Development of a Water Exhibit and Interactive Outreach Program for the Santa Fe Children's Museum

An Interactive Qualifying Project

Submitted to the Facility of

Worcester Polytechnic Institute

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

in cooperation with the

Santa Fe Children's Museum

Submitted 12/16/2022

Submitted By:

Cameron Carlin

James Doucette

Mackenzie Pryor

Krish Shah-Nathwani

Submitted To:

Hannah Hausman

Santa Fe Children's Museum

Professor Zoe Eddy & Melissa Belz

Worcester Polytechnic Institute

Abstract

Water scarcity and pollution are prevalent issues in New Mexico**,** creating a need for water conservation efforts. Our team collaborated with the Santa Fe Children's Museum (SFCM) to increase water conservation awareness in New Mexico. Through interviews, surveys, observations, and comparative analysis, we established findings regarding residents' water conservation awareness, child behavioral patterns, and successful museum exhibits. We designed a stationary museum exhibit for the SFCM to inform children on the importance of water conservation. Also, we developed an interactive outreach program and take-home kits that should be used to increase public outreach in local communities. We believe that our recommendations reinforce the concepts of water conservation to the Santa Fe community.

Executive Summary

Development of a Water Exhibit and Interactive Outreach Program for the Santa Fe Children's Museum

Submitted By: Cameron Carlin, James Doucette, Mackenzie Pryor, Krish Shah-Nathwani

Introduction and Background

New Mexico has an arid climate with only a few viable water sources. The climate, in combination with residents' underestimation of their water consumption, has led to a lack of water conservation (City of Santa Fe, 2022). This problem needs to be brought to the general public's attention to prevent it from escalating.

Educating children on water issues is an important step in increasing community awareness of household water conservation. Children will return home with the message that water conservation is important, effectively increasing outreach to adults.

Our background research showed that children learn best through play and investigation (Fromberg, 2012, 1:17). Interactive museum exhibits are an effective way of teaching children about topics in an engaging manner. Water conservation can be expressed through a museum exhibit to educate children on its importance.

Our project goal was to collaborate with the Santa Fe Children's Museum (SFCM) to design an interactive exhibit on water conservation. We also worked with the City of Santa Fe Water Division and Simtable to achieve our goal.

Methodology

Our project aimed to design an interactive water exhibit for visitors of the Santa Fe Children's Museum to express the importance of water conservation. The objectives that aided us in reaching this goal are as follows:

1. Gain a thorough understanding of water conservation in New Mexico
2. Recognize child behavioral patterns while they learn from hands-on exhibits
3. Observe various styles of successful exhibits and the features associated
4. Become familiar with exhibit portability and self-sustainability

We used several research methods to assist us in the completion of our objectives: participant observation, interviews, surveys, and comparative analysis. Our team conducted 28 interviews with local experts, museum staff, parents, and children. Additionally, we collected 100 survey responses from visitors of the Santa Fe Children's Museum. We also observed child behavioral patterns and took note of successful museum exhibits at various museums. Finally, comparative analysis was performed to produce findings for this project.

Findings

We identified categories of findings based on our objectives. The categories were:

1. Domestic Water Conservation Perspective
2. Child Behavioral Patterns in Museums
3. Successful Museum Exhibits

Participants of the survey acknowledged that the state does not perform enough outreach in terms of water conservation. Additionally, a majority of participants expressed that they actively think about and execute water conservation during their daily routine. However, a large majority

of participants had a lack of understanding on how much water they actually use daily. The average amount of water used per day for one person in New Mexico is 93 gallons. Out of all of the participants who estimated their daily usage, 80% estimated under the average. 24% of participants had no idea how much water they utilize daily. Overall, the data displayed that participants acknowledge water conservation and its importance but do not know how much water they use on a daily basis.

After conducting visits to multiple museums, participant observation, and interviews, we came to our findings about child interactions within museums. Children are more engaged when they are allowed to explore concepts and experiment in different ways. Collaboration also encourages increased engagement and allows children to explore together.

Regarding successful museum exhibits, we found that interactive exhibits inform children while maintaining engagement. We also found that various approaches, outcomes, and challenges within an exhibit encourages experimentation. Both of these components lead to increased child engagement and prolonged exhibit popularity. Our findings led us to eliminate the possibility of using a portable exhibit to satisfy the needs of this project. Portable exhibits have multiple constraints including weight, volume, power, assembly, durability, and manpower. Due to the limitations of portable exhibits, we concluded that concept distribution was a more efficient method of outreach for our project.

Recommendations

After the conclusion of our findings, our team proposed three recommendations for the Santa Fe Children's Museum to continue this project. The three recommendations were:

1. A stationary exhibit at the SFCM should be created to express the importance of water conservation to children
2. An interactive outreach program should be used to increase water conservation outreach
3. A "Grab & Go Kit" should be sent home with children to reinforce concepts

<u>Recommendation 1: Stationary Exhibit</u>

A stationary exhibit will be more impactful than a portable exhibit due to the physical constraints a portable exhibit has. In order to create a portable exhibit, certain components need to be taken into consideration, such as: volume, weight, durability, assembly, power, and manpower. A stationary exhibit will remove many of these constraints.

Our team developed criteria for a stationary exhibit to be successful at the SFCM. The exhibit should include:

1. A water conservation theme
2. Interactive and engaging aspects
3. Various approaches and outcomes
4. The ability to collaborate and experiment
5. Accessibility to all users

These stipulations can be used as guidelines to design a successful exhibit.

Based on these criteria, we produced a potential design the Santa Fe Children's Museum could utilize (Figure A). The goal of this exhibit is to prevent water from being wasted. Water is pumped out from the top of the large, center tube, in a manner similar to a faucet. The water is then captured in bowl-shaped funneling pieces on rotating posts to flow down the steps of the exhibit. The user's goal is to transport the water to the bucket at the legs of the exhibit and prevent the water from spilling to the sides. The pieces can be taken off and swapped with different shaped

pieces to implement interactivity as well as varying approaches and outcomes. Additionally, this exhibit is spacious enough for collaboration and exploration.

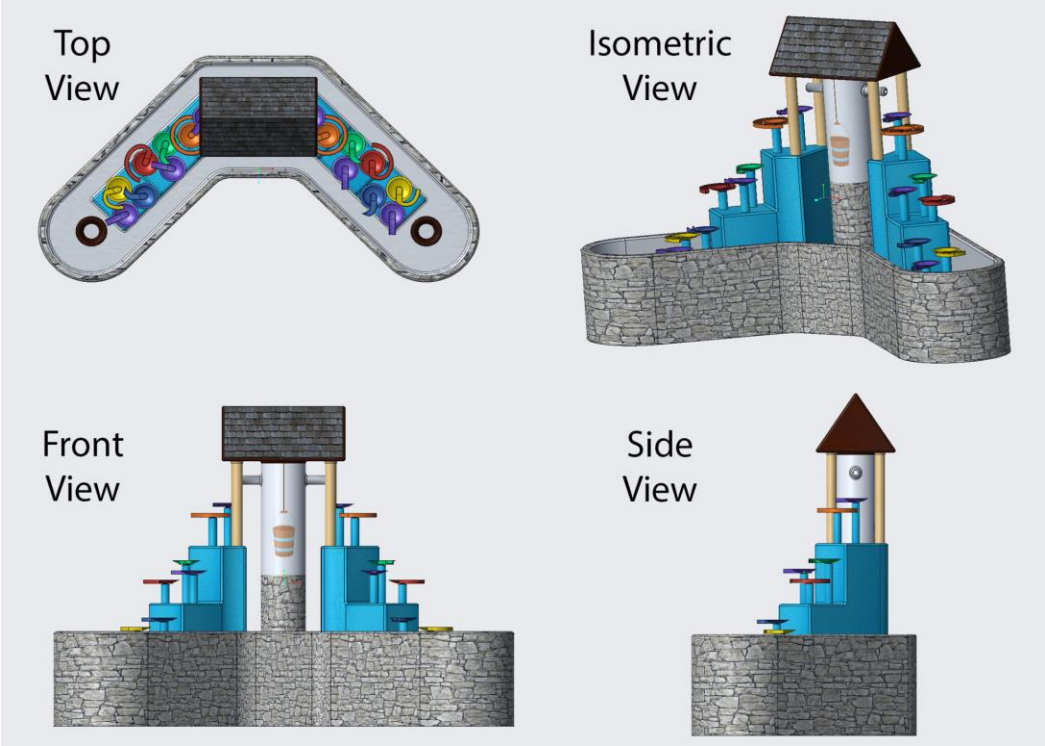


Figure A. *Potential Water Exhibit Concept for the Santa Fe Children's Museum*

Recommendation 2: Interactive Outreach Program

The museum currently conducts various outreach events at schools. We recommend a water conservation outreach program that contains multiple interactive activities to expose children to the importance of water conservation. A water conservation activity program can contain several displays and games, ranging in participant size and interactivity. We recommend the following activities to raise awareness of water conservation:

1. *Conservation Display.* A faucet that will leak throughout the presentation. This will fill a separate container to display how fast water can be wasted through small actions.
2. *Pollution Activity.* Fishing magnetic pieces out of a tub of water to 'clean' it.
3. *General Water Display.* A 3D printed landscape of northern New Mexico to show where a town's water is sourced from.
4. *Conservation Activity.* A cooperative game where the goal is to transfer water from one cup to another in a relay until every cup has been used. This demonstrates how water conservation is an issue that requires a team effort to make a difference.

We created a supplementary guide that illustrates how the program should be conducted. This guide will allow any staff member to lead the outreach program.

Recommendation 3: Grab and Go Kit

In addition to a stationary museum exhibit and an interactive outreach program, children should be given "Grab & Go Kits" to take home from the museum or the outreach program. A "Grab & Go Kit" is an activity kit that can be taken home with the goal of reinforcing concepts

learned in the museum. Our team has designed the "Grab & Go Kit" to inform families about water conservation practices. We recommend that the kit contains the following items:

1. *Cold Water Catcher Bucket.* This bucket will be placed in the shower to collect the cold water before children get into the shower. The water can then be used to water plants, mop the floor, and wash the car.
2. *Shower Timer.* A five-minute sand timer can be used during showers to help limit water use in a manner reminiscent of a game to keep them entertained.
3. *Faucet Filter.* A faucet aerator will be provided in the bag. The filter will go onto sink faucets and limit the flow rate of the water, which limits the water wasted.
4. *Plant Seeds.* These plant seeds will require minimal water, ultimately raising awareness on sustainability and gardening in addition to water conservation.
5. *Water Conservation Tracking Sheet.* A chart with numerous daily tasks will be included in the kit. Children and their families can all keep track of their water conservation practices on a daily basis. Some of the tracking sheet items may include: *Did you turn off the water while brushing your teeth?*, *How long was your shower?*, and *Did you turn off a dripping faucet?*. This tracking sheet can be completed daily, and then the families can compare them at the end of the week.
6. *Pamphlet on Water Conservation.* The pamphlet will include facts about water conservation and tips to reduce the daily water usage within a household. Additional strategies on conservation using household items will be provided. Using recycled items is an easy way to perform water conservation daily.

These "Grab & Go Kits" will reinforce the concepts of domestic water conservation to families. The goal of the kit is to help children and their families implement proper water conservation practices to decrease the amount of daily water used.

Considerations & Conclusions

Throughout the research process our team encountered some limitations that we were unable to address before the completion of the project. We planned to hold multiple focus groups at the Santa Fe Children's Museum in order to gauge children's opinions on exhibits. However, due to cancellations and lack of interest, the sessions were never held. Additionally, our findings made us aware of the importance of including water conservation in New Mexico's school curriculum. However, our team was unable to research what is currently being taught within the schools. While these limitations have hindered aspects of our research, this deficit is negligible in relation to the project as a whole.

Initially, our team was tasked by the SFCM to design a portable exhibit that would inform children on water in New Mexico. Our research revealed that water scarcity and pollution are major issues within New Mexico. We decided that domestic water conservation should be the topic of consideration. Additionally, we discovered that a portable exhibit is not the optimal method to convey this to children at outreach events. Instead, an interactive outreach program and a "Grab & Go Kit" would be used to increase public outreach on water conservation within New Mexico. This has been paired with a design for a stationary exhibit in the museum to satisfy the idea that children will reinforce what they have learned previously at a museum. We believe that these recommendations will provide the SFCM with an effective exhibit and outreach program on the topic of water conservation.

Executive Summary References

City of Santa Fe Water Sources | City of Santa Fe, New Mexico. (n.d.). Retrieved September 5, 2022, from https://www.santafenm.gov/where_does_our_water_come_from

Fromberg, D. (2012, October 22). *What Kindergarten should be*. https://youtu.be/YhpM_jbVopo

Acknowledgements

Our team would like to acknowledge the individuals who helped us in completing this project. First, we would like to thank our sponsor, Hannah Hausman and the Santa Fe Children's Museum, for the guidance on this project. We appreciate the opportunity and resources provided to work on this impactful project. Our team would also like to thank our cosponsors the City of Santa Fe Water Division and Simtable for assisting this project. Jesse Roach and Stephen Guerin provided us information and guidance on important matters relevant to our research. Additionally, we would like to thank our advisors, Professor Zoe Eddy and Melissa Belz for their continued support, advice, and recommendations throughout this process. Our team would also like to recognize our fellow classmates at the Santa Fe Project Center for making the Interactive Qualifying Project experience memorable. A special thank you to Clayton Hanlon for his assistance in our project throughout the term. Finally, we would like to thank all those who take the time to read our paper and consider our recommendations. We have spent many weeks working on this project and are very proud of the work we have accomplished.

Table of Contents

Table of Figures

Authorship

Section	Author	Editor
1. Introduction	Cameron Carlin	All
2. Background	Mackenzie Pryor	All
2.1 The Water System of Santa Fe	James Doucette	All
2.2 Problems with Santa Fe Water System	James Doucette	All
2.3 Water Conservation	James Doucette	All
2.4 Museum Exhibits	Cameron Carlin	All
2.5 Educating Children in Museums	Mackenzie Pryor	All
2.6 Educating Children through Interactive Exhibits	Krish Shah-Nathwani	All
2.7 Project Background	Mackenzie Pryor	All
3. Methods Chapter	Cameron Carlin	All
3.1 Objective One: Gain a Thorough Understanding of Water Conservation in New Mexico	James Doucette	All
3.2 Objective Two: Recognize Child Behavioral Patterns While They Learn from Hands-On Exhibits	Mackenzie Pryor	All
3.3 Objective Three: Observe Various Styles of Successful Exhibits and the Features Associated	Cameron Carlin	All
3.4 Objective Four: Become Familiar with Exhibit Portability and Self-Sustainability	Krish Shah-Nathwani	All
4. Findings	James Doucette	All

4.1 Domestic Water Conservation Perspective	James Doucette	All
4.1.1 New Mexico Residents Identify Deficits in Water Conservation Efforts	James Doucette	All
4.1.2 Participants Actively Acknowledge and Perform Water Conservation Routinely	James Doucette	All
4.1.3 Participants have Misconceptions about their Water Consumption	James Doucette and Mackenzie Pryor	All
4.2 Child Behavioral Patterns in Museums	Mackenzie Pryor	All
4.2.1 Children Learn Effectively Through Exploration	Mackenzie Pryor	All
4.2.2 Collaboration Enhances Engagement for Children	Mackenzie Pryor	All
4.3 Successful Museum Exhibits	Cameron Carlin and Krish Shah-Nathwani	All
4.3.1 Successful Exhibits Incorporate Interactivity to Inform Children while Maintaining Engagement	Cameron Carlin	All
4.3.2 Various Approaches, Challenges, and Outcomes within an Exhibit Encourages Experimentation	Cameron Carlin	All
4.3.3 Self-Sustainability Reduces the Need for Exhibit Maintenance	Krish Shah-Nathwani	All
4.3.4 Portable Exhibits are not Practical for the Needs of This Project	Cameron Carlin and Mackenzie Pryor	All
4.3.5 Concept Distribution is a More Efficient Method of Outreach than Exhibit Portability for This Project	Krish Shah-Nathwani	All
5. Discussion	James Doucette and Mackenzie Pryor	All

6. Recommendations	Cameron Carlin and James Doucette	All
6.1 A Stationary Exhibit within the SFCM Should be Used to Educate Children on Domestic Water Conservation	James Doucette	All
6.2 An Interactive Outreach Program Should be Used to Increase Domestic Water Conservation Outreach	Mackenzie Pryor	All
6.3 “Grab & Go Kits” Should be Sent Home with Children to Reinforce Concepts	Cameron Carlin	All
7. Considerations	Cameron Carlin and Mackenzie Pryor	All
8. Conclusion	Cameron Carlin and Mackenzie Pryor	All
References	All	All
Appendix	All	All

1. Introduction

Las Vegas, New Mexico is a city 40 miles away from Santa Fe; the two are separated by the Santa Fe National Forest. In September of 2022, Las Vegas's water supply was polluted with ash after an intense monsoon season. The citizens of the area were told to "reduce their water usage down to 44 gallons of water a day per person" (Nilsen, 2022, n.p.). The average person in New Mexico tends to use over double that amount daily (Figure 1). However, water pollution and scarcity are not just problems in the state's northern region: they are issues all around New Mexico. These urgent problems are the reason that our team traveled to Santa Fe, New Mexico with Worcester Polytechnic Institute.

Our team collaborated with the Santa Fe Children's Museum to design an exhibit for children that expresses the importance of water conservation in areas facing water scarcity and pollution. The goal of this project was to help the community of Santa Fe by providing information and raising awareness about water conservation to increase understanding of local water issues. We aimed to inform the youth on water conservation now so that they can help fix water issues in the future.

Our background chapter provides information on the Santa Fe water system and the problems associated with it. In order to clarify these issues, we discuss water scarcity and pollution, emphasizing the importance of water conservation. Next, our team considers various types of exhibits, including the comparison between hands-off/non-interactive and hands-on/interactive designs. Following this, we discuss the science behind the learning process for children. We then present examples of interactive exhibits that educate children. To conclude the background chapter, we summarize our research and introduce the project sponsors.

The next chapter of our report establishes the objectives and methods required to achieve our project goal. Our team conducted interviews, observed how children interacted with museum exhibits, distributed surveys, and performed comparative analysis. Following the methodology chapter, our report introduces the findings chapter. We divided the findings into three categories: household water conservation, child behavioral patterns in museums, and successful museum exhibits. Additionally, in our discussion section, we considered topics such as water conservation in the New Mexico school curriculum and exhibit accessibility. Our team proposed recommendations and considerations for the Santa Fe Children's Museum regarding the continuation of this project with the intent of perpetually raising awareness about water conservation. Finally, we conclude our report with thoughts of this project's overall impact. References and appendices are located at the end of the report.

2. Background

Museums are, in general, a place to go in order to learn or discover something new. People of all ages can learn from museums, whether the purpose is for art, history, science, and/or other topics. While museums have their differences, almost all strive to entertain and educate their audiences. Museums communicate information through the use of educational materials (Caporaso et al., 2022). While taking a tour of the museum, observing displays, or talking with staff members, the visitors learn through experiencing the exhibits (Ponsignon & Derbaix, 2020). The displays can share information in a variety of ways, and museum specialists use different strategies when

creating exhibits for the museum audience. Many museums also educate on serious issues like flooding and hurricanes. Relevant to this project, many museums tackle water conservation. As this project deals with water scarcity and pollution in New Mexico, it is important to first understand the local system.

2.1 The Water System of Santa Fe

The state of New Mexico, as well as the entirety of the southwest of the United States of America, is an arid landscape. Compared to the rest of the country, this region has a limited amount of major water sources. The surface water sources within New Mexico include major rivers like the Rio Grande, the Canadian River, and the San Juan River, all of which flow south from the Rocky Mountains. Additionally, the residents of New Mexico depend on another water source, groundwater. Roughly 90 percent of the 2.11 million New Mexico residents use groundwater for drinking water. Roughly 50 percent of water used by the whole state is groundwater (Li et al. 2005). Smaller communities within New Mexico can extract groundwater through the distribution of local wells. For more populated areas, like Albuquerque and Santa Fe, the population utilizes a mixture of both surface water and groundwater sources.

Santa Fe is the fourth largest city in New Mexico. According to the 2021 United States Census, the population of Santa Fe was 87,497 people and is rapidly growing. A substantial amount of water is needed to satisfy the daily needs, facilities, and processes of an area with this many people. Each Santa Fe resident uses roughly 93 gallons of water per day (Figure 1).

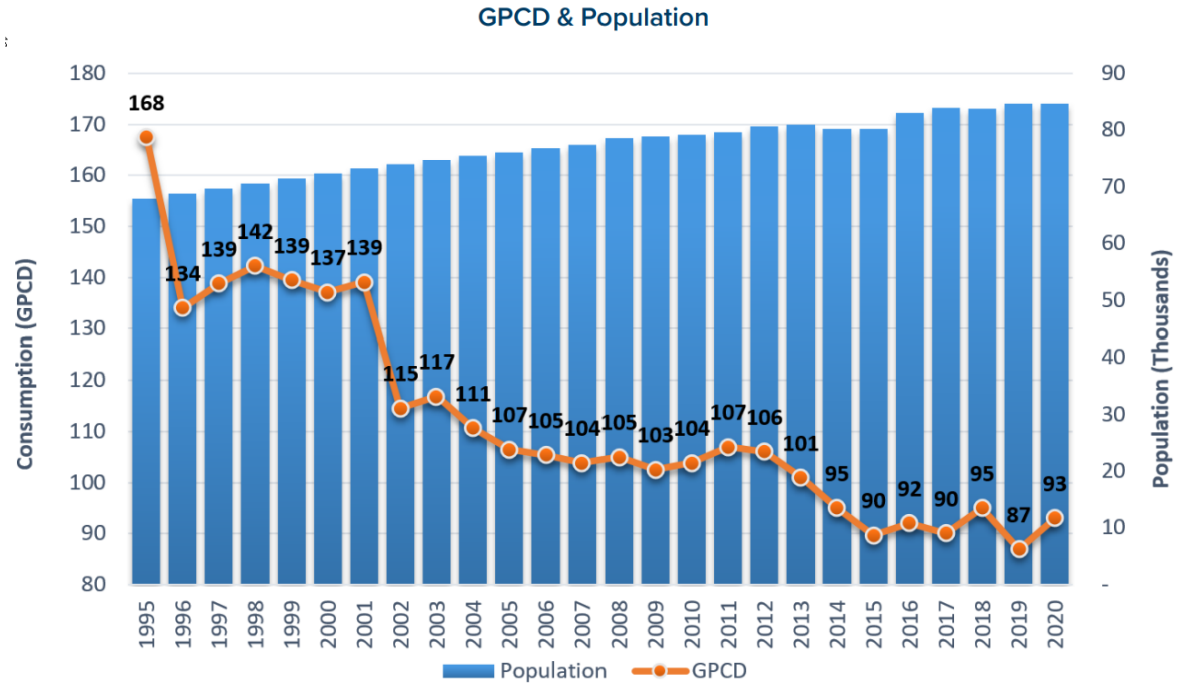


Figure 1. *Gallons of Capita per Day & Population of Santa Fe*

Note. The figure displays the consumption of water per person in Santa Fe and the population of Santa Fe per year from 1995-2020. (*City of Santa Fe Water Sources*)

Figure 1 indicates that the entire population of Santa Fe on average used 8,201,949 gallons of water per day in 2020. The city of Santa Fe takes water from both the Rio Grande and the Santa

Fe River (Figure 2). As shown in Figure 2, about 79% of Santa Fe's water in 2021 came from surface water. Specifically, the city took surface water from the Buckman Direct Diversion on the Rio Grande (Dark Blue Section in Figure 2) and the Canyon Road Water Treatment Plant on the Santa Fe River (Light Blue Section). The remaining 21% of Santa Fe's water came from groundwater sources, including the Buckman Well Field on the Rio Grande (Orange Section) and the City Well Field on the Santa Fe River (Yellow Section).

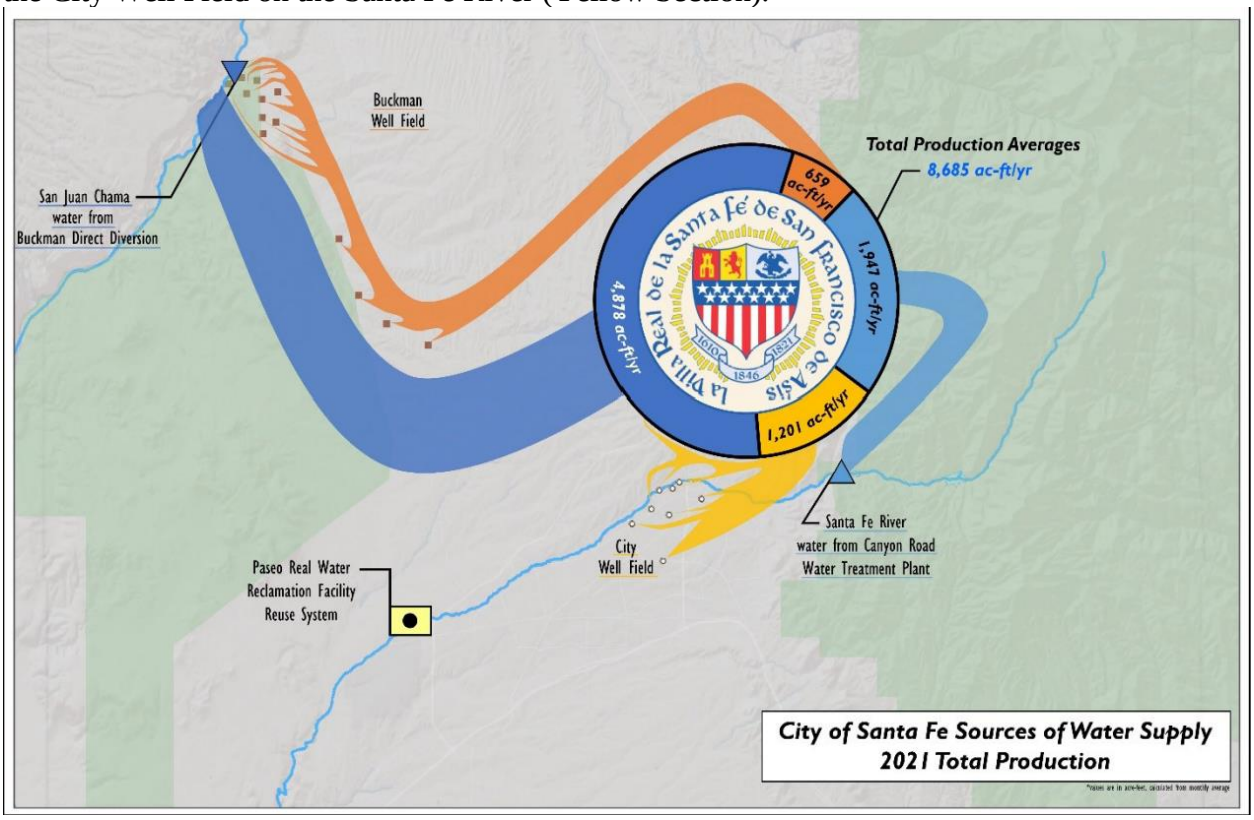


Figure 2. *City of Santa Fe Sources of Water Supply 2021 Total Production*

Note. The diagram displays the distribution of water sources for the city of Santa Fe, NM. The water is taken from the Rio Grande (Left) and the Santa Fe River (Right). (*City of Santa Fe Water Sources*)

Although the water from these two rivers is currently sufficient to meet needs, the use of this water has and will continue to be problematic in various ways (Li et al., 2005). Considering Santa Fe's population growth and consumption rates along with drought and climate change, the current water supply is expected to be exhausted within 20 to 30 years (Li et al., 2005; Ahn and Sheng, 2021). The dry climate of Santa Fe causes water scarcity and pollution, which are expected to become more prevalent as time continues (Li et al., 2005; Ahn and Sheng, 2021).

2.2 Problems with the Santa Fe Water System

Given Santa Fe's climate and pressure on the water system, it is unsurprising that the city faces water scarcity and pollution problems. The absence of rainfall has "dramatically lowered reservoir levels and raised concern about the future of the water supply, particularly when combined with projections of a warmer and drier future climate" (Margolis et al., 2011, p. 118). This prediction is based on a long-term study of tree-ring reconstruction showing the difference in

water levels over the past century. The tree ring widths help determine the amount of water absorbed per cool season. The analysis of this data determined that the water absorbed in more recent years was much less than earlier years, proving a decrease in water level over time (Margolis et al., 2011). Other components significantly impact the amount of water, such as the community's usage, and will create water shortages within Santa Fe (Singha et al., 2022). Collectively, these issues exacerbate each other, exponentially decreasing the water supply. Various factors including "temperature rise, consumptive use, groundwater depletion, and lack of ideal water prioritization and allocation will contribute to more pronounced water shortages in the near future" (Li et al., 2005, p. 16). The city of Santa Fe and other parts of New Mexico will suffer in the future if this trend continues.

Beyond water scarcity, there are several other factors that can affect the availability of freshwater in the city. Polluted water is a major threat to the water system in Santa Fe, decreasing the amount of available water even further when paired with water scarcity. Several policies have been put in place to help reduce general contamination, however, those did not solve every issue. Stormwater, or the water built up on the surface of the landscape due to heavy precipitation, is one of the leading contributors to contaminated water. Bacteria is collected and transported throughout the environment, continuously building up within rivers and streams and eventually flowing to sources of water for human use (Hajic, 2018). Additionally, there are various other contaminants integrated into the water that bypass the safety regulations, such as arsenic and chloroform. These contaminants in the water are legally acceptable, however, "legal does not necessarily equal safe" and the federal government's water safety standards do not always meet the latest health guidelines (EWG Tap Water Database, 2022, n.p.). Reducing water pollution through better filtration can theoretically help provide more water to Santa Fe residents. Additionally, bringing awareness of this polluted water concern to the community can help motivate the push for a better water system (EWG, 2022). The quality of water is equally as important as the quantity. The combination of stormwater and available water creates a pollutant concern. Stormwater is known to transport bacteria and other hazardous contaminants, such as fecal matter, ash, and chemicals, to water sources used for drinking and other necessities (Hajic, 2018). New Mexico experiences a monsoon season in the summer when intense rainstorms occur. Stormwater during this period has a greater chance of collecting hazardous substances due to the overall quantity of water flowing over the landscape (Hajic, 2018).

Water scarcity and pollution are still prominent within the Santa Fe water system. In order to correct these problems, action needs to be taken by not only political and business figures, but also the people of Santa Fe in their own daily lives (Liu et al., 2022, p. 62). Li-Yin Liu (2022, p. 63), a professor at the University of Dayton, Ohio, states that "environmental stressors, such as incidents of pollution and resource scarcity, will motivate individuals to take pro-environmental actions to resolve the issue." The moment when people become aware of their own actions is when they are personally affected.

2.3 Water Conservation

Practicing water conservation is vital and ultimately creates a greater chance of providing water availability in the future (Singha et al., 2022). Water conservation is the act of preserving and developing water sources to create a sustainable amount of water while also preventing contamination and pollution. Individuals need to notice the importance of water conservation in order to make a significant impact on water availability.

Individuals within their own homes must be aware of water conservation needs because "house-hold effects have shown to impact water conservation" (Liu et al., 2022, p. 63). For example, not leaving the sink on while brushing one's teeth, doing fewer loads of laundry throughout the week, and not excessively watering lawns can lead to water supply longevity (Liu et al., 2022). When people observe others incorporating water conservation into their daily routine, they will become more encouraged to implement these habits into their own lives (Singha et al., 2022). Communities focusing on saving water within their daily routine leads to a substantial impact not only for themselves, but for future generations (Singha et al., 2022).

Understanding water conservation is valuable; based on the available research, New Mexico would benefit from raising awareness about water conservation. Through water conservation education, individuals will understand the importance of water conservation and how it can be incorporated into their lives. One way of teaching people within a community about a certain concept can be through museums. Museums are generally accessible to locals and tourists alike. A museum exhibit can easily display the importance of a concept, like water conservation, to people of all ages when executed correctly. Therefore, the use of museums can assist in educating the people of a community on this major issue.

2.4 Museum Exhibits

Museums are able to inform their visitors through the use of exhibits. Museum exhibits come in many forms and have various qualities. Generally, museums have two different types of exhibits: hands-off/non-interactive and hands-on/interactive. Hands-off exhibits provide a visual learning approach and oftentimes express information through the use of signs, pictures, and diagrams (Kotut et al., 2021). Certain displays may not allow touch or interaction because they are fragile. Therefore, these exhibits aim to be engaging and entertaining to its audience through a visual approach. However, traditional hands-off exhibits "may be read or observed but do not change physically in response to visitors' actions" (Shaby et al., 2017, p. 255). This limitation prevents active participation from the audience, which decreases the ability to be an effective learning environment (Shaby et al., 2017). Instead of relying on a hands-off technique, museums have looked in another direction to provide interactions between the visitors and the exhibits.

More positive visitor interactions come when museums implement attractions that encourage active learning. This increased interaction leads to more engagement with museum displays. A key factor to an interactive design is reciprocity: the exhibit will respond if someone uses it (Shaby et al., 2017). Implementing a back-and-forth communication between the exhibit and the audience will increase the time spent at the exhibit. As a result, opportunities for learning become greater. The evolution of exhibits from a hands-off to an interactive approach has improved the learning environment within these museums.

Two characteristics that facilitate successful exhibits are educational value and visitor engagement. If an exhibit contains those two features, it will be a popular attraction at a museum (Caporaso et al., 2022). It is difficult to find a balance between these two factors of learning and fun. The frequency with which individuals visit an exhibit and the amount of time they spend at it are used as metrics when investigating the engagement that the exhibit draws. These metrics can be linked to the amount of learning the consumer gets from the display (Caporaso et al., 2022). Interaction between people and an exhibit correlate highly with popularity and interest.

Children's museums use a diverse set of strategies to captivate children and adolescents; because of this, they serve as locations with unique opportunities. For example, museums are often

the destination of field trips, school visits, summer camps, and conventions. Since children are the target audience, the exhibits are catered towards them. Children learn better from interactive, hands-on exhibits: as Professor Jessica Caporaso states, “exhibit interactivity is considered essential to children’s museum learning experiences” (Caporaso et al., 2022, p. 3). Compared to exhibits that are purely visual, interactive exhibits provide better learning opportunities for children because they receive a response from the exhibit. Children that interact with museum attractions are able to apply what they have learned to science-based tasks better than the children who only participate in free exploration (Yannier et al., 2022).

When children connect with an exhibit through their actions, they are able to process and understand the information more. The exhibit acts as a guide for children as it teaches them about its components. Children can develop a social relationship with one another through the interaction with exhibits. A display that promotes collaboration for children is important. Designs that enable collaborative participation for children have heightened the engagement and educational value (Degotardi et al., 2019). At young ages, children learn from their own experiences and when around peers. This promotes a learning environment for all groups involved, increasing engagement (Degotardi et al., 2019). The outcomes of a successful exhibit provide a positive education experience for children. It is important that the contents of the attractions allow for children to learn and take information away from the exhibit. In the setting of a children’s museum, this information can be used alongside child learning techniques to create a successful exhibit.

2.5 Educating Children in Museums

Educational value is an important aspect when designing exhibits for children because it is important for childhood development. Something to consider when creating educational content, especially in the context of museums, is the idea that children learn in a different manner than adults (Griffin et. al, 2016; Zosh et al., 2017). The skills that allow children to grow cognitively are called executive functions. According to *Introduction to Executive Function in Preschool-Age Children*, these functions are “fundamental to learning because they lay the foundation for adaptive, goal-directed behaviors that enable the child to override more automatic (e.g., cry, scream, run away) or impulsive (e.g., grab for or throw objects) thoughts and responses. It is crucial for young children to acquire these skills in order to be ready to learn when they begin school and to have continued academic success” (Griffin et. al, 2016, p. 4). Children develop their executive functions through engagement in order to retain knowledge. Interactive education helps build engagement and encourages healthy executive function development. In a study done on the executive functions of children, the outcome showed “the importance of science activities within a preschool setting not only for the development of science itself but also for supporting the development of children’s [Attention Shifting] and [Inhibitory Control], which is a basis for their social development” (Vidal Carulla et al., 2021, p. 9). Creating educational science activities for children is mutually beneficial for all involved. Children gain more cognitive skills, and therefore, are able to retain the knowledge being taught to them.

Some strategies for developing executive functions can be seen in the classroom setting. One example of how to communicate information is through play because children “learn by comparing physical experiences, by interactions with other people and their own feelings. And they learn an enormous amount through their imagination... Play is what pulls together the logical and creative parts of the brain” (Fromberg, 2012, 1:17). Humans are constantly learning through personal experiences, even when they do not realize it. Learning through trial and error helps

children to form their own ideas, which allows the concepts to endure in the child's mind. This can promote learning in general, since "children are intrinsically motivated to play, which makes it a fertile ground for learning and developing new skills. Play harnesses children's potential and has a central role in preparing children for challenges in childhood and through adulthood" (Zosh et al., 2017, p. 12). Essentially, children can be tricked into learning by making the information fun to consume and investigating for themselves is extremely beneficial for their learning.

Going along with this method is providing children space to solve problems on their own and enabling "children to become autonomous and independent in relation to thought and the acquisition of know-how" (Ferreira et al., 2016, p. 5620). Children are naturally curious and have the desire to expand their minds. Providing more opportunities for self-discovery can be beneficial to their learning experience. Having children work through problems without too much adult interaction leads them to grow in their problem-solving abilities and retain more information.

Conversely, there are times when having a guiding force can help children gain the intended information from a lesson or exhibit. In two studies done on children's exploration of exhibits, it was found that "4-8-year-old children were more engaged and discovered more properties of the [subject] when they explored it with their parents as opposed to their peers or on their own. These children also left the exhibit with a deeper understanding of [the subject], including a deeper understanding of the underlying mechanisms that support its operation" (Attisano et al., 2022, p. 188). While children may be able to come to conclusions on their own, they may not be able to fully grasp the exhibit and gain all of the intended information, so some parental guidance is useful in these situations. Assistance from their parents allowed the children to learn more from the exhibits than they could on their own. In certain instances, children may be unable to make this kind of connection with a parent or guardian, such as during a school field trip to a museum. In lieu of a familiar adult, staff can also interact with children to aid their learning (Attisano et al., 2022).

These education concepts and techniques must be considered when creating a children's museum exhibit. As stated previously, exhibits can be in the form of interactive or hands-off. In a study on the pros and cons of these exhibits, the results "demonstrate that there is not one optimal design that facilitates all forms of engagement; different design features promoted different types of child engagement (including pretend play and sharing) and parent involvement" (Caporaso et al., 2022, p. 26). Interactive exhibits allow children to do the learning themselves, with activities like pressing buttons or operating devices, while hands-off exhibits teach through visual displays. While both exhibit types have benefits in different situations, interactive exhibits are the more engaging option for children (Fromberg, 2012).

2.6 Educating Children through Interactive Exhibits

With interactive exhibits, children are given the freedom to explore and learn on their own (Caporaso et al., 2022). When educating children on water issues, an interactive exhibit will allow for a stronger understanding of the subject. This connection, along with the entertainment value that comes with playing with water, fosters strong knowledge retention (Fromberg, 2012). Whether these issues are taught through pictures or interactive methods, it is important that the information is easy to understand and conveyed properly to its audience. There are many examples of how to teach children about these issues in an engaging way. One example is the water table at the Kearney Area Children's Museum in Kearney, Nebraska (Figure 3).

Figure 3. *Kearney Area Children's Museum Water Exhibit in Kearney, NE*

Note. The image displays the Water Exhibit currently on display in the Kearney Area Children's Museum. The exhibit aims to teach children about water conservation (*Kearney Area Children's Museum*).

This exhibit shows how the Rocky Mountains supply water to the state of Nebraska through various dams and rivers. More importantly, this exhibit educates children on water conservation. The museum displays an 8-minute video about different types of irrigation, as well as graphics about the water system along the wall of the exhibit ("Water Education Exhibit," n.d.). This format allows children to absorb information about water and retain important lessons. The exhibit has a myriad of toys and water faucets across the table allowing children to play and learn at will.

Another exemplary exhibit is the "Stream Table" at the KidsQuest Museum in Bellevue, Washington (Figure 4). This table has movable barriers that can be used to redirect the water flow and push objects through the water in various ways. This exhibit also incorporates playing and experimentation into it, allowing children to learn about water independently.

Figure 4. *Stream Table located at KidsQuest Museum in Bellevue, WA*

Note. The image displays the Water Exhibit known as the Stream Table currently on display in the KidsQuest Museum. The exhibit aims to teach children about water flow (*KidsQuest Museum*).

Finally, a perfect example of education through interactive exhibits is "Move With the River", a water table located at the Louisiana Children's Museum ("Move With the River," n.d.). It is an interactive 100-foot water table that depicts the Mississippi River (Figure 5). The exhibit features mechanical cranes to move cargo between ships, a build-a-pipe station to teach children about water flow, and toy boats that children can use to navigate through all of the river's bends and curves. The table is covered with license plates from all around the country to show how far the Mississippi River reaches. The most important aspect of this table, however, is the miniature version of New Orleans. The city of New Orleans has experienced multiple hurricanes and floods, namely hurricane Katrina, during the lifetime of both parents and children, generating anxiety around the subject (Vestal, 2017). The miniature model of New Orleans periodically fills with water to symbolize a flood. The children are faced with the task of pumping the water out of the city, providing a small-scale example of a very relevant problem to the people of Louisiana.

Figure 5. *"Move With the River" located at the Louisiana Children's Museum*

Note. The image displays "Move With the River", a 100-foot water table depicting the Mississippi River. The exhibit has many interactive features that aim to teach children about a myriad of topics regarding water. (*Louisiana Children's Museum*)

All of these exhibits incorporate playing, education, and relevant community aspects, which are effective for child learning. When discussing water conservation, implementing these concepts into an interactive exhibit at a children's museum will increase the likelihood of knowledge retention. Viewing interactive water exhibits is an important step to take for our team, as these are primary examples of what can be done in our project.

2.7 Project Background

To summarize our research, museums are places that expose visitors to opportunities that spark exploration and creativity. Our project focuses on teaching water conservation to children in New Mexico. Since the target audience of the project is children, our team is working with a children's museum. Our primary sponsor for this project is the Santa Fe Children's Museum (SFCM), with Hannah Hausman as our liaison. Asis Gonzalez, a museum educator at the SFCM, works primarily with mobile presentation and educating children at the museum. Mr. Gonzalez has previously built a water table exhibit for the museum on the topic of erosion. We were encouraged to use this exhibit as inspiration for our own. Additionally, we worked with multiple cosponsors. The first is Jesse Roach, who is the director of the City of Santa Fe Water Division. Our second collaborator is Stephen Guerin, the CEO of Simtable. We planned to use their assistance and advice throughout our project.

3. Methods Chapter

Our project aimed to design an interactive water exhibit for the Santa Fe Children's Museum to inform its audience on water conservation and its importance. The target audience of this exhibit was children. Through research, we hoped to develop an interactive exhibit that would expose them to the topics of water scarcity and pollution.

The objectives that aided us in reaching this goal are as follows:

1. Gain a thorough understanding of water conservation in New Mexico
2. Recognize child behavioral patterns while they learn from hands-on exhibits
3. Observe various styles of successful exhibits and the features associated
4. Become familiar with exhibit portability and self-sustainability

We used several research methods to assist us in the completion of our objectives: participant observation, interviews, surveys, and comparative analysis.

3.1 Objective One: Gain a Thorough Understanding of Water Conservation in New Mexico

In order to achieve a greater understanding of water conservation within New Mexico, our team established communication with experts on water as well as local community members. We conducted semi-structured interviews with water system and conservation experts; we paired these with surveys for the Santa Fe Children's Museum visitors.

Our team organized a semi-structured interview with our co-sponsor, Jesse Roach, the Director of the City of Santa Fe Water Division. Establishing a semi-structured interview creates a more casual environment, allows the interviewers to adapt the script throughout the interview, and provides the individual being interviewed more "freedom to express their views in their own terms" (Cohen & Crabtree, 2006). Mr. Roach informed us more on the general Santa Fe water system, going in depth on where the water is collected, and the process needed before the water reaches the general population. Following this interview, Mr. Roach suggested that our team interview Christine Chavez, the Water Conservation Manager, from the City of Santa Fe Water Division. From this semi-structured interview with Ms. Chavez, our group gained insight on the water system and how water conservation is taught to the general Santa Fe community.

In order to focus on the general community of New Mexico, our team produced an anonymous survey. This survey was distributed to the visitors of the SFCM to identify their understanding on domestic water conservation. Surveys have the ability to collect data from a large population efficiently and "therefore have a greater statistical power" and "the ability to gather large amounts of information" (Jones et al., 2013, p. 7). The purpose was to increase our knowledge of the local community's understanding on water conservation and if they think about water conservation practices in their daily lives. The survey consisted of nine questions that took approximately five minutes to complete. Our group distributed it in physical and digital form to the visitors of the SFCM to expand the range of options for individuals completing the form. In total, our team received 100 survey responses from visitors of different backgrounds (Appendix A).

3.2 Objective Two: Recognize Child Behavioral Patterns While They Learn from Hands-On Exhibits

When designing a museum exhibit for children, it is important to consider how they behave in different environments. Our team investigated how children learn and retain information; we also investigated their level of engagement with exhibits. Based on our research, there are different levels of direct interaction with children in a museum setting. The least invasive method is participant observation, where researchers fully delve into a group by engaging in local activities and experiencing the local culture. Due to the firsthand interactions with the group being observed, this method can give "an intuitive understanding of what's going on in a culture and allows you to speak with confidence about the meaning of data" (Bernard, 2011, p. 355). This immersive method allowed us to gather prior knowledge before directly interacting with specific members of the community. The Ecotarium in Worcester, Massachusetts and Explora in Albuquerque, New Mexico are science museums that cater to elementary and middle school children. We observed children interacting with exhibits and used them ourselves, which gave us a new perspective on our project. Additionally, our team observed at the Santa Fe Children's Museum for 20 hours over the course of four weeks, which helped us gain insight on our exact demographic of children.

Furthermore, we interviewed individuals from several groups in the local community. The staff at the Santa Fe Children's Museum were valuable resources for this objective. Howard T. Hommer is a Fun Facilitator at the museum, meaning he ensures children are engaged, entertained, and learning while they are visiting. Leona Hillary is the museum's Director of Education, as well as a special education teacher. In their interviews, these two staff members provided us with significant information on how children behave at the museum. We utilized this information to aid us in conducting parent and child interviews in tandem.

Parent and child interviews were done by having two of our group members converse with the adult while the other two members talked to the child. It is important to consider that interviews with children tend to be more complicated than adults, since the interviewee is more inclined to run away or get distracted. The issue was negated by playing with the child instead of sitting down and asking questions. This tactic eases the child into a comfort zone which helps researchers "gain access to insider knowledge that may otherwise have remained hidden, while child participants have the opportunity to learn more about their potential role in understanding and changing their environment" (Zwiers, 2017, p. 120).

3.3 Objective Three: Observe Various Styles of Successful Exhibits and the Features Associated

To determine the characteristics that make an exhibit successful, our team expanded our knowledge on museum exhibits through comparative analysis and in-person visits. We researched twelve museum exhibits online and noted the common components of these exhibits (Appendix L). It is important to perform comparative analysis on the exhibits to determine similar characteristics of successful exhibits. This method identifies components that "excel, are lacking, or are missing" relative to other similar objects or concepts (*Comparative Analysis*, n.d.). Our team utilized the research that was already completed to build upon others' knowledge and avoid performing any redundant experiments.

Following online research, our team began to visit museums in-person. We observed various styles of exhibits and saw the strategies that worked effectively when designing an

attraction for children. Along with our visits to the Ecotarium, Explora, and the Santa Fe Children's Museum, we visited the Electric Playhouse and the Museum of Natural Science and History in Albuquerque, New Mexico. In total, 25 hours of observation was done over the course of five different days. As mentioned previously, a successful exhibit is able to inform and engage the audience, therefore, our team looked for features that did this during museum visits. Our team observed children at museums which allowed our team to draw conclusions about child interaction and prolonged exhibit engagement and learning. There are many exhibits within a museum and children move quickly from one place to the next. Determining the components that kept children entertained at an exhibit was important for the completion of this objective.

Aside from looking at the components of successful exhibits, our team conducted various interviews with people connected to our project. In addition to talking to museum staff about child behavior, we interviewed three staff members about exhibit design and their perspectives on working with museum exhibits. They provided information on exhibits at the SFCM and which of those exhibits children gravitate towards. Additionally, our team interviewed two members of the Santa Fe Children's Museum Board about their experiences with the SFCM.

3.4 Objective Four: Become Familiar with Exhibit Portability and Self-Sustainability

At the start of the project, the SFCM had made it clear that they would like the exhibit to be portable. Their hope was to bring the exhibit to the greater New Mexico Area in order to teach a larger audience of children. The museum recently acquired a 2022 Ford XL van which they will use to transport mobile exhibits around the state to increase their outreach. Additionally, to allow for as little exhibit maintenance as possible, we decided that our exhibit would need to have some level of self-sustainability. Thus, our fourth objective was to become familiar with exhibit portability and self-sustainability. We were successful in doing so by completing various museum visits, exhibit observations, and semi-structured interviews with experts.

As previously mentioned, our team visited three museums in Albuquerque during our first week in Santa Fe. These visits gave us valuable insight on how children interact with exhibits, however, none of these exhibits were portable or self-sustainable. Instead, our team resorted to other sources to gather research. For example, our team spent time at the SFCM observing an erosion table made by Asis Gonzalez, a museum educator.

Additionally, our team spent time examining the "Grab-and-Go Kits" offered at the SFCM. This helped us gain a better understanding of the various portable activities used by the museum.

Out of the six semi-structured interviews we conducted during our third week on-site, two stood out in the context of this objective. Sam Wasson, a frequent patron of the SFCM, provided useful insight on exhibit design. Mr. Wasson's son is homeschooled and is educated partially through museums, thus allowing him to see plenty of exhibits. Next, we talked to Leona Hillary at the SFCM. She has a passion for exhibit design and art, which allowed her to give us many tips regarding the design of the exhibit. She is very knowledgeable on the opinions of children and helped us balance the portability and self-sustainability aspects of museum exhibits with child enjoyment.

4. Findings

In this chapter, we present findings collected from project data. Following the completion of our methods, we identified categories based on our objectives. The categories were: 1) domestic water conservation perspective, 2) child behavioral patterns in museums, and 3) successful museum exhibits. The data we collected from interviews, observations, surveys, and literature review were used to support these findings.

4.1 Domestic Water Conservation Perspective

After receiving 100 surveys on domestic water conservation awareness from visitors of the SFCM, our team cleaned and compared the data. Based on the data, we established specific findings including deficits in water conservation efforts, the acknowledgement and execution of water conservation, and misconceptions on water consumption. These findings demonstrated the participants' perspective on water conservation within their personal lives.

4.1.1 New Mexico Residents Identify Deficits in Water Conservation Efforts

Survey participants provided our group context on New Mexico's water conservation outreach by answering the question "*Do you think the state of New Mexico does a good job on informing the public about water conservation*?" (Appendix A). The participants reported mixed feelings about the outreach of water conservation. The results showed that 46% of participants did not believe the state provides adequate water conservation outreach, while 44% believe the state does perform water conservation outreach effectively (Figure 6). The remaining 10% of participants were not residents of New Mexico and were omitted from this question.

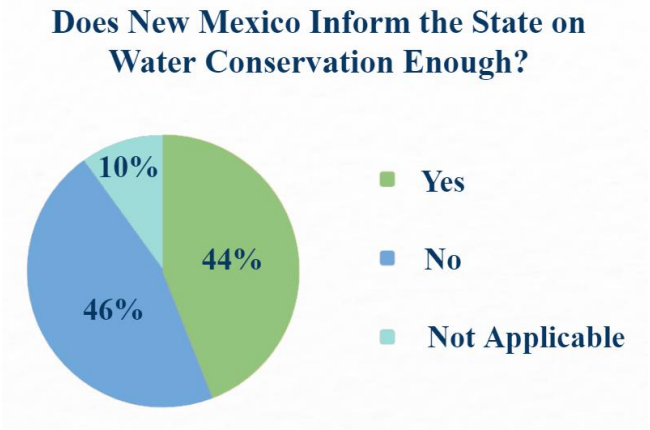


Figure 6. *Graph of survey results on If New Mexico Informs the State on Water Conservation Enough*

Note. The graph displays survey results to the question "Does New Mexico Inform the State on Water Conservation Enough?"

Participants who answered 'no' for this question stated that there is "not much in the media" and "not a lot of education in conservation." Individuals believe there is not enough information available on how to save water, however, they also acknowledge its importance in the arid region.

Despite the survey participants' opinions on water conservation efforts, the city of Santa Fe does have various outreach programs. During her interview, Christine Chavez, the Water Conservation Manager for the City of Santa Fe Water Division, stated that the city promotes outreach through general marketing platforms such as their website, social media, radio shows, monthly articles, adult programs, and school programs. These strategies appear to be effective for the residents of Santa Fe. However, one survey participant, who has been a resident of New Mexico for 23 years, stated that "all of our outreach goes to … cities like Albuquerque/Santa Fe." As a result of the lack of direct outreach from the state itself, people in remote communities may have more difficulty receiving information on water conservation.

Respondents who answered 'yes' to the adequacy of water conservation outreach provided a different perspective. The most prominent source of water conservation outreach seen in the data came from signage within public building bathrooms such as those found in restaurants and businesses. However, signage does not indicate the state's actions on water conservation outreach, but rather the actions of the organizations in which the signs reside. Furthermore, these participants stated that New Mexico's efforts could use improvement, meaning that the outreach is still not sufficient. Additionally, participants who answered yes or no both acknowledged that it is up to the individual to make an effort and that an increase in education on water conservation is crucial. Ultimately, regardless of the state's actions, individuals need to actively conserve water on their own terms to make the greatest impact.

Another question participants answered on the survey was "If [you have been informed on water conservation], where did you learn about it?" (Appendix A). Respondents' answers were then distributed into three categories: school, other sources, or never learned about the topic (Figure 7). The school category was then divided into schools in New Mexico and schools out of state.

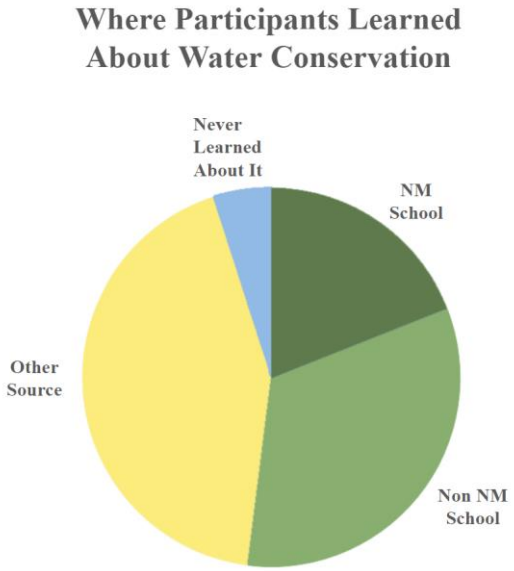


Figure 7. *Graph of survey results on Where Participants Learned About Water Conservation*

Note. The graph displays survey results of where participants learned about water conservation

52% answered that they learned about water conservation at school in some manner. 43% answered that they learned about water conservation through a different source, which include museums, articles, websites, community events, and more. The last 5% have never learned about water conservation. When comparing the 52 participants who learned about water conservation in school, their time of residency, and their age range, our team determined that at least 33 participants learned about water conservation in schools out of state. Therefore, at most, 19 out of the 100 total participants learned about water conservation at school in New Mexico. As a result, out of the 35 participants that could have gone to school in New Mexico, up to 19 of them learned about water conservation in school. That is only 54%, which can be significantly improved. During our semi-structured interview with Christine Chavez and a meeting with our sponsor, Hannah Hausman, our team identified that parents learn from children bringing information home. Children share topics that they have learned, such as water conservation. Thus, a larger range of people will learn about its importance.

4.1.2 Participants Actively Acknowledge and Perform Water Conservation Routinely

Despite the negative views on state outreach, 95% of survey participants think about water conservation in their daily routine (Appendix A). The remaining 5% either barely think about water conservation or do not think about it at all (Figure 8).

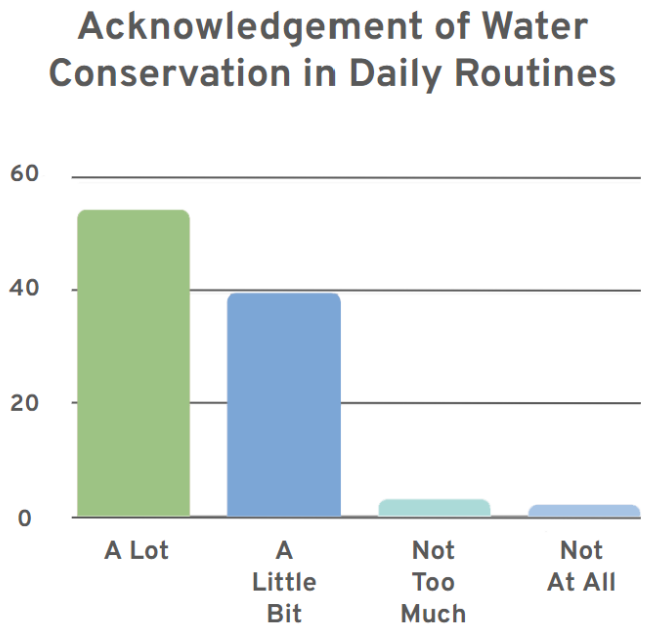


Figure 8. *Graph of survey results If Participants Acknowledge Water Conservation in their Daily Routines*

Note. The graph displays survey participants' awareness of water conservation when going about their daily routines

Additionally, participants specifically identified if they acknowledge and perform water conservation in certain daily routines (Appendix A). The five routines included 1) brushing your teeth, 2) showering, 3) washing dishes, 4) washing clothes, and 5) watering plants. Participants were then asked to answer if they do both, one, or none of these activities. For all categories, at

least 68% or more participants answered that they acknowledge as well as perform water conservation, indicating again that a majority of participants think and actually execute water conservation on a daily basis (Figure 9).

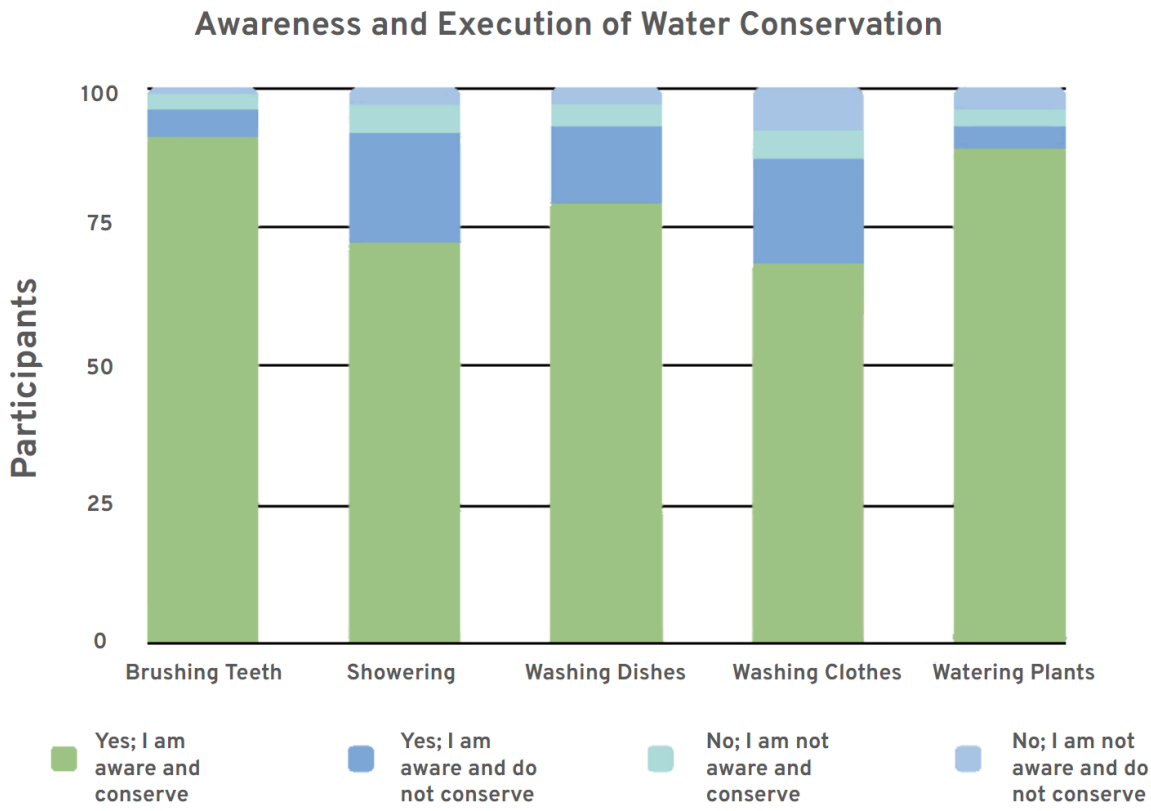


Figure 9. *Graphs of survey results on Participants Awareness and Execution of Water Conservation in Specific, Typical Routines Involving Water*

Note. The graphs display whether or not participants practice water conservation during specific daily routines and if they are aware of it or not.

The remaining participants do not think about water conservation or do not actively conserve within these typical daily routines. Overall, our data indicated that a majority of participants understand the importance of water conservation within their households.

4.1.3 Participants have Misconceptions about their Water Consumption

Although many of the survey participants stated that they actively attempt to conserve water, our data shows that they do not conserve as much water as they believe (Figure 9; Figure 10). Another question asked participants "How much water do you think you use on a daily basis?" (Appendix A). While the average usage in New Mexico is about 93 gallons per person per day, 80% of people guessed far below this amount (Figure 1; Figure 10). 67% of participants estimated their daily water usage is 25 gallons or less. In reality, this volume of water is used within a ten-minute shower (Take Care of Texas, 2021). This disparity between believed and actual amounts shows that, while the local community cares about conserving water in their

everyday lives, they do not know how much of an impact their own practices can have.

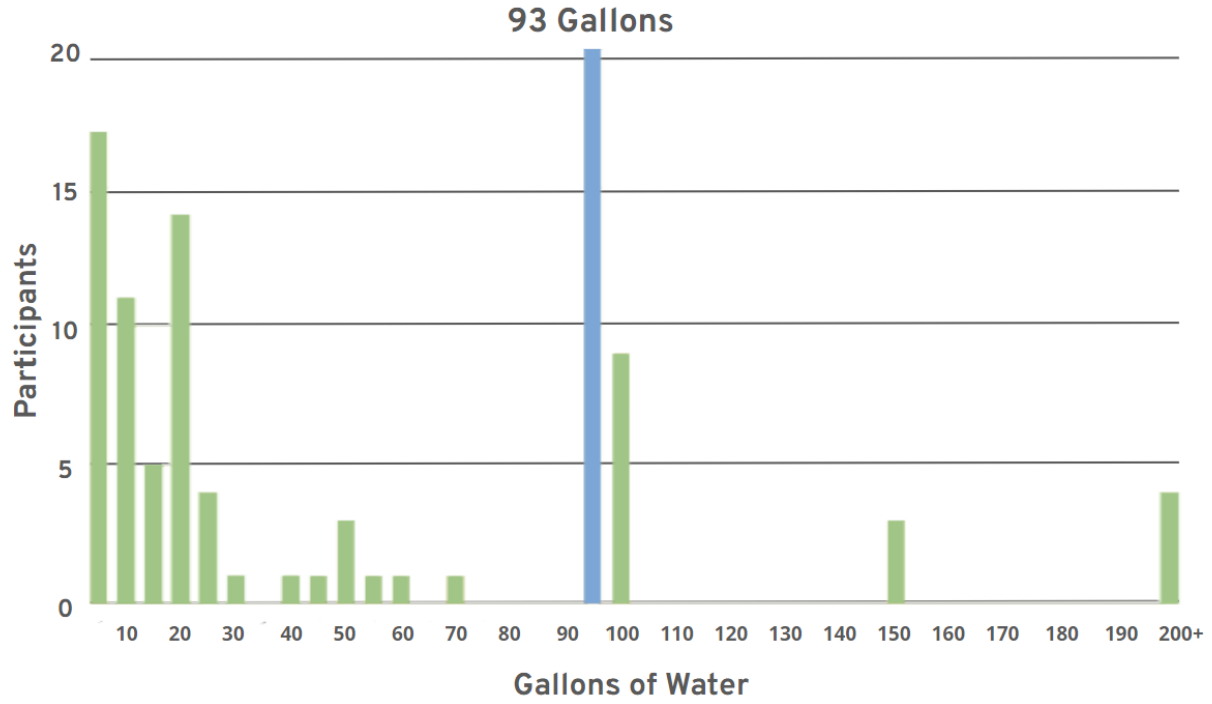


Figure 10. *Graph of survey results on Participants Estimation of Daily Water Usage*

Note. The graphs display participant's estimations for how many gallons of water they use per day, with the average of 93 gallons per day shown in comparison

Additionally, 24% of participants had no idea on how much water they use on a daily basis. Out of all participants, 9% were within a ten-gallon range of the actual 93-gallon average.

4.2 Child Behavioral Patterns in Museums

While on one of our team's regular visits to the SFCM, we observed an interaction between two children. The first child was playing with a whirlpool exhibit and decided to test its limits. They clogged the whirlpool with a toy that was much too large for the drainage hole and loaded it with more toys as the cylinder filled with water. As the exhibit began to overflow, the child seemed overwhelmed and was not sure what to do. This is when a second child approached and helped unclog the whirlpool by removing the large toy. The pair watched as the water and all of the toys got sucked down the drain, then proceeded to repeat this process several times. This interaction encapsulates the essence of exploration and collaboration among peers, which are representative of the findings we distinguished through our research.

4.2.1 Children Learn Effectively Through Exploration

As established in our background research, information retention increases through higher engagement, which can be achieved through experimentation (Fromberg, 2012). Our group's firsthand interactions with children and interviews with experts confirms this information. During

our many museum visits we noticed that children enjoyed seeing the consequences of their own actions, stimulating their senses, and performing experiments several times.

On many occasions we would see a child use several tools at an exhibit to get different results with each new playthrough. One parent that we interviewed said that he was amazed that children keep coming back to the same exhibits and are still entertained; this sustained engagement can be attributed to the explorative aspect of the exhibits. Sensory based exhibits were also popular in all of the museums we visited. The SFCM Director of Education, Leona Hillary, said in an interview "mess is success at the children's museum" This was seen in action when we witnessed how children enjoyed splashing in water, playing with lights, and making their own music at exhibits, allowing them to remain engaged through immersion.

Another common theme between various museums was that exhibits would provide tools to children that would create different outcomes depending on what was used. One exhibit at Explora in Albuquerque, New Mexico involved crafting a paper airplane and launching it with a burst of air (Figure 11). Children were given creative freedom with the construction of their planes. This allowed them to use trial and error to make an aircraft that would fly through the target holes. Providing children the space to experiment and learn from their failures will help them remember the lesson being taught. This sentiment is already being utilized at the SFCM, as Howard T. Hommer told us "Let them do wrong to learn right."

Figure 11. *Explora Moving Air Exhibit*

Note. The image displays the paper airplane exhibit in the Moving Air section of Explora in Albuquerque, New Mexico.

4.2.2 Collaboration Enhances Engagement for Children

In our research we discovered that collaboration between peers can lead to an increase in engagement and educational value (Degotardi et al., 2019). Building on this, collaboration is also

a natural instinct for many children. The desire to work together can be fostered through exhibits and their facilitators.

During our observations we witnessed children working together and caring about each other without any outside influence. We saw one child explaining a concept to another child who seemed confused while playing together at a water table. A similar story was told to us in an interview with a parent, where he witnessed his son discussing with friends how to best solve a problem they were facing. The children all had varying solutions to the issue and decided to work together and decide what course of action to take. The child in this story also made it clear to us that his favorite aspect of the museum was that he was able to see and play with all of his friends. Our cosponsors at the City of Santa Fe Water Division are already utilizing an educational strategy involving collaboration. According to Christine Chavez, there is a program where teenagers create and present slideshows about water issues to younger children.

4.3 Successful Museum Exhibits

Through various interviews, observations, and literature reviews, our group identified findings revolving around successful museum exhibits. The findings in this section discuss the features and components that contribute to the proposed exhibit being successful.

4.3.1 Successful Exhibits Incorporate Interactivity to Inform Children while Maintaining Engagement

During our research on museum exhibits, we found that a successful exhibit keeps children entertained while also teaching them about a topic. The balance between learning and fun is an essential part of what makes an exhibit successful (Caporaso et al., 2022). After the completion of interviews with museum staff and observations of museum exhibits, our team found that the most successful exhibits contain interactive features to keep children engaged. Our research findings align with Neta Shaby's idea that the most successful exhibits include interactive design and increased child engagement (Shaby et al., 2017).

In our observations at the SFCM and Explora, the most popular exhibits contained interactive features. Children gravitated towards exhibits where they could manipulate objects and play with the moving parts. On the contrary, less popular exhibits did not contain interactive features. Sarah Haghi, an education coordinator at the SFCM pointed out in an interview that the least popular exhibits do not have elements with which the children can interact. The implementation of interactive features creates an engaging environment for children.

An additional aspect that successful exhibits displayed was providing an opportunity for collaboration between multiple children. In our interview with Leona Hillary, we were told that the most popular exhibits at the SFCM are the ones that had enough space to fit several children at once. Through observations, we found that the exhibits that allowed children to collaborate, resulted in longer engagement times. Children were able to interact with the exhibit and each other, which exemplifies a common quality in successful exhibits. An example of an exhibit that incorporates collaboration between children is one of the water flow tables at Explora (Figure 12). During our observations, we witnessed various children collaborating at the exhibit. This table promotes collaboration by including numerous toys for children to play with. The toys were used to alter the flow of water as well as keep the children entertained. Collaboration between children was seen throughout the most popular exhibits, contributing to the finding that interactivity helped to keep children learning and engaged.

Figure 12. *One of the exhibits in the "Water Patio" at Explora Science Center and Children's Museum of Albuquerque*

4.3.2 Various Approaches, Challenges, and Outcomes within an Exhibit Encourages Experimentation

An aspect that was found in many successful exhibits was the encouragement of experimentation. Successful exhibits provided the users with numerous ways of interaction with differing outcomes each time. The combination of various approaches, challenges, and outcomes encouraged children to experiment with different techniques when playing with these exhibits.

A great example of an exhibit that encompasses these features is the water flow table at the SFCM (Figure 13). This exhibit creates many opportunities for learning and exploration. The water table contains flowing water, barriers to alter its movement, and other objects to play with. This museum exhibit can be interacted with in many ways. Some children may use barriers, and some may not because there is not one correct way to interact with the table. During our observations at the Santa Fe Children's Museum, our team noticed that children enjoyed moving the barriers from one place to another and then watching how the flow of the water changed. The ability to use tools and objects at an exhibit is an important part of exploration. Each tool will change the approach and outcome that children will use, resulting in more experimentation. Finding 4.2.1 showed that experimentation led to effective learning, so the use of tools and objects within an exhibit is important.

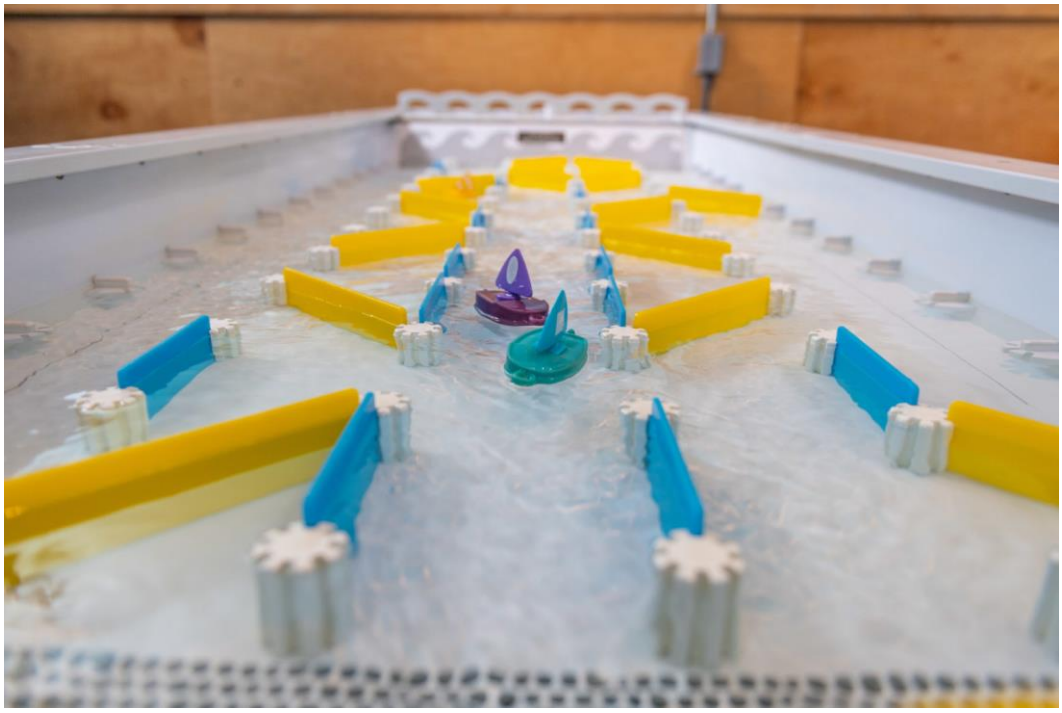


Figure 13. *Water Flow Table at the Santa Fe Children's Museum (Santa Fe Children's Museum)*

Experimentation within a museum exhibit varies depending on the age of the child. In interviews with museum staff, we learned that the Santa Fe Children's Museum targets children ranging in age from 0-10 years old. As a result, a 10-year-old will have a greater understanding than a toddler when it comes to the topics of museum exhibits. A successful exhibit will allow children to gain something out of it, regardless of their age. In an interview with Caitlin Brodsky, the president of the SFCM Board of Directors, she stated that "each child gathers something different out of the exhibit depending on their age." An exhibit that incorporates learning for a range of children is very beneficial to the children's exploration. Our background research showed that children who explore while playing learn information in the process (Zosh et al., 2017). Therefore, making sure that an exhibit can be beneficial to a child's learning, regardless of their age, is a necessity for a successful exhibit.

Additionally, through our observations and interviews, our team noticed that many museum exhibits include a challenge or objective to complete. This extra target is a strong example of how varying ages of children will experience different outcomes at an exhibit. In an interview with Howard T. Hommer, our team learned exhibits that include challenges and objectives for children to complete will lead to more interaction and engagement. Mr. Hommer stated that within museum exhibits, "challenges make [them] more fun and encourage experimentation." The addition of a goal to complete at an exhibit gives children an objective to strive for. Implementing a challenge results in children taking numerous attempts to complete it, leading to increased learning and engagement time.

The water table at the SFCM has an additional challenge for children to attempt. The goal is to get the boat to flow down the table, circle back, and float up to the start. Children have to experiment with varying methods and approaches to accomplish this goal. The method of experimentation allows for children to make mistakes and learn from them. The varying approaches and outcomes led to more experimentation at the exhibit, which resulted in our finding.

4.3.3 Self-Sustainability Reduces the Need for Exhibit Maintenance

Through our museum visits and semi-structured interviews, we gathered data that led us to find that self-sustainability reduces the need for exhibit maintenance. During our first visit to the SFCM, we observed an erosion table made by Asis Gonzalez (Figure 14). This table pumps out water, which seeps into the sand, showing the principle of erosion.

Figure 14. *Asis Gonzalez's self-sustainable water erosion table located at SFCM*

What is important to note about this table is that it is self-sustainable. Through our interview with Mr. Gonzalez, we were able to find out how he did this. The water is pumped through the spouts, flows down the table, and is filtered back into the storage tank. The most impressive aspect of this exhibit is that it is powered by portable batteries (Figure 15).

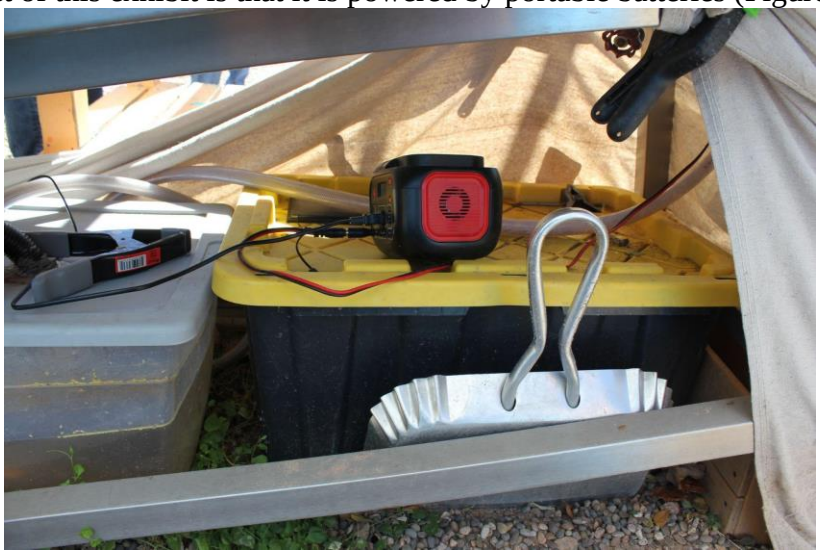


Figure 15. *A portable battery*

Note. This battery is located directly below the aforementioned sand table and is its power supply

Furthermore, this exhibit charges its portable batteries with solar panels located above the area in which the exhibit is housed (Figure 16). This allows the exhibit to be almost completely self-sustainable, with batteries having to be changed rarely. In fact, Mr. Gonzalez told us in his interview that the table was able to run uninterrupted for almost a week.

Figure 16. *Aerial photo of a section of the SFCM outdoors*

Note. This photo displays the area in which the aforementioned sand table is housed and the solar panel that is used to charge the battery in the previous figure.

Due to these different self-sustainable aspects, this table requires very little maintenance. Hector Solis, the SFCM Facilities Manager, confirmed this in an interview where he stated that he has rarely needed to perform maintenance on this exhibit. After speaking with Mr. Solis, we considered the importance of making the lives of those maintaining the exhibits as effortless as possible.

4.3.4 Portable Exhibits are not Practical for the Needs of This Project

While portable exhibits are a method of increasing outreach, our team found that they are not ideal for this project. Coming into this project, our team envisioned a museum exhibit that could be located at the museum, as well as be brought to local schools, camps, and communities. After completion of data collection, our team realized that a portable exhibit would have more drawbacks than benefits.

Early interviews gave us indications that a portable exhibit may not be as effective as we intended. During an interview with Leona Hillary, she stated that children love exhibits that are "kinetic" and get their entire body involved. Upon hearing this, our group became worried as the constraints of a portable exhibit may not allow for our exhibit to be as movement friendly as the ideal exhibit that Ms. Hillary had pictured. In our interviews with children, we noticed that they tended to gravitate more towards exhibits where they could be creative and move around. For example, the children enjoyed running around the flow table at the SFCM and trying to solve the

challenge in front of them (Figure 13). Our group had many trepidations that a portable exhibit would garner the same level of engagement.

On our first day at the SFCM, we were greeted by a member of the staff that works mainly in outreach. This staff member was clearly in pain and explained that they had injured their back while transporting an exhibit. We were made aware by other staff that this was not the first instance of injury from exhibit transportation. This experience showed us that a new portable water exhibit could be unsafe for the staff members to move.

Along with the physical danger posed by moving a portable exhibit, it also necessitates staff training. An exhibit that may be easier to transport would require more setup and breakdown in order to carry less strenuous loads. Proper training would be necessary for those assembling the exhibit. Leona Hillary mentioned in an interview that disinfection and general upkeep would also be performed by staff, leading to further training on maintenance. This could potentially lead to a situation where outreach cannot be done without a specific staff member available, as explained to us by Hannah Hausman.

Additionally, we discovered the importance of safety and accessibility in a museum setting. Safety in its purest sense is a given for any type of exhibit, but through our observations we witnessed several children attempt to move mechanisms in unintended ways. Similarly, supplied tools were inevitably used in ways that were not expected, usually in an attempt to break or hinder another aspect of the exhibit. Any feature that children directly interact with needs to be safe and sturdy regardless of how it is used. A portable exhibit cannot be guaranteed to adhere to this constraint, since it needs to be lighter than stationary exhibits and therefore less sturdy.

Overall, a portable exhibit needs certain requirements to work properly. Based on the constraints that these exhibits possess, our team realized that a portable exhibit should not be used in the SFCM as a part-time stationary exhibit. The two types of exhibits require different aspects, and it is difficult for one exhibit to effectively do both tasks.

4.3.5 Concept Distribution is a More Efficient Method of Outreach than Exhibit Portability for This Project

At the start of this project, our sponsor suggested the idea of a portable exhibit, which was something on which our team fixated. Mrs. Hausman envisioned the exhibit reaching many different communities that would not be able to reach the museum. However, through our research, museum visits, and semi-structured interviews with many different parties, we decided that concept distribution could be more efficient than exhibit portability for outreach.

Through our semi-structured interviews, we found a balance where we could accomplish engagement and portability. The SFCM has a selection of what they call “Grab-&-Go Kits”, where a lesson is taught through an activity contained in a plastic bag (Figure 17; Figure 18). This allows museum visitors to leave the establishment with a lesson to take home, thus distributing the concept further.

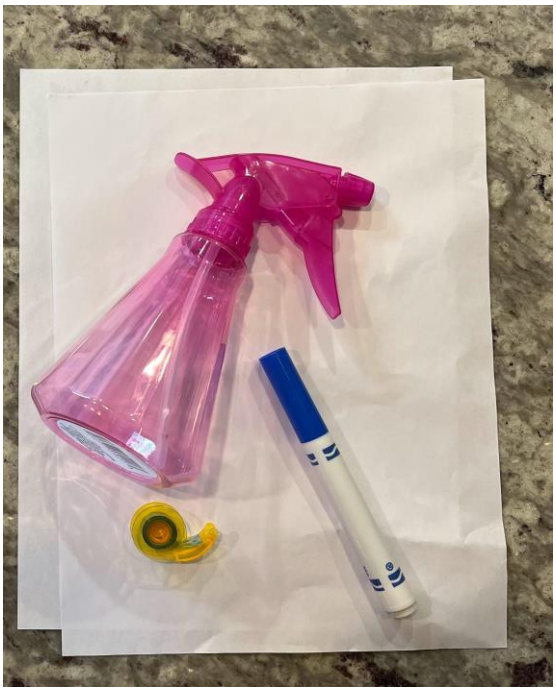


Figure 17. *SFCM Grab & Go Kit*

Note. This specific Grab-and-Go Kit teaches children about how rain runs down mountains. Instruction paper can be found in Appendix B.

Figure 18. *Completed SFCM Grab & Go Kit*

Note. This specific Grab-and-Go Kit teaches children about how rain runs down mountains. Instruction paper can be found in Appendix B.

When asked about the effectiveness of the "Grab & Go Kits" during her interview, Caitlin Brodsky stated, "it's like taking a little piece of the museum home with you." Caitlin has seen the effectiveness of this method first-hand through her children.

Additionally, Hannah Hausman gave us the idea to produce an interactive outreach program. The program can feature many different, simple activities that can travel easily. This reflects a similar method of outreach primarily used in England called "Loan Boxes" (Steele, 2018). Used in history-based museums, these boxes are sent to schools, and contain a variety of artifacts that teachers can use to show their students pieces of history (Figure 19). However, rather than artifacts, Mrs. Hausman's idea suggested the use of water conservation demonstrations and activities within the program.

Figure 19. *The "Teeth Box" from the Museum of Zoology at the University of Cambridge in Cambridge, England (Loans Boxes for Learning)*

All of this supporting data led us to decide that a myriad of ways to spread the message of household water conservation is more beneficial than a singular portable exhibit for the Santa Fe Children's Museum. The combination of an interactive outreach program and a "Grab & Go Kit" proves much more effective in outreach than a portable exhibit.

5. Discussion

Throughout our research, we discovered additional topics that were unable to be condensed into specific findings. Our group identified a correlation between school systems and learning through a museum. Based on interviews and survey answers, children reinforce what they learned through extracurricular activities and then communicate what they learned when they return home. Finding 4.1.1 indicated that, at most, only 19% of participants learned about water conservation in New Mexico schools. However, these participants learned about water conservation at least a decade ago. Therefore, we do not have a great understanding on whether water conservation is being taught in New Mexico school curriculum in the present day. Unfortunately, our group was unable to interview professionals within the education system to further back up this point.

Our team also realized that an exhibit should be accessible to all children who wish to participate, regardless of any differing abilities. Leona Hillary was very passionate about this in her interview, saying, “any kid should be able to play with the exhibits not in a modified way.” Even though it is not possible for an exhibit to be completely accessible, we have considered these ideas in our design. However, the data was not significant enough to construct a finding.

The general consensus on water conservation among the survey participants was that it is an important matter but is not fully understood. In order to increase the outreach of water conservation, the most ideal approach would be to inform children about its importance and for them to ultimately take the information back home to their family. This can be achieved through an interactive exhibit where children tend to be more engaged, have the ability to explore, and can collaborate with their peers. Our findings show that a portable exhibit is not the best option for this project. We believe a stationary exhibit paired with an interactive program and take-home kit will be easier and just as effective as a portable exhibit.

6. Recommendations

After synthesizing the findings, our team made three recommendations in regard to how the message of household water conservation can be spread. Our team believes that a stationary exhibit should be created at the museum and an outreach program should be designed to go along with this exhibit. The SFCM can use these recommendations to increase water conservation awareness in Santa Fe and the surrounding communities.

6.1 A Stationary Exhibit within the SFCM Should be Used to Educate Children on Domestic Water Conservation

As a result of findings 4.3.3, 4.3.4, and 4.3.5, we believe that a stationary exhibit should be used to teach children in the SFCM about the importance of water conservation. A stationary exhibit will be more impactful than a portable exhibit due to the physical constraints a portable exhibit presents. In order to create a portable exhibit, certain components need to be taken into consideration, such as: volume, weight, durability, assembly, power, and manpower. A stationary exhibit will remove or lessen many of these constraints.

The limitations portable exhibits contain will not have to be considered to the same extent when producing a stationary exhibit. Based on our research, a future stationary exhibit at the SFCM should have specific criteria in order to create a successful water exhibit. The criteria include:

1. *Exposure to Water Conservation.* The exhibit concept should focus on the idea of water conservation and expose visitors to the importance of water conservation.
2. *Interactive.* Children must have the ability to physically be involved with the exhibit. Allowing for play creates a more memorable experience and increases engagement while learning.
3. *Explorative.* In order to establish developmentally appropriate problem-solving skills, children must be able to figure out the challenges associated with the exhibit.
4. *Opportunities for Collaboration.* Concepts are reinforced through collaboration with others, including parents/guardians, peers, and museum staff.
5. *Easily Accessible and Safe.* The exhibit must follow the guidelines associated with the Americans with Disabilities Act and be safe for children to use.

6. *Contains Various Approaches and Outcomes.* The opportunity for several approaches and outcomes increases exhibit engagement.
7. *Self-Sustainable Elements.* The addition of self-sustainable elements reduces the amount of maintenance needed for the exhibit. Overall, this could save staff time and energy cleaning and filtering.

As long as the criteria is accomplished, the remaining aspects of the exhibit are freeform.

Based on the criteria, our team has designed a potential exhibit idea that may support the SFCM's goals and needs. We believe a multi-level flow exhibit would be a suitable option and impactful addition to the SFCM (Figure 20).

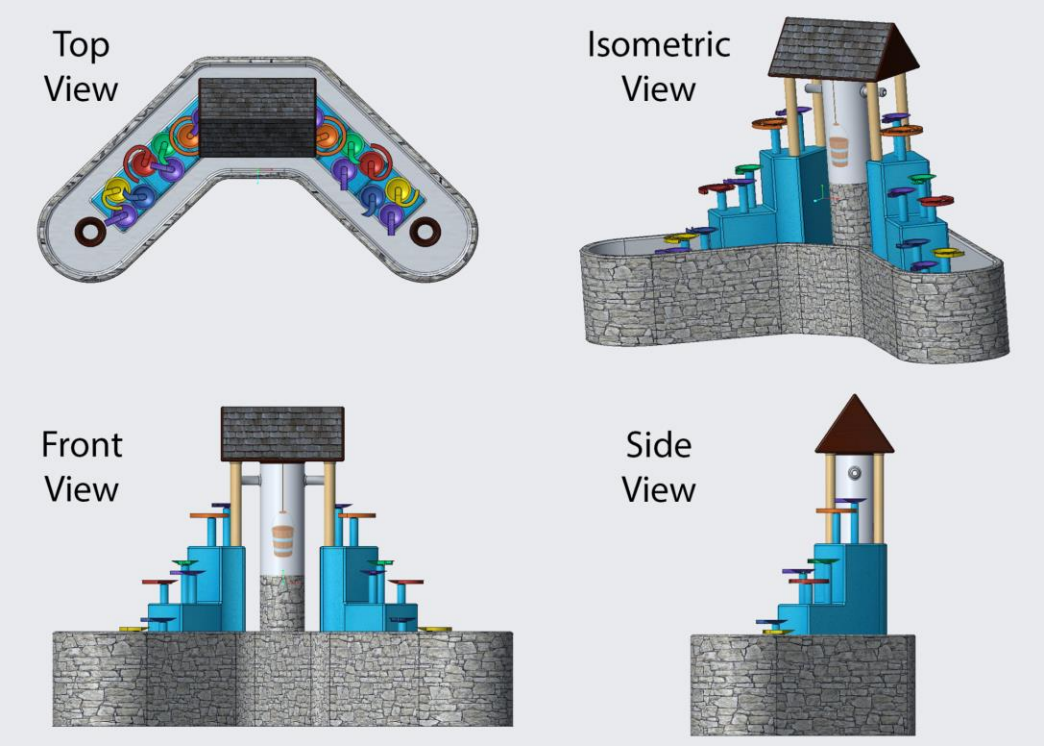


Figure 20. *Potential Water Exhibit Concept for the Santa Fe Children's Museum. Designed by James Doucette, December 8, 2022.*

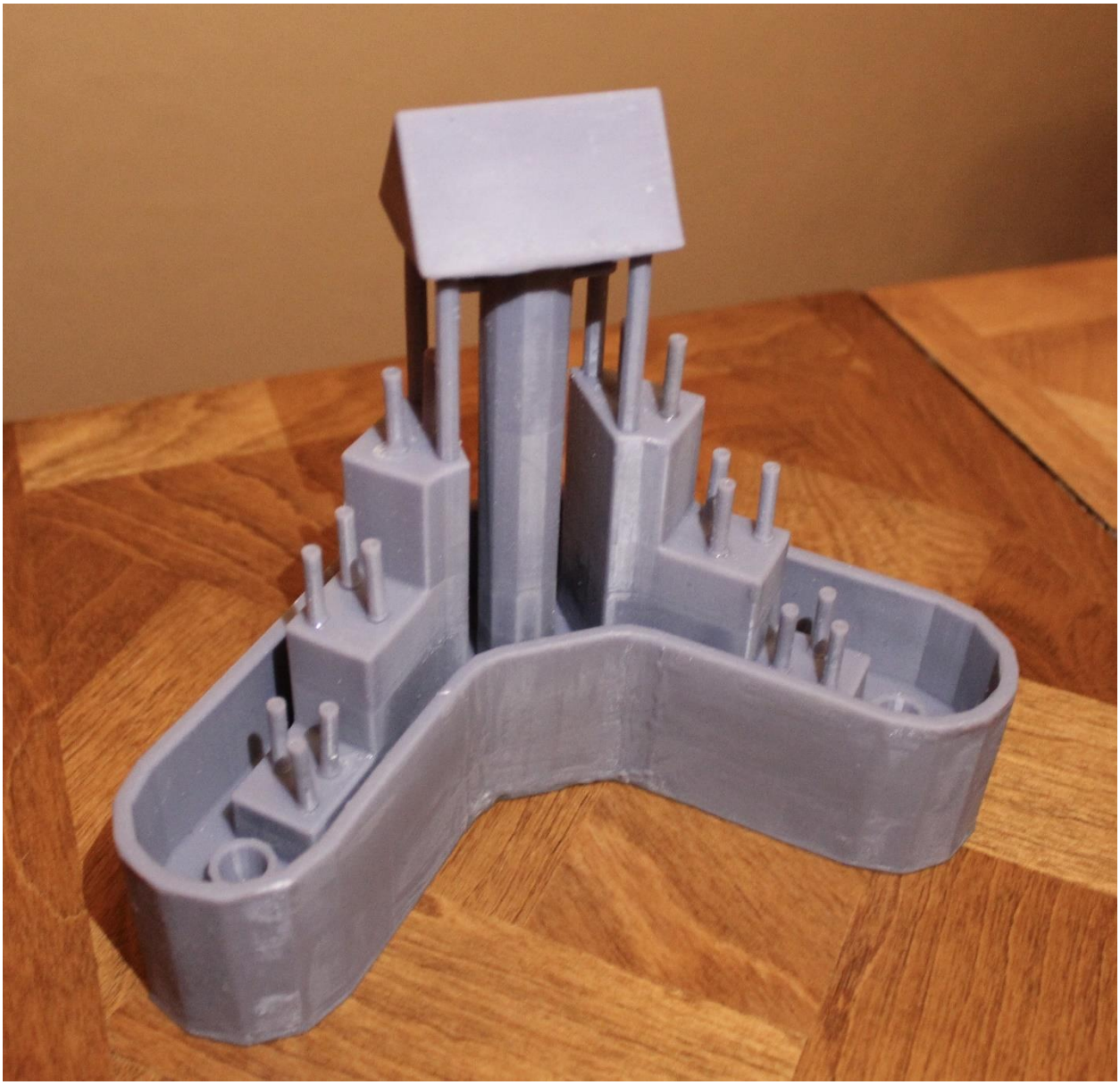


Figure 20. *3D Printed Potential Water Exhibit Concept for the Santa Fe Children's Museum. Designed by James Doucette, December 8, 2022. Printed by Asis Gonzalez, December 13, 2022.*

This exhibit design accounts for many of our criteria as listed above. Water will flow from up the middle of the exhibit and then down each side. The two sides will each contain numerous rotating posts at different levels. The top of each post will be magnetic and allow for variously shaped funnels to be placed on them. Having an array of tools in the form of magnetic water funnels that fit atop the poles will provide opportunity for interaction and experimentation. Additionally, the versatility of the posts can alter the direction of water flow. This encourages the user to experiment with different ways to get the water from the top to flow to the buckets at the bottom. The V-shaped design allows for multiple children to interact with it at once, while also being short and wide enough to be accessible for all.

The goal of the exhibit will be to expose children to the importance of saving water. This is accentuated by the exhibit's well-shaped design, as well as the buckets at the bottom. The center column of the exhibit will be painted to look like a well, which will emphasize the goal of collecting water. Children will need to guide the water so that it gets collected in the buckets. The exhibit will show that water collected in the bucket can be used, whereas the water that falls into the moat will go to waste. This provides opportunities for children to make connections to water conservation and can practice saving water while playing with the exhibit.

6.2 An Interactive Outreach Program Should be Used to Increase Domestic Water Conservation Outreach

In our findings we established that a portable exhibit is not practical for travel, which led us to recommend a stationary exhibit for the museum. We also found evidence that portable exhibits can be unnecessary if there is a suitable replacement. This alternate option teaches the same amount conceptually, but on a smaller scale. In order to satisfy the portable aspect of our goal, an interactive outreach program should be utilized at outreach events.

An interactive outreach program can contain several activities, ranging in participant size and interactivity. Our team recommends that the interactive outreach program contains several demonstrations and activities, not limited to but including:

1. *Conservation Display.* A pseudo leaking faucet could be introduced at the start of this outreach event and left to drip into a bin while other activities are held. At the end of the event, attention can be drawn back to the display and a point can be made about how much water is lost when people are not careful.
2. *Pollution Activity.* One of the bins used to transport this outreach program would be filled with a small amount of water and a few metallic objects that would symbolize pollutants. Children would take turns using a magnet to fish out these metal pieces until the water has been cleared, providing a hands-on lesson about water filtration. A point should be made at the end of the outreach event to inform the children that the water used for this would not go to waste and would be used to water plants outside of the school.
3. *General Water Display.* A 3D printed landscape of Northern New Mexico will be provided in order to educate on where a town's water comes from. This will be specialized to each location the outreach program will be brought to and will provide a fun visual for children.
4. *Conservation Activity.* A cooperative game would be used to reinforce the lesson taught on water conservation in an engaging manner. One child would be given a full cup of water to begin, with several other children receiving empty cups. The children would be lined up several feet apart to start. The goal of this game would be to transfer the water from one cup to another in a relay until every cup had been used. Throughout the course of the activity water would inevitably be spilled, showing how water conservation is an issue that requires a team effort to make a difference. This game would satisfy our findings on how children learn through exploration and collaboration.

This outreach program would also contain a step-by-step guide that details how the displays are set up and what should be taught alongside each activity or demonstration. This would allow any staff member to run this event with ease (Appendix C).

We have also considered the funding needed for this arrangement. A proposal for this outreach program will be given to the City of Santa Fe Water Division in order to request funding.

6.3 "Grab & Go Kits" Should be Sent Home with Children to Reinforce Concepts

In addition to a stationary museum exhibit or an interactive outreach program, children should be given "Grab & Go Kits" to take home. Our findings showed that the SFCM's kits have been very effective at supplementing learning done in the museum. Finding 4.3.5 explains that concept distribution is an efficient method of outreach for this project. Our team has designed the "Grab & Go Kit" to inform families about water conservation practices. Therefore, we recommend that the Santa Fe Children's Museum provides these "Grab & Go Kits" to children that visit the museum or participate in the interactive outreach program. We recommend that the kit contains the following items:

1. *Cold Water Catcher Bucket.* This bucket will be placed in the shower to collect the cold water before children get into the shower. The water can then be used to water plants, mop the floor, and wash the car.
2. *Shower Timer.* A five-minute sand timer will be provided for children to use when they shower. This will limit the water that children use in a manner reminiscent of a game to keep them entertained.
3. *Faucet Filter.* A plastic faucet cap will be provided in the bag. The filter will go onto sink faucets and limit the flow rate of the water, which limits the water wasted.
4. *Plant Seeds.* These plant seeds will not require a lot of water to limit the amount of water needed to make them grow. Children will learn to take care of a plant without wasting water.
5. *Water Conservation Tracking Sheet.* A chart with numerous daily tasks will be included in the kit. Children and their families can all keep track of their water conservation practices on a daily basis. Some of the tracking sheet items may include: *Did you turn off the water while brushing your teeth?*, *How long was your shower?*, and *Did you turn off a dripping faucet?*. This tracking sheet can be completed daily, and then the families can compare them at the end of the week (Appendix D).
6. *Pamphlet on Water Conservation.* The pamphlet will include facts about water conservation and tips to reduce the daily water usage within a household. Additional strategies on conservation using household items will be provided. Using recycled items is an easy way to perform water conservation daily (Appendix E).

The "Grab & Go Kits" will reinforce the concepts of domestic water conservation to families. Our data showed that in finding 4.3.1, participants of the survey showed misconceptions about domestic water conservation. The "Grab & Go Kits" will help children and their families implement proper water conservation practices to decrease the amount of daily water used. Additionally, the pamphlet on water conservation will provide facts about daily water consumption to raise awareness on the misconceptions on water usage.

This kit will cost approximately $11 to produce (Appendix F). While giving all of these items would be the most effective way, common items that can be just mentioned could be removed from the "Grab & Go Kit" to reduce costs.

7. Considerations

Throughout the research process our team encountered some limitations that we were unable to address before the completion of the project. We planned to hold multiple focus groups at the Santa Fe Children's Museum in order to gauge children's opinions on exhibits. However, due to cancellations and lack of interest, the sessions were never held. In the future, it would be important to reach out to more people to eliminate the impact of cancellations. Additionally, our findings presented data on the importance of teaching water conservation in the Santa Fe schools system. We wanted our deliverables to reinforce the importance of including water conservation in New Mexico's school curriculum. However, our team was unable to research what is currently being taught within the schools. To combat this, local educators could be interviewed to determine how water conservation is presented to children in Santa Fe schools. While these limitations have hindered aspects of our research, this deficit is negligible in relation to the project as a whole.

8. Conclusion

Initially, our team was tasked by the SFCM to design a portable exhibit that would inform children on water in New Mexico. Through research and data collection, our team investigated the water system in New Mexico and the areas that needed improvement. The data revealed that water scarcity and pollution are major issues within the water system. Our team decided that domestic water conservation should be the topic of consideration. Additionally, we discovered that a portable exhibit is not the optimal method to convey this to children at outreach events. Instead, an interactive outreach program and a "Grab & Go Kit" would be used to increase public outreach on water conservation within New Mexico. This has been paired with a stationary exhibit in the museum to satisfy the idea that children will reinforce what they have learned previously. Our team provided recommendations for the Santa Fe Children's Museum to implement a strategy to increase water conservation awareness. We believe that our recommendations will provide the SFCM with an effective exhibit and outreach program on the topic of water conservation.

References

Ahn, S., & Sheng, Z. (2021). Assessment of Water Availability and Scarcity Based on Hydrologic Components in an Irrigated Agricultural Watershed Using SWAT. *JAWRA Journal of the American Water Resources Association*, *57*(1), 186–203. https://doi.org/10.1111/1752-1688.12888

Attisano, E., Nancekivell, S. E., Tran, S., & Denison, S. (2022). So, what is it? Examining parent-child interactions while talking about artifacts in a museum. *Early Childhood Research Quarterly*, *60*, 187–200. https://doi.org/10.1016/j.ecresq.2022.01.003

Bernard, H. R. (2011). *Research methods in anthropology: qualitative and quantitative approaches* (5th ed). AltaMira Press.

Caporaso, J. S., Ball, C. L., Marble, K. E., Boseovski, J. J., Marcovitch, S., Bettencourt, K. M., & Zarecky, L. (2022). An Observational Investigation of How Exhibit Environment and Design Intersect to Influence Parent–Child Engagement. *Visitor Studies*, 1–32. https://doi.org/10.1080/10645578.2022.2051386

City of Santa Fe Water Sources | City of Santa Fe, New Mexico. (n.d.). Retrieved September 5, 2022, from https://www.santafenm.gov/where_does_our_water_come_from

Cohen, D., & Crabtree, B. (2006, July). *RWJF - Qualitative Research Guidelines Project | Semi-structured Interviews | Semi-structured Interviews*. http://www.qualres.org/HomeSemi-3629.html

Comparative analysis. (n.d.). 18F. Retrieved December 14, 2022, from https://methods.18f.govhttps://methods.18f.gov/decide/comparative-analysis/

Degotardi, S., Johnston, K., Little, H., Colliver, Y., & Hadley, F. (2019). "This is a Learning Opportunity": How Parent–Child Interactions and Exhibit Design Foster the Museum Learning of Prior-to-School Aged Children. *Visitor Studies*, *22*(2), 171–191. https://doi.org/10.1080/10645578.2019.1664849

EWG. (2022). *EWG's Tap Water Database: What's in Your Drinking Water?* https://www.ewg.org/tapwater/system.php?pws=NM3505126

Ferreira, M. E., Cruz, C., & Pitarma, R. (2016). Teaching Ecology to Children of Preschool Education to Instill Environmentally Friendly Behaviour. *International Journal of Environmental and Science Education*, *11*(12), 5619–5632. https://eric.ed.gov/?q=Teaching+Ecology+to+Children+of+Preschool+Education+to+Instill+Environmentally+Friendly+Behaviour&id=EJ1115695

Free Gray Issue Tracking Sheet Template In Google Docs. (n.d.). Retrieved December 16, 2022, from https://thegoodocs.com/sheets/gray-issue-tracking-sheet.php

Fromberg, D. (2012, October 22). *What Kindergarten should be.* https://youtu.be/YhpM_jbVopo

Griffin, J. A., Freund, L. S., McCardle, P., DelCarmen-Wiggins, R., & Haydon, A. (2016). Introduction to Executive Function in Preschool-Age Children. In J. A. Griffin, P. McCardle, & L. S. Freund (Eds.), *Executive function in preschool-age children: Integrating measurement, neurodevelopment, and translational research.* (pp. 3–7). American Psychological Association. https://doi.org/10.1037/14797-001

Hajic, H. (2018). WATER QUALITY ASSESSMENT IN THE SANTA FE RIVER: TRACKING POLLUTION SOURCES VIA QUANTITATIVE POLYMERASE CHAIN REACTION ANALYSIS. *Geography ETDs*. https://digitalrepository.unm.edu/geog_etds/39

Jones, T. L., Baxter, M. a. J., & Khanduja, V. (2013). A quick guide to survey research. *Annals of the Royal College of Surgeons of England*, *95*(1), 5–7. https://doi.org/10.1308/003588413X13511609956372

Kotut, L., Hoang, A., Panda, H., Shenk, J., Newbill, P., Kellogg, D., & Scott McCrickard, D. (2021). Supporting child–group interactions with hands-off museum exhibit. International Journal of Child-Computer Interaction, 27, 100240. https://doi.org/10.1016/j.ijcci.2020.100240

Li, Y., Arnold, S. D., Kozel, C., & Foster-Cox, S. (2005). Water Availability and Usage on the New Mexico/Mexico Border. *National Environmental Health Association (NEHA)*, *68*(3), 10–17. https://www.jstor.org/stable/pdf/44528468.pdf?refreqid=excelsior%3Aba2c258c1a055dd45155d4e8ab752e52&ab_segments=0%2Fbasic_search_gsv2%2Fcontrol&origin=

Liu, L.-Y., Brough, C. B., & Wu, W.-N. (2022). When water conservation matters: Examining how water scarcity experiences create windows of opportunity for effective water-saving policy initiatives. *Environmental Science & Policy*, *137*, 61–69. https://doi.org/10.1016/j.envsci.2022.08.013

Margolis, E. Q., Meko, D. M., & Touchan, R. (2011). A tree-ring reconstruction of streamflow in the Santa Fe River, New Mexico. *Journal of Hydrology*, *397*(1), 118–127. https://doi.org/10.1016/j.jhydrol.2010.11.042

Move With The River. (n.d.). LCM. Retrieved November 9, 2022, from https://lcm.org/experiences/move-with-the-river/

Nilsen, E. (2022, September 3). *This city has around 20 days of fresh water left. Officials are racing to find another source*. CNN. https://www.cnn.com/2022/09/03/us/las-vegas-new-mexico-water-crisis-climate/index.html

Ponsignon, F., & Derbaix, M. (2020). The impact of interactive technologies on the social experience: An empirical study in a cultural tourism context. *Tourism Management Perspectives*, *35*, 100723. https://doi.org/10.1016/j.tmp.2020.100723

Shaby, N., Ben-Zvi Assaraf, O., & Tal, T. (2017). The Particular Aspects of Science Museum Exhibits That Encourage Students' Engagement. *Journal of Science Education and Technology*, *26*(3), 253–268. https://www.jstor.org/stable/45151210

Singha, B., Eljamal, O., Karmaker, S. C., Maamoun, I., & Sugihara, Y. (2022). Water conservation behavior: Exploring the role of social, psychological, and behavioral determinants. *Journal of Environmental Management*, *317*, 115484. https://doi.org/10.1016/j.jenvman.2022.115484

Steele, S. (2018, December 18). *Loans Boxes for Learning* [Text]. https://www.museum.zoo.cam.ac.uk/learning-outreach/learning-resources/loans-boxes-learning

Vestal, C. (n.d.). *"Katrina brain": The invisible long-term toll of megastorms*. The Agenda. Retrieved November 9, 2022, from https://www.politico.com/agenda/story/2017/10/12/psychological-toll-natural-disasters-000547

Vidal Carulla, C., Christodoulakis, N., & Adbo, K. (2021). Development of Preschool Children's Executive Functions throughout a Play-Based Learning Approach That Embeds Science Concepts. *International Journal of Environmental Research and Public Health*, *18*(2), 588. https://doi.org/10.3390/ijerph18020588

Water. (n.d.). *KidsQuest Children's Museum*. Retrieved October 10, 2022, from

https://www.kidsquestmuseum.org/exhibits/water/
Water - Human Activity and Consumption. (n.d.). Retrieved December 16, 2022, from https://www.engineeringtoolbox.com/water-use-activity-d_1900.html
Water Conservation Facts & Water Consumption Facts | Think H2O. (n.d.). Retrieved December 16, 2022, from https://www.thinkh2onow.com/water_conservation_facts.php#:~:text=You%20can%20refill%20an%208,day's%20supply%20of%20U.S.%20newsprint.
Water Education Exhibit. (n.d.). *Kearney Children's Museum*. Retrieved October 3, 2022,from https://kearneychildrensmuseum.org/portfolio/waterzone/
Yannier, N., Crowley, K., Do, Y., Hudson, S. E., & Koedinger, K. R. (2022). Intelligent science exhibits: Transforming hands-on exhibits into mixed-reality learning experiences. *Journal of the Learning Sciences*, *31*(3), 335–368. https://doi.org/10.1080/10508406.2022.2032071
Zosh, J. N., Hopkins, E., Jensen, H., Liu, C., Neale, D., Hirsh-Pasek, K., Solis, L., & Whitebread, D. (2017). *Learning through play: a review of the evidence*. LEGO Foundation.
Zwiers, M. L. (2017). Interviewing children for research. In B. Hopkins, E. Geangu, & S. Linkenauger (Eds.), *The Cambridge Encyclopedia of Child Development* (2nd ed., pp. 117–120). Cambridge University Press. https://doi.org/10.1017/9781316216491.020

Appendices

Appendix A: SFCM Water Conservation Survey

1. How long have you been a resident of New Mexico?
2. How old are you?
    a. 30 or younger
    b. 31-45
    c. 46-60
    d. 60+
3. Do you think about water conservation in your daily routine?
    a. Yes, a lot
    b. Yes, a little bit
    c. No, not too much
    d. No, not at all
4. How much water do you think you use on a daily basis? (In Gallons)
5. Have you ever been informed on what water conservation is?
    a. Yes
    b. No
6. If so, where did you learn about it?
    a. School
    b. Museum
    c. Article/Website
    d. Community Event
    e. Other:
    f. Never been informed about it
7. Do you think the state of New Mexico does a good job on informing the public about water conservation?
    a. Yes
    b. No
8. Explain your reasoning (optional)
9. Here is a list of potential daily routines involving water. Please state if you are aware of water conservation when performing these routines (Y/N), and if you actively conserve water
    a. Brushing teeth
        i. Yes; I am aware and actively conserve
        ii. Yes; I am aware but do not actively conserve
        iii. No; I am not aware and actively conserve
        iv. No; I am not aware and do not actively conserve

b. Showering
    i. Yes; I am aware and actively conserve
    ii. Yes; I am aware but do not actively conserve
    iii. No; I am not aware and actively conserve
    iv. No; I am not aware and do not actively conserve
c. Washing Dishes
    i. Yes; I am aware and actively conserve
    ii. Yes; I am aware but do not actively conserve
    iii. No; I am not aware and actively conserve
    iv. No; I am not aware and do not actively conserve
d. Washing Clothes
    i. Yes; I am aware and actively conserve
    ii. Yes; I am aware but do not actively conserve
    iii. No; I am not aware and actively conserve
    iv. No; I am not aware and do not actively conserve
e. Watering Plants
    i. Yes; I am aware and actively conserve
    ii. Yes; I am aware but do not actively conserve
    iii. No; I am not aware and actively conserve
    iv. No; I am not aware and do not actively conserve

Appendix B: Example "Grab & Go Kit" Instructions

Paper Rivers

SANTA FE CHILDREN'S MUSEUM

Rivers populate every corner of the Earth. They feed the oceans and provide fresh water for plants and animals. But how are they made? Why do they move? Where do they go? Let's create a paper mountain and discover how rivers form and flow in our very own experiment.

Materials Provided
2 Blank sheets of White Paper 8.5x11
Blue Washable Marker
Spray Bottle
Tape

Materials from Home
Optional Table Coverings (e.g. Trash bag, towel, cardboard)
Water to fill your spray bottle

Instructions
Cover your work station with a table covering; plastic or cardboard work well. Fill your spray bottle with water. Now take one piece of paper and crumple it around the outside of your fist. Take it off your fist and crumple it up some more! Now, unwrap the paper carefully to form your mountain! Line up the corners of your paper with the other piece of paper, but don't go all the way to the very edges, leave about an inch on every corner. Tape the corners down. Look at your model and decide where the three highest places (or "peaks and ridges") are. Color those high peaks and ridges with the blue marker so just the fold of the paper has ink. Color those same areas over again a few times so they are fully saturated with blue. This is important for the next phase of the experiment to be successful. Spray the model five times with your water bottle, then WAIT one minute (just count to 60!). Now, spray it again, at least five more times (like rain!). See the blue rivers flow? What happened when it rained on your model?

Inquiry Based Questions
1. Where did the water flow? why?
2. Where did it puddle? Why?
3. Now you made a mountain, what if you made a crater? What happens to the water then?

Answer
1. *The water flows down the mountain slope. It follows the cracks and folds in the paper because of gravity to make rivers*
2. *Puddles form where there are bowls, or depressions, in the Earth.*
3. *The water would puddle up in the crater to form a lake!*

Appendix C: Outreach Activity Program Instructions

Water Conservation
Interactive Outreach Program

Goal

To increase awareness of prevalent water issues in New Mexico and encourage children to conserve water in their own lives.

Materials

- Plenty of water
- Bin with a faucet/drain
- 2 clear plastic bins
- Safe, rounded magnetic metal pieces
- Fishing rods with magnets the ends
- 3D printed landscape of northern New Mexico
- Cups (at least one for each audience member + 2)

Procedure

1. Water Leak Display:
    a. To start, place the container with the faucet on the edge of the table with the faucet/drain off the edge. Place another bin on the ground underneath the faucet/drain. Open the faucet/drain to allow water to drip slowly out throughout the program. Acknowledge water is leaking at the Reference the amount of water that dripped out through the program and at the end to show how much water can be wasted in a short time period.
2. Water Pollution Activity:
    a. Explain what water pollution is briefly. Fill the second plastic bin with water. Dump metal pieces into the bin with water to represent pollutants. Distribute magnetic fishing rods to audience members. Explain the goal is fish out the magnets to clear the pieces and “clean the water”.
3. New Mexico Landscape Display:
    a. Use the 3D-printed landscape of Northern New Mexico to show the audience where their water comes from and how it is transported. This display can be specific to where the demonstration is taking place if possible.
4. Water Conservation Activity:

a. Option 1: Collaborative
    i. Have the audience members line up shoulder to shoulder. Distribute cups to each audience member. Pour water to the top of one of the audience member's cups, preferably the audience member standing at the end of the line. Explain the goal to the audience, which is to pour the water into another audience member's cup, trying not to spill. Once the last member receives the water, they must pour the water into a cup on a table. Express how much water the audience saved compared to the initial amount of water.
b. Option 2: Competitive and Collaborative
    i. Have the audience members line up shoulder to shoulder into two separate lines. Distribute cups to each audience member. Pour water to the top of the audience members' cups at the beginning of each line. Explain the goal to the audience, which is to pour the water into another audience member's cup next to them in the line, trying not to spill. The team that saves the most amount of water wins. Once the last member receives the water, they must pour the water into a cup on a table designated to their team. Compare how much water the teams saved.

5. Water Leak Display Continued:
    a. Close the faucet/drain. Acknowledge how much water leaked into the clear plastic bin on the ground. Explain to the audience that the water can be wasted easily and that the smallest actions can be used to save water.
6. Grab & Go Kits:
    a. Distribute the water conservation Grab & Go Kits to each audience member.

Appendix D: “Grab & Go Kit” Water Usage Tracking Sheet

How much water do I use?

TASK NAME	WATER USED (GALLONS)	NOTES
Total Water:		

Appendix E: “Grab & Go Kit” Pamphlet

Let’s Save Water!

SANTA FE CHILDREN’S MUSEUM

Materials

- Collapsible Bucket
- Shower Timer
- Faucet Filter
- Seeds
- Tracking Sheet

Activities

- Bucket:
  - Use this bucket to catch the water from the shower while it's warming up! You can use this to water plants, mop the floor, and wash the car!
- Shower Timer
  - This timer lasts 5 minutes before the sand runs out, see how fast you can shower to save water!
- Faucet Filter
  - Have a parent help you replace the end of your sink faucet with this, it will make less water come out and help save water!
- Seeds
  - These seeds are for a mystery plant that does not need a lot of water. Make sure to give your seed water once a month and give it lots of love every day!
- Tracking Sheet
  - Use this to keep track of how much water you use every day. See who can use the least water in your family!

Did You Know...

- The average person in Santa Fe, New Mexico uses about 93 gallons of water per day
- It takes 70 gallons of water to fill a bathtub
- A 10 minute shower uses about 25 gallons of water

Want to do More?

Here are some fun ways you can use stuff around the house!

- Fill an empty milk jug with water and put it in the back of your toilet. Every time you flush you’ll be saving water!
- Shut the water off while you're brushing your teeth to save about 5 gallons of water!
- Half empty water bottles can be used to water plants, or give the water to your pets!
- Fill your sink with water and use that to clean dishes instead of leaving the water running!
- Use a watering can instead of a hose to water your plants!

How much water am I using?

Use the statistics below to fill out the tracking sheet to see how much water you use!

Activity	Water Used
Bath	30-40 gallons
Shower (per minute)	2-4 gallons
Brushing teeth (with tap running)	2-3 gallons
Dish-washing by hand (with tap running)	10-20 gallons
Dishwasher	7-10 gallons
Washing hands (with tap running)	1-2 gallons
Laundry Machine	40 gallons
Toilet (per flush)	1.5-4 gallons

Appendix E References

City of Santa Fe Water Sources | City of Santa Fe, New Mexico. (n.d.). Retrieved September 5, 2022, from https://www.santafenm.gov/where_does_our_water_come_from

Free Gray Issue Tracking Sheet Template In Google Docs. (n.d.). Retrieved December 16, 2022, from https://thegoodocs.com/sheets/gray-issue-tracking-sheet.php

Water - Human Activity and Consumption. (n.d.). Retrieved December 16, 2022, from https://www.engineeringtoolbox.com/water-use-activity-d_1900.html

Water Conservation Facts & Water Consumption Facts | Think H2O. (n.d.). Retrieved December 16, 2022, from https://www.thinkh2onow.com/water_conservation_facts.php#:~:text=You%20can%20refill%20an%208,day's%20supply%20of%20U.S.%20newsprint.

Appendix F: Potential Cost of "Water Conservation Grab & Go Kit"

Cold Water Catcher Bucket (Optional) = **$9.50**
https://www.amazon.com/Collapsible-Foldable-Rectangular-Cleaning-Waterpot/dp/B08LK1WWMZ/ref=sr_1_3?keywords=bucket&qid=1670978908&sr=8-3

Shower Timer = **$1.50**
https://www.amazon.com/Teacher-Created-Resources-Minute-Timer/dp/B00KQ6IEC4/ref=sr_1_6?keywords=5+minute+sand+timer&qid=1670978949&sr=8-6

Faucet Filter = **$0.30**
https://www.amazon.com/AQSXO-Restrictor-Replacement-Bathroom-fittings/dp/B08FDF7R22/ref=sr_1_13?crid=CHLR37HZNRUR&keywords=sink+aerators&qid=1670979201&sprefix=sink+aerators%2Caps%2C1678&sr=8-13

Plant Seeds = **$0.01**
https://www.amazon.com/Mixture-Succulents-Seeds-Garden-Bonsai/dp/B08QD5QBDR/ref=sr_1_3?crid=3RXLBQ30TLMRH&keywords=succulent+plant+seeds&qid=1670979368&sprefix=succulent+plant+seed%2Caps%2C292&sr=8-3
—----------

Total = $11.31

Appendix G: Interview Preamble

We are a group of students from Worcester Polytechnic Institute in MA. We are designing a portable water exhibit for the Santa Fe Children's Museum. For this interview, we wanted to ask you about [INSERT TOPIC]. The interview will be about 30 minutes. Your name will be kept confidential unless you give us permission to use it. This interview is voluntary. You may skip any questions that you do not wish to answer. You may also stop at any time. This research will be available to the public via the WPI Library. Please feel free to ask any questions you have about this research at any time. You may also contact our research advisors, Prof. Zoe Eddy and Melisa Belz, at zeddy@wpi.edu and mbelz@wpi.edu, or our group at wpi@santafechildrensmuseum.org, with any questions you have about this process.

Appendix H: List of Interviewees

Interviewees	Date of Interview	Time of Interview
Hector Solis	11/8	12:30 PM
Sam Wasson	11/9	11:00 AM
Anonymous Child	11/9	11:00 AM
Howard Hommer	11/10	1:00 PM
Donna Ralph	11/10	10:00 AM
Leona Hillary	11/10	2:00 PM
Christine Chavez	11/18	1:00 PM
Anonymous Child	11/20	1:00 PM
Cailtin Brodsky	11/21	10:00 AM
Sarah Haghi	11/22	12:30 PM
Anonymous Parent	11/30	3:30 PM
Anonymous Child	11/30	3:30 PM
Anonymous Child	11/30	3:30 PM
Anonymous Parent	11/30	4:00 PM
Anonymous Child	11/30	4:00 PM
Anonymous Child	11/30	4:00 PM
Anonymous Child	11/30	4:00 PM
Anonymous Parent	11/30	5:00 PM
Anonymous Child	11/30	5:00 PM
Anonymous Child	11/30	5:00 PM
Anonymous Child	11/30	5:30 PM
Anonymous Child	11/30	5:30 PM
Anonymous Parent	12/1	3:30 PM
Anonymous Child	12/1	3:30 PM
Anonymous Child	12/1	3:30 PM
Anonymous Child	12/1	3:30 PM
Maria Tucker	12/1	4:00 PM
Anonymous Child	12/2	2:00 PM

Appendix I: Interview Questions for Water Experts

1. Could you confirm your job title and how long have you worked for the City of Santa Fe Water Division?
2. What components of the water system do you deal with?
3. What is the most prominent issue within the Santa Fe water system in terms of water conservation?
4. How has the water system in Santa Fe changed since you began working here?
5. In what ways does Santa Fe inform the public on water conservation?
6. What are some effective methods to get the idea of water conservation across?
7. In your perspective, what is the most effective way to represent water conservation for a younger audience?

Appendix J: Interview Questions for Museum Staff

1. Could you confirm your job title? What is your role?
2. How long have you worked at this museum?
3. What would you estimate the average age of children that come here to be?
4. Which exhibits do you personally enjoy most?
5. Which exhibits do children tend to gravitate towards?
    a. What emotions do children display at these exhibits?
6. If any, what are the museum exhibits that are not as popular?
7. Would it be inconvenient for our exhibit to have water/dirt/sand in terms of maintenance?
8. Does the museum need another water exhibit?
9. Would you say more children come here on field trips or with their families?
10. Do kids from other places act differently?
11. Is exploring more important?
12. Are there any exhibits that you believe best educate children in an impactful way?
13. Which exhibits tend to need the most upkeep?
14. Do you have any experience with designing exhibits?
15. What is the standard procedure when designing and building an exhibit?
16. What is the most important aspect we should consider when designing our exhibit?
17. What are some safety concerns that we should be aware of when designing a water exhibit for children?
18. Are there any significant differences between designing exhibits for adults and for kids?

Appendix K: Interview Questions for Parents/Guardians

1. Do you visit the Santa Fe Children's Museum often?
2. Do you visit the Santa Fe Children's Museum often?
3. How old are the children/grandchildren that you visit the museum with?
4. Which exhibit did the children/grandchildren seem to enjoy the most from your experiences?
5. Was there anything that the child(ren) has/have communicated that they learned at the museum that has stuck out to you?
6. Do you and the child(ren) have fun when you visit the Santa Fe Children's Museum?
7. Would you bring the child(ren) back here to play with this/these exhibit(s) again?
    a. Why/why not?
8. Are you comfortable with the idea of the child(ren) getting messy at a children's museum? How do you believe the child(ren)'s age impacts them interacting with the exhibit?
9. What did the child(ren) communicate that they learned today?
    a. What were the facts? (Analyze exhibit to understand how information was portrayed)
10. Are you comfortable with the idea of the child(ren) getting messy at a children's museum?
11. How effective would you say the "Grab & Go Kits" from the museum are? Do you use them at home at all?
12. Would a program associated with an exhibit be successful?
13. What is your child(ren)'s favorite water exhibit
14. What topics of water are engaging for children, depending on age
15. Would signage help with exhibit knowledge retention?

Appendix L: Interview Questions for Children

1. How old are you?
2. Who did you come to the museum with?

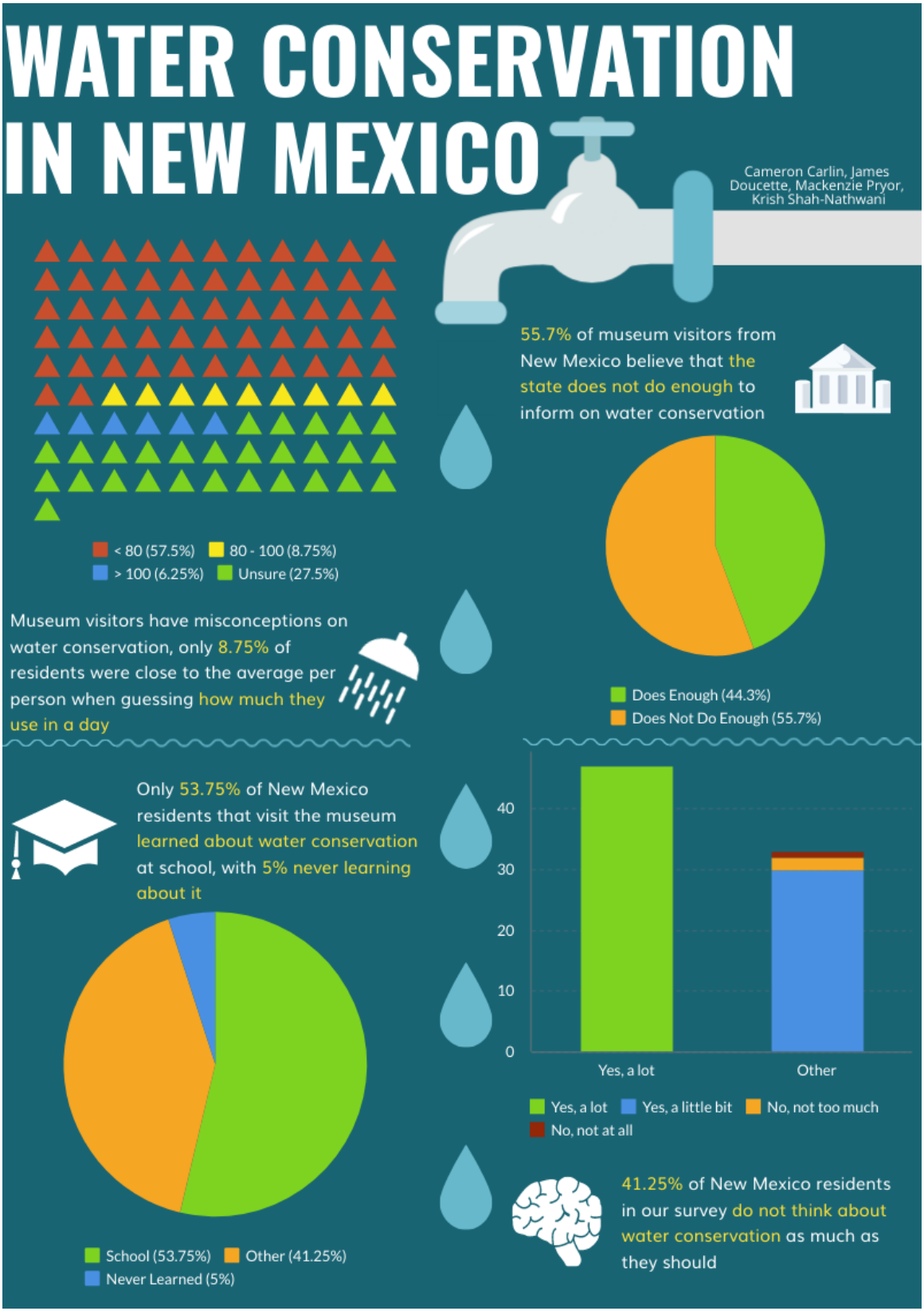
General Visit Questions

3. What is your favorite exhibit at this museum?
    a. What do you like about it?
4. What is something you learned at the museum today?
    a. What exhibit did you learn that from?
5. Were there any exhibits you did not like?
    a. What didn't you like about it?

Exhibit-Specific Questions

6. Did you know about [exhibit topic] before using the exhibit?
7. Do you like the exhibit?
    a. What did you learn from the exhibit?
    b. What parts helped you learn that?
    c. What about the exhibit do you like/dislike?
    d. What would you change about the exhibit?

Appendix M: Water Conservation Survey Infographic



Appendix N: Participant Observation Coding

KEY
Collaboration
Tasks
Water
Safety
Parents
Interaction
Etc

Notes
1 child explained how an exhibit worked to another
Another kid fixed it
Make sure there's lots of space for multiple children
Collaboration is key
Kids got all of the objects stuck in the tunnel and they all laughed
Child got injured falling down the steps and kids came up and asking what happened
3 Kids racing to see who can make it to the top the fastest
Taking turns delivering the mail to each other
Kids building a fort and then knocking it over and laughing
Kids making lots of bubbles and then trying to pop them
Music, lights, touching water
Very interested in how water flows
Blocked off water from drains
Some children chose to wear the water smocks
Splashing around, making a mess
They like to splash
They enjoy putting toys in the water
They sometimes try to drink the water
Very popular kids love splashing
If the exhibit is high up make sure the steps are accessible and safe
Some children do not care about an exhibit's intended use
Don't use pieces as intended
Fit the water blocking pieces into holders in strange ways
Couldn't get a piece to fit, so they left
Kids like to test the limits of exhibits
Child fell off wind tunnel steps
They do not use exhibits how you initially intend
Hannah's son spinning a dinosaur in the vortex
Got toys stuck in water vortex

Children want their parents to help/watch them
One child pulled a parent to an exhibit to explain how something worked
Lots of parents
Chaperone
Love having their parents around
One parents helped a child clog the vortex, then watched what happened when they unclogged it
Some parents stayed with their kids
They like to show off to their parents
Kids look around a lot for approval or lack thereof
Younger kids seem to enjoy playing with their parents, while older kids do independent play
Exclaims his victory and gives a parent a big high 5 (excited with accomplishing things)
Some children like to act like they're adults/their parents
Projectors with interactive games/ movement codes
One child was playing with a mars rover replica
Moving the camera via joystick and watching the feed on a screen
Children like to see consequences
Provide different tools for experimentation
Place a piece of fabric in a tube, watch the wind carry it up
Watching boat flow down table over and over
Add in toys that can be experimented with
Did this multiple times to see results
They liked to push down the spouts of the vortex table to see the other spouts' intensity increase
Kids constantly putting the objects into the tunnel and watching it go up to the sky
They are enjoying being able to physically hold something and move it around
Build the legos very tall and then knock them all down and there's a big crash
Enjoy throwing bubbles into the air and then watching them fall
Try to blow the bubbles out themselves
Being immersed keeps attention
Sensory Based exhibits keep attention
Kids enjoy active play rather than observation
They like to run around
Enjoy taking the pieces apart and then building them
Love the vortex and say "cool" when the ball gets thrown around in a circle
Exhibits that give tasks perform better
Let go and slowly fall down to the button and they are excited that they "completed" the task
Kids run by the table, move one magnet and then keep going
Kids love moving the mail back and forth from one mailbox to another
Using fort as a hiding place for hide and go seek game
Kids going down the slide constantly
Field trip in the morning from the same school and they kids were calmer
Afternoon kids are wilder because of the built up energy
Asking where the snake is? Can they go see it
This place is very cool. Never been here but having fun
Yelling and screaming over the ping pong balls
Bubble table is a big hit
Some parents were not paying attention

Appendix O: Table of Researched Museum Exhibits

Exhibit Name	Museum	Location	Website URL
Water Education Exhibit	Kearney Area Children's Museum	Kearney, NE	https://kearneychildrensmuseum.org/portfolio/waterzone/
Stream Table	KidsQuest Children's Museum	Bellevue, WA	https://www.kidsquestmuseum.org/exhibits/water/#4
Move with the River	Louisiana Children's Museum	New Orleans, LA	https://lcm.org/experiences/move-with-the-river/
Erosion Table	Santa Fe Children's Museum	Santa Fe, NM	https://santafechildrensmuseum.org/themes/water-play/
Splash Table	Santa Fe Children's Museum	Santa Fe, NM	https://santafechildrensmuseum.org/themes/water-play/
Thoughts Flow Interactive Water Table	Santa Fe Children's Museum	Santa Fe, NM	https://santafechildrensmuseum.org/themes/water-play/
WaterWorks	The Regnier Family Wonderscope Children's Museum of Kansas City	Kansas City, MO	https://wonderscope.org/resources/
FlowWorks	Children's Museum Houston	Houston, TX	https://www.cmhouston.org/exhibits/floworks#:~:text=FlowWorks%20is%20an%20interactive%20exhibit,in%20to%20make%20it%20work!

Moving Air	Explora Science Center and Children's Museum of Albuquerque	Albuquerque, NM	https://www.explora.us/visitor-information/exhibits/#permanent-exhibits
Water Patio	Explora Science Center and Children's Museum of Albuquerque	Albuquerque, NM	https://www.explora.us/visitor-information/exhibits/#permanent-exhibits
Freshwater	Ecotarium Museum of Science and Nature	Worcester, MA	https://ecotarium.org/exhibit/freshwater/
Water Planet	Ecotarium Museum of Science and Nature	Worcester, MA	https://ecotarium.org/exhibit/water-planet/