Now I'm going to ask you a few questions about the exhibits. You tell me what you think—your honest thoughts; there are no right or wrong answers.

3. What was the most interesting part of the exhibit for you? *[Probes: Why was that? Can you tell me more about that?]*

4. What was the main idea of the exhibit? *[What do you think the museum wanted visitors to know after seeing it?]*

5. Do you think the topic of this exhibit is something that is important for you to know about?
   (Circle One) Yes No Not Sure (*If yes or not sure, continue to A and B)*
   a) How important is it for you to know about?
      (Show scale) Not at all A Little Quite a Bit A Lot!
   b) What about it is important? Why should you know about it?

6. Was there anything in the exhibit that talked about the role of water in Florida's environment?
   (Circle One) Yes No Not Sure *(If yes or not sure, continue to A and B)*
   a) How much would you say the exhibit talked about the role of water in Florida's environment?
      (Show scale) Not at all A Little Quite a Bit A Lot!
   b) What do you remember from the exhibit that was about the role of water in Florida's environment?
      Tell me more about that. Anything else that was about the role of water?

7. Was there anything in the exhibit that talked about how Florida's environment changes over time?
   (*Circle One)* Yes No Not Sure *(If yes or not sure, continue to A and B)*
   a) How much would you say the exhibit talked about the how Florida's environment changes over time?
      (Show scale) Not at all A Little Quite a Bit A Lot!
   b) What do you remember from the exhibit that was about how Florida's environment changes over
      time? Tell me more about that. Anything else that was about change over time?

<u>Now I'd just like to ask a few questions about you.</u>
Are you:
__Male
__Female

How old are you? _____
What grade are you in? _____
What is your zip code? _____
When was the last time you visited the museum? _____

How many people are you visiting the museum with today? (including yourself)
Total: _____
Number of Adults: _____
Number of Children under 18: _____

Focus Groups with Teen Volunteers

In an effort to increase the amount of in-depth data we can collect on the *Water's Journey* kiosks, we will include teens who volunteer at the Museum as participants in the evaluation study. The goal is to conduct a total of six hour-long focus groups with 5 to 8 teens in each group.

On a day when they are already scheduled to volunteer, teen volunteers will be asked to arrive an hour before their shift starts to participate in a focus group with an ILI staff member. To participate in the focus group, teens will be required to have their parents complete a permission slip attached to a letter explaining the purpose of the study, the nature of the focus group, the voluntary nature of participation, that the focus group will be audio recorded, and with contact information for Museum and ILI staff. Teens will have to return a completed permission slip to Museum staff in order to participate in the focus group. All communication with teens on the scheduling of the focus group, their arrival time, and the required permission from parents will be facilitated by Museum staff. A copy of the permission slip and letter to parents is included as an attachment.

During the focus groups, teens will be introduced to the ILI researcher and oriented to the focus group activities. The ILI staff member will begin by asking the teens a few questions to provide background information (their age, how long they have volunteered at MODS, and their motivations for volunteering). Then teens will be asked to interact with the *Water's Journey* kiosks on their own or in pairs. As teens interact with the kiosks, the ILI staff member will be on-hand to answer questions as well as conduct observations of kiosk use in the same style as described for museum visitors above. After teens interact with a set of kiosks, the group will reassemble for a conversation about the kiosks. The ILI staff member will use a set of questions to guide the discussion (included as Appendix A); however, it is anticipated that the conversation will be free-flowing and that the questions included on the focus group guide are designed to anchor the discussion, not to dictate its direction or pace. This portion of the focus group will be audio recorded by the ILI staff member using a small digital audio recorder. Before beginning the audio recording, the ILI staff member will let all participants know that the audio recording is starting. If time permits, teens will be asked to use another set of kiosks followed by another audio recorded discussion of those kiosks.

All audio files from the focus groups will be saved on ILI's secure, password protected server. All permission slips will be maintained by MODS staff, ensuring that ILI staff do not have access to the full names of the teen volunteers or their parents. At no time will names of participants or any other identifiable information be associated with the audio recording, any transcripts made of the recordings, or any reports or articles based on the data.

Teen Volunteer Focus Group Discussion Guide

Hi everybody! I'm _____and I am an evaluator at the Institute for Learning Innovation in Maryland. We are working with the museum and the University of Central Florida to talk to people about some of the new exhibits in the EcoDiscovery Center. This is part of a study that will help the museum and the university know if the exhibits met the goals they had set for them. As an evaluator, my job is to talk to people and get their feedback on the exhibits. I don't work for the museum or the university, and I did not help to build the exhibits. So you can give me your honest feedback—it won't hurt my feelings.

I'll give you a preview of what we are doing today and then we'll get started. Has anyone here ever participated in a focus group before? Well, that's what we are doing today. A focus group is a way to get the opinions from a group of people at the same time—it's just a conversation led by someone like me. The important thing to know about a focus group is that everyone's opinion matters. So if you have an

opinion that is the same or different from someone else, let me know! I'm here to listen to your opinions. First we're going to talk about your experience so far with MODS, then I'm going to ask you to interact with some of the exhibits we studying for this evaluation. Then we'll get back together in a group to talk about the exhibits. Any questions before we start? Just so you know, you are free to leave at anytime—if you need to go to the bathroom or make a phone call or anything, you don't need to ask, just do it.

Museum Experience Questions

I just want to learn a little bit about you before we get started, so here's my first set of questions.

1. How old are you? What grades are you in?
2. How long have you volunteered here?
3. Why are you volunteering at the museum? What made you interested in volunteering?
4. What's the best part of volunteering?

Kiosk Interaction

(Point out the Water's Journey kiosks. Depending on the size of the group, you might need to have them use all of them at once or a portion of them. Have each teen or a pair of teens start on a kiosk and then rotate around to other kiosks. Let them know that they have about 10 minutes to interact with the kiosks. Give them a countdown as you go (5 minutes left, 2 minutes left, 1 minute left). As they are interacting, observer their usage at the kiosks. Have the group re-assemble and then walk as a group together to the exhibits they interacted with.)

Kiosk Discussion

Great! Now what we are going to do is walk around to each exhibit and talk about it and then we'll move on to the next one. I have a set of questions I'd like to ask you about each one, but if you have anything you'd like to add that I'm not asking about, speak up. I am going to audio record this part so I don't have to take notes. Is that ok with everyone? I'm turning on the recorder now. *(Start recording)*

(Repeat the following line of questions for each kiosk)

1. First, just generally what did you think of this exhibit?
    a. What was good about it? Why is that?
    b. What could be improved? Why is that?
    c. Who do you think this exhibit was designed for? Little kids, elementary age, middle school, high school, adults? How can you tell?
        i. If your friends were visiting the museum, would you have them use it? Why or why not?
        ii. Do you think it is geared to teens? If not, what do they need to change to make it interesting to teens?
2. What do you think is the main idea of this exhibit?
    a. Does it do a good job of conveying the main idea? Why or why not?
    b. What could be improved? Why is that?
3. If you were going to explain this exhibit to a visitor, what would you say?
    a. What you would emphasize or make sure they do?
    b. What areas do you think they might need help with? How would you try to help them?

4. Is there anything else you want to talk about at this one before we move on?

(If time allows and there are kiosks they did not use in the first rotation, start a second rotation and round of questioning)

Great! Thanks so much for all your feedback at each exhibit. Now before we go, I want you to think more broadly for a minute. Think about all of the exhibits as I ask you these next questions.

1. One of the goals of the people who made these exhibits was to get visitors thinking about water and how it impacts the environment.
    a. To what degree did that message come out?
    b. Where was it the strongest? The weakest?
    c. What else could the designers have done to supported that message?
2. Another of the goals of the exhibit designers was to get visitors thinking about environmental changes and how they happen over periods of time.
    a. To what degree did that message come out?
    b. Where was it the strongest? The weakest?
    c. What else could the designers have done to supported that message?
3. Another goal of the exhibit designers was to help visitors understand how science is relevant to them, how it is connect to their lives and why it is important.
    a. Thinking about yourself, did you see these exhibits as relevant to your life? Why or why not?
    b. Which exhibit was most relevant to you? Which was least? Why was that?
    c. What else could the designers have done to make the exhibits more relevant to the lives of teens?
4. Do you have any other feedback to give the exhibit designers? Any other comments before we end?

Thanks a lot for all your help today. I'm also going to be around talking to visitors about these exhibits all day. So if you want to talk to me more now or later in the day, please do. I'm happy to share more with you about what I do or how I ended up evaluating museum exhibits. Thanks!! *(End recording)*

Appendix 3 **Focus Group Permission Slip and Letter to Parents of Teen Volunteers**

February 24, 2012

Dear Parent or Guardian,

As you may know, the Museum of Discovery and Science recently opened a new wing, the EcoDiscovery Center. We are asking teen volunteers to participate in a focus group to help us learn more about the appeal of the new exhibits to teens. We need your written permission to include your child in this activity. Please review the information below, complete the form on the next page, and have your teen return it to Ciara Bostick Museum of Discovery and Science Volunteer Coordinator when they arrive to volunteer or fax it to 954.467.0046.

What is the purpose of the focus group?
The focus group with teen volunteers is part of a research study of the exhibits in the EcoDiscovery Center. Some of the new exhibits were designed by the University of Central Florida's Media Convergence Lab and funded by a grant from the National Science Foundation. The Museum and UCF are required by the grant funding to study the exhibits and collect information about how they are being used. This information will help the museum, the university, and the National Science Foundation determine if the exhibits were successful at meeting their goals. Since the exhibits were designed with teens in mind, we wanted to include teen volunteers in this study.

What will teen volunteers do in the focus group?
In small groups, teens will be asked to interact with the exhibits in the EcoDiscovery Center that are part of the study—all of the exhibits are technology-based, hands-on, and focused on Florida's environment. After using the exhibits, the group of teens will be asked questions about the exhibits, including what they liked, what changes could be made, and what were the main ideas of the exhibits. This question and answer session will be audio recorded. This focus group will be led by a researcher from the Institute for Learning Innovation, the non-profit research and evaluation group that is conducting the study.

The whole process will last about 60 minutes and will take place on a day teens are scheduled to volunteer at the Museum. Taking part in this study is completely voluntary, and teen volunteers are not required to participate. The answers given by teens will be confidential. No identifying information (such as names) will be included in any reports resulting from this study.

If you have any questions or wish to discuss the focus group, please call me at 954.713.0921 or email me at modsvolunteer@mods.net You can also talk to Susan Foutz, Senior Research Associate at the Institute for Learning Innovation about the study. She can be reached at 410-956-5144 or foutz@ilinet.org.

Sincerely,

Ciara Bostick
Museum of Discovery and Science Volunteer Coordinator

Focus Group Permission Form

My teen _____ has permission to participate in the focus group about the
(teen's name)
EcoDiscovery Center exhibits and to be audio recorded as part of the focus group.

Parent/Guardian Name: _____
(Please print)

Parent/Guardian Signature: _____ Date: _____

Teens: Please return this form ASAP to
Ciara Bostick Museum of Discovery and Science Volunteer Coordinator when they arrive to volunteer or fax it to 954.467.0046.

Appendix 4 *Water's Journey* Team Interview Guide

Thank you for taking the time to speak with me today. As you know we are nearing the end of the *Water's Journey* project. The summative evaluation data is currently being analyzed and the report will be delivered to Eileen at the end of July. I know it has been quite an undertaking for everyone involved and part of the reason for doing these interviews with team members is so that the report includes as much of the context of the project as possible. It is very common for projects like this to change as they progress, especially projects of this length. Knowing more about how this project changed and how the project team adapted will ultimately serve to inform the fields of science centers and exhibit designers. So the idea here is to capture what really happened over the course of the project so that others can learn from your experience.

I'll be interviewing [name them] as well. The final report will include the analysis of the interviews and specific quotes from the interviews in the final report. However, I will not use any one's name in connection with the quotes. Rather the report will say "a museum team member said…"

Any questions before we start? Ok. I have a list of specific questions I'd like to ask you, but if at any point you'd like to talk about something I haven't asked about, that is great. This is a really conversational format.

Goals and purpose of the project as it was originally conceived

I'd like you to think back to the grant proposal stage of *Water's Journey,* before there was an exhibit and the team was batting around ideas.

- What was the value it would have for MODS?
- What was the value it would have to the larger museum field?

Why was it important to seek NSF funding for the project?

What was the original concept for the exhibit? Think back to the grant proposal.

a. What did you feel were the most important features of what was proposed?
b. What were the outcomes of the project that stood out for you?
    i. Outcomes for visitors/children
    ii. Outcomes for the museum
    iii. Outcomes for the field

Evolution of the exhibit design and the Constraints and/or opportunities that shaped the evolution of the exhibit over time

We're going to talk about how the project many have changed over time in a moment, but first I'd like to get a bit of background.

What was your primary role during the exhibit design process?

a. How and when were you involved?

In what ways, if at all, do you think the exhibit concept changed from what was proposed to what is currently in the museum?

How did the concept for the exhibit change over time?

a. Walk me through a few key changes to the exhibit [or stages of the project].
b. What were the reasons or factors that influenced that change?
c. What was the process like among the team members for negotiating or deciding on these changes? (did they have regular meetings? Who lead the process?)
d. What was the role, if any, of the other exhibit designers or architects in influencing the course of the Water's Journey project?

Is there anything else you can think of that was a factor in the evolution of the exhibit from what was proposed to what is currently in the museum?

The degree to which the final product fulfills the project goals

Now let's talk a bit about the final product of this project, the Water's Journey kiosks as they are now, installed in the new areas of the museum.

What's your opinion of the Water's Journey kiosks?

Is there anything that you wished was included in the final product that wasn't?

a. What and why?
b. What would that add to the exhibit?

To what degree does the final product fulfill the original goals of the grant? [completely, mostly, somewhat?- try to get them to give a qualitative response and then tell what goals were or were not met]

Do you think any of the changes to the exhibit design impacted the ability of the project to meet its goals, either positively or negatively?

The importance of the final exhibit to the museum and/or field

Thinking beyond the grant's goals, how do the Water's Journey kiosks help to fulfill the museum's mission or goals?

- What role do they play in the EcoDiscovery Wing? In the visitor experience?

What lessons have you learned as a result of this project?

- How will you apply that lesson to your future work?

What do you think the museum field can learn from the *Water's Journey* project?

- Why is that an important take away message?

Appendix 5 **Additional Tables**

Table 38: Stay Time at *Water's Journey* Kiosks from the Contextual Study (Naturalistic/Un-Cued Observation)

***Water's Journey* Kiosks**	**n**	**Mean**	**Median**	**St. Dev.**	**Min**	**Max**
Wet & Dry Season	2	3 min 28 sec	3 min 28 sec	4 min 16 sec	27 sec	6 min 29 sec
Hurricanes: Storm	6	2 min 19 sec	2 min 21 sec	1 min 43 sec	5 sec	4 min 32 sec
Hurricanes: House	3	2 min 15 sec	2 min 22 sec	1 min 16 sec	56 sec	3 min 27 sec
Sheet Water Flow	2	1 min 26 sec	1 min 26 sec	48 sec	52 sec	2 min
Hydrologic Cycle	6	53 sec	47 sec	42 sec	15 sec	2 min 8 sec
Core Sample: Water	12	44 sec	28 sec	41 sec	2 sec	1 min 28 sec
Human Encroachment	10	36 sec	24 sec	38 sec	5 sec	1 min 51 sec
Tree Island	4	29 sec	13 sec	35 sec	10 sec	1 min 22 sec

Note: During data collection, Core Sample: Land was not operating. Thus, not available to visitors.

Table 39: Stay Time at *Water's Journey* Kiosks from the Kiosk-Based Study (Cued Observation)

***Water's Journey* Kiosk**	**n**	**Mean**	**Median**	**St. Dev.**	**Min**	**Max**
Invasive Species	17	5 min 28 sec	5 min 33 sec	2 min 37 sec	1 min 41 sec	11 min
Hurricanes: House	12	4 min 59 sec	4 min 34 sec	2 min 40 sec	2 min 2 sec	8 min 57 sec
Human Encroachment	20	4 min 15 sec	3 min 35 sec	2 min 25 sec	1 min 17 sec	9 min 16 sec
Hurricanes: Storm	12	4 min 5 sec	3 min 27 sec	1 min 56 sec	2 min 12 sec	7 min 44 sec
Core Samples*	20	3 min 45 sec	3 min 47 sec	1 min 30 sec	58 sec	5 min 34 sec
Sheet Water Flow	20	3 min 26 sec	3 min 25 sec	1 min 29 sec	47 sec	7 min 10 sec
Wet & Dry Seasons	19	2 min 26 sec	2 min 17 sec	1 min 22 sec	30 sec	5 min 11 sec
Hydrologic Cycle	19	1 min 44 sec	1 min 35 sec	49 sec	20 sec	3 min 20 sec

Note: Visitor observations were not conducted at the Tree Island kiosk.
**Groups of two or more *Water's Journey* kiosks.