



## **Developing a Strategic Plan for an Experiential Environmental Education Program in Piñones, Puerto Rico**



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# **Developing a Strategic Plan for an Experiential Environmental Education Program in Piñones, Puerto Rico**

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*This report represents work of one or more WPI undergraduate students submitted to the faculty as evidence of a degree requirement. WPI routinely publishes these reports on its web site without editorial or peer review.*

# Abstract

Jami Claypoole, the founder of LimPiaR, believes that people “cannot care about things which they know nothing about.” This idea has led LimPiaR to create an environmental education program in Piñones, Puerto Rico. As of May 2022, LimPiaR has been educating children at COPI, however, they have been doing this without a developed curriculum. Our goal was to help LimPiaR outline an environmental education curriculum for children in the Piñones community as well as find new settings where the curriculum can be implemented. To accomplish this, we developed main topics and macro-objectives that outline a curriculum, three interactive lesson plans, and identified P.A.Y.E as an organization that could implement LimPiaR’s curriculum.

# Acknowledgments

The success of this research project developed from the contributions of several individuals. Our team would like to put forward a thank you to all the individuals who contributed and made this project possible.

We would first like to thank Auraluz Guzmán. Her knowledge on the local environment and ability to teach children about pertinent environmental topics are undeniably strong. She took time out of her busy schedule to meet with us and help us develop our ideas further. Auraluz provided us with the contact information of many individuals that were of help to us in our research. She also set up and attended interviews for us that provided us valuable information. Auraluz's guidance and knowledge was a key part to ending with a successful result. Our team greatly appreciates all of the time she spent with us and for allowing us to collaborate on this project with her.

Next, we would like to thank LimPiaR as an organization and Jami Claypoole. LimPiaR has inspired our team and shown us how a small group of people can produce a positive impact in the world. Jami provided us with this opportunity to get involved with her organization and we will forever be grateful for this experience. The knowledge Jami has and the future ideas she hopes to implement throughout Puerto Rico were of great help to us in our research and recommendations.

Lastly, we would like to thank our professors at Worcester Polytechnic Institute. Our advisors Brigitte Servatius and Alex Sphar provided us with advice, feedback, and strategies to make our project impactful and meaningful. We greatly appreciate the long hours spent working alongside us and for taking the time to travel to Puerto Rico with us.

# Authorship

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<b>2.4 Waste Reduction Practices</b>	Emily & Nathaniel	Samuel
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<b>3.2 Community Perspective on Environmental Education</b>	Samuel	Emily & Nathaniel
<b>3.3 Environmental Education Organizations</b>	Emily	Nathaniel & Samuel
<b>Chapter 4: Results and Findings</b>	All	All
<b>4.1 LimPiaR's Mission</b>	Nathaniel	Samuel & Emily

<b>4.2 Organizations Interviews</b>	Emily	Nathaniel & Samuel
<b>4.3 Community Surveys</b>	Nathaniel	Samuel & Emily
<b>4.4 Developing Learning Objectives and Lesson Plans</b>	Samuel & Nathaniel	Emily
<b>4.5 Lesson Observations</b>	Emily & Nathaniel	Samuel
<b>Chapter 5: Recommendations and Conclusions</b>	Nathaniel	Emily & Samuel
<b>Appendices</b>	Samuel	Nathaniel & Emily

# **Executive Summary**

## **Overview**

Piñones is a small neighborhood consisting of approximately 2,000 people. It is located on the northeast side of the island in the municipality of Loíza. Our team has partnered with the non-profit organization, LimPiaR. LimPiaR believes that educating the youth on their local ecosystems leads the children and future generations to make environmentally conscious decisions. As of May 2022, LimPiaR has been educating children at COPI, however, they have been doing this without a developed curriculum. Our goal was to help them outline an environmental education curriculum for children in the Piñones community as well as find new settings where the curriculum can be implemented. We focused on incorporating topics into the lessons that directly relate to the children's environmental surroundings, developing these lessons to be interactive, and finding new places where LimPiaR can implement the curriculum. To accomplish this, we understood the mission of LimPiaR and each team members role, understood the community's perspective on environmental education, and adapted lessons from organizations with environmental education programs to connect with the Piñones ecosystems.

## **COPI**

COPI is a cultural center located in Piñones. On Saturdays COPI provides drumming classes, bomba lessons, and activities related to the environment for children to participate in. Our team spent two Saturdays at COPI observing these activities. We found that with all the distractions from the drumming and bomba classes, it was difficult for the children to stay engaged in the environmental activities for extended periods of time.

## **P.A.Y.E**

P.A.Y.E. is a community project that operates out of the abandoned school of Emiliano Figueroa Torres. P.A.Y.E offers an after-school program through the academic year and a three-week summer program starting in June. After interviewing Tanisha Gaspar, the Foundress of P.A.Y.E, we determined that LimPiaR would benefit from the structured setting of P.A.Y.E. The

setting would have less distractions and allow for the students to focus on the topics being taught to them.

## **Curriculum Outline**

Through researching environmental organizations and discussions with LimPiaR, our team developed an outline for an environmental education curriculum. The curriculum is broken down into six main topics: ecology, diversity and interdependence, water, soil and food, solid waste management, and climate change. Each topic has a correlating macro-objective description from which 2-3 lesson plans can be developed to create a curriculum. Our team developed three lesson plans as examples for LimPiaR to follow.

## **Scavenger Hunt**

The scavenger hunt lesson was adapted from the Cornell Waste Management Institute to fit under the topic of ecology (Cornell Waste Management Institute 1991). The lesson was designed to have students look for living and nonliving things around COPI and to discuss their differences. We found that this was an unsuccessful lesson for the COPI setting due to several distractions and the lesson not being eye-catching. We determined that this lesson would be better suited in a more structured setting such as P.A.Y.E.

## **How Trash Travels**

The How Trash Travel Infographic and lesson plan was adapted from the Ocean Conservancy to fit under the topic of solid waste management (Ocean Conservancy 2017). The infographic displays the consequences humans can create on their local ecosystems through improper waste disposal. Through utilizing textures, colors, and action figures, the children stayed engaged and participated throughout the lesson.

## **Cycle of Organic Matter**

The Cycle of Organic Matter infographic and lesson plan was adapted from Sitopia to fit under the topic of solid waste management (Sitopia 2020). The interactive infographic describes the composting process through figures and is designed to be taught alongside a composting bucket. The infographic allows for the figures to be shuffled so that students must put the process back into the correct order by memory. Through the utilization of colors and a memory game the students stayed engaged throughout the lesson.

## **Conclusions and Recommendations**

Based on the information we have collected, our team determined that LimPiaR's plans for an environmental education program would be better suited to a more structured setting than COPI. To grow LimPiaR's program, they need to have a developed curriculum which can be implemented into other organizations. This will allow LimPiaR to continue spreading environmental awareness throughout Puerto Rico.

In addition to this conclusion, we recommend the following ideas to LimPiaR:

- We recommend that LimPiaR continues developing interactive lessons for each main topic
- We recommend LimPiaR adapts their curriculum to be implemented into the P.A.Y.E after-school program at the abandoned Emiliano Figueroa Torres school.
- We recommend LimPiaR develops a way to evaluate the students' understanding of each lesson.
- We recommend that LimPiaR develops a pamphlet or PowerPoint that defines their mission and outlines the macro-objectives that were developed.
- We recommend LimPiaR updates their website with current projects and media.

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# Chapter 1: Introduction

Environmental education started to gain widespread popularity in the 1970s with growing concerns about human-caused harm to natural biotic and abiotic systems. The focus was on the study of nature, conservation, and ecology with pollution starting to gain interest. As public concern over species loss, waste mismanagement, and energy usage grew, environmental education expanded to encapsulate biodiversity, sustainable development, and climate change (Hungerford 2009). With many competing philosophies and approaches, there was an unclear goal for increasing environmental knowledge. In “Two Hats,” John Hug (1977) argued that educators often take on two roles, that of the environmental educator and that of the environmentalist. While the environmental educator presents information to help people analyze different viewpoints on environmental issues, the environmentalist instead advocates for action to be taken against any wrong that is affecting the environment. An educator can be, and often is, an environmentalist but they must work to present all facts and viewpoints fairly to reduce any biases.

LimPiaR is a small non-profit organization working to become an active environmental educator and environmentalist within the Piñones community. Our team will be working alongside LimPiaR, looking to engage with community centers and outline a curriculum focused on local environmental issues. LimPiaR’s goal is to develop an environmental education curriculum, which will fill an important gap in the current educational system. An environmental education curriculum is crucial to incorporate into children's education because, “environmental education helps students understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues, as well as ways we can take action to keep our environment healthy and sustainable for the future” (Point 2019). The outline of the curriculum was designed for children between the grades K-9. Studies show that early childhood environmental education “improve environmental literacy outcomes such as environmental cognition, attitudes, and behavior, while building knowledge and skills that lay the foundation for more environmentally responsible and engaged adults” (North American Association for Environmental Education 2016). LimPiaR wants to be an active organization in Piñones, promoting public discussion and providing everyone the opportunity to participate in cleaning Puerto Rico.

Throughout this project the team worked to determine what the environmental education is like in Piñones, Puerto Rico, as well as what the most pressing environmental issues are in the area. We accomplished this through conducting interviews with local organizations, surveying community members, and observing children's interactions with Auraluz Guzmán as she presents an activity to them. Once we gathered and synthesized this information, the team created lesson plans and infographics that highlighted the objectives of the curriculum. These infographics are to be used by LimPiaR to gain support and connections with local schools and community centers that the curriculum could be implemented into, as well as recommend a curriculum for LimPiaR to follow as the program develops.

## **Chapter 2: Background**

### **2.1 Chapter Overview**

As previously mentioned, our team is working alongside LimPiaR to outline an environmental based curriculum in Piñones, Puerto Rico. This chapter will begin by discussing childhood environmental education and the importance of utilizing hands on activities. Next, the chapter will discuss the 5E lesson plan and the goal behind each of the five E's. The chapter will then move into education within Piñones, including the organizations of P.A.Y.E, COPI, and LimPiaR. Furthermore, there will be an overview of Piñones including the different ecosystems in the area. These will help to incorporate local topics within the curriculum. Finally, the chapter will dive into waste reduction practices.

### **2.2 Education**

#### **2.2.1 Childhood Environmental Education**

At a young age children can't yet read academic studies and dissertations on ecology, nor can they fully grasp the many complex factors associated with waste management and plastic pollution. However, Amy Cutter-Mackenzie and Susan Edwards (2013) conducted a study in

Australia across 16 early learning centers with over 100 total students on implementing three forms of play in early childhood environmental education. They found that these three kinds of play: open-ended, modeled, and framed, worked best in combination for “supporting the teaching and learning of environmental education in early childhood education” ( -Mackenzie et al., 2013).

A more abstract way of engaging students in environmental education is by interacting with nature. Through their research, Cynthia McPherson Frantz and F. Stephan Mayer (Frantz 2014) assert that there is a link between a person’s connection to nature and their behavior. When people feel connected to something, they are more likely to adjust their actions or make sacrifices in order to protect it. Then, a strong connection to the environment would lead to more sustainable actions overall. This is an important aspect to environmental education: if the children can develop a connection with nature early on, they will be more eager to continue learning about the environment and it will increase their propensity for enacting positive change in the future.

### 2.2.2 5E Lesson Plan

Science educator Roger Bybee and colleagues at BSCS (Biological Sciences Curriculum Study) developed the 5E model, which is an educational planning tool that aims to “...translate what is known from research in a variety of disciplines about how humans learn...into a tool that can guide instructors in planning effective learning experiences for students” (Tanner 2010). The five E’s consist of Engagement, Exploration, Explanation, Elaboration, and Evaluation. The first E, engagement, involves the educator using short activities to promote curiosity in students and connect their prior knowledge to the current topic being presented (Tanner 2010). This step helps to encourage students’ interest and organize their thinking toward the desired learning outcomes of the lesson. The next E, exploration, provides students with the opportunity to increase interest and articulate questions through the introduction of new concepts and skills, which help to facilitate conceptual change (Tanner 2010). In this step, the students encounter conflicting ideas and confusion which can help them to think about what they do and do not understand. The next E, explanation, gives the teacher an opportunity to guide students towards a deeper understanding of the topic being presented while allowing for the students to demonstrate the

processing skills and conceptual understanding (Tanner 2010). This phase involves active participation from both teacher and students, and questions from the previous exploration step can be addressed. Elaboration follows explanation, where the teacher challenges students' skills and understanding through additional activities (Tanner 2010). In this phase, students can apply their newfound knowledge to new contexts in order to develop a deeper understanding and refine their skills. The final phase is evaluation, which encourages students to assess their own abilities and allows teachers to gauge students' progress toward reaching the educational objectives (Tanner 2010). This phase gives students the opportunity to reflect on their mastery of concepts and can be displayed through a final project, exam, or creation.

### 2.2.3 Environmental Education in Piñones

Between 2007 and 2019 Puerto Rico has closed 673 public schools (Abizeid 2020). “The dramatic decline accelerated following the government debt crisis which began in 2014 and the subsequent hurricanes Irma and Maria in 2017” (Abizeid 2020). Loíza, the municipality that Piñones is in, has a total of 8 operating public schools with a total capacity of 2,680 students (Department of Education 2022). As of April 2022, Piñones does not have any operating schools (Guzmán, 2022). In response to these school closures, neighborhoods, such as Piñones, are beginning to renovate these buildings and turn them into community centers. The Emiliano Figueroa Torres school is in Piñones but was closed due to Hurricane Maria. It has now become a community project called Piñones Aprende Y Emprende (P.A.Y.E) where community members are renovating the building. These community centers are a place where the residents can come together and hold events. They are also a place where students come for additional education or tutoring after school (Gaspar 2022).

La Corporación Piñones Se Integra (COPI) is a community-based non-profit that is seeking to improve the lives of residents in Loíza through the development of services within their community. Within COPI they have implemented ecotourism services such as bike and kayak rentals, Bomba classes and educational discourses that teach visitors about local culture and wildlife. One COPI employee, Julio César Carronero Albandoz teaches children about the organisms and ecosystems of Piñones by bringing paintings and toy animals for the children to

interact with and learn from. He focuses on hands-on activities because the children that come to COPI are restless so it can be hard to keep their attention for extended periods of time (Albandoz 2022).

LimPiaR has been also conducting environmental lessons for students at various community centers but has struggled with consistency due to them not having a defined educational setting and schedule (Guzmán, 2022). Their most frequented educational setting is at the COPI community center on Saturdays, where Auraluz Guzmán teaches between 5-20 children during any given session.

## 2.3 Piñones Overview

Piñones, Puerto Rico is a neighborhood within the municipality of Loíza, near San Juan. It is an underserved community with a population of approximately 2,000 residents (COPI 2015). The area has beaches, coral reefs, and the largest mangrove forest in Puerto Rico. These areas are littered with municipal waste causing environmental concern (Claypoole 2022). The waste management issues are then exacerbated by the fact that Piñones' waste management infrastructure is subpar (Guzmán 2022). Overall, Piñones brings in a lot of tourists which causes waste management issues in the area.

### 2.3.1 Bosque Estatal de Piñones

Bosque Estatal de Piñones, also known as the Piñones State Forest, is home to a wide variety of species including birds, fish, reptiles, amphibians, wetland plants, and mangroves (Estuario de la Bahía de San Juan Programa [EBSJ] 2022). “The Piñones State Park makes up a third of the remaining protected mangrove forests in Puerto Rico,” and includes red, black, white, and button mangroves (Estuario de la Bahía de San Juan Programa 2022). These mangrove forests are valuable to the Piñones area and the organisms that live there as they provide protection to the coasts and improve water quality by blocking out contaminants (Estuario de la Bahía de San Juan Programa 2022). Besides the many native species that call the mangrove forests home, there are also invasive species that are becoming a threat to local biodiversity. According to the EBSJ there are, “three invasive species related to aquatic

ecosystems... the green iguana or “gallina de palo” (Iguana iguana), caimán (Caimán crocodilus) and lionfish (Pterois volitans)” (Estuario de la Bahía de San Juan Programa 2022). These invasive species compete with native species for land and resources, pushing them out of their ecological niches (Estuario de la Bahía de San Juan Programa 2022).

### 2.3.2 Piñones Lagoon

The Piñones Lagoon, referred to as La Laguna de Piñones, is located in the southeast section of Piñones. This can be seen in Figure 1, where Piñones is outlined in red and the Piñones Lagoon is outlined in green. Figure 1 also displays how the lagoon is connected to different canals as well as the Torrecilla Lagoon and eventually connects to the Atlantic Ocean. According to Britannica, a lagoon is an “area of relatively shallow, quiet water situated in a coastal environment and having access to the sea but separated from the open marine conditions by a barrier” (Schwartz 2019). One of the barriers in the Piñones lagoon is the coral reef. Coral reefs are beneficial to aquatic life because they provide shelter and promote biodiversity (Estuario de la Bahía de San Juan Programa 2022). At minimum, there are 38 species of fish within the Piñones Lagoon with the majority of them being shad, bass, tilapia, mullet, and mojarra fish (Area Management Program Puerto Rico Waterfront 2002). Puerto Rico has three bioluminescent bays, Vieques, Laguna Grande, and La Parguera (Lascom 2021), and according to Area Management Program Puerto Rico Waterfront, bioluminescence may also be observed in the Piñones lagoon (Area Management Program Puerto Rico Waterfront 2002).



*Figure 1. Map displaying the outline of Piñones in red and the Piñones Lagoon in green (Google 2022.41 Environmental Education in Piñones)*

### 2.3.3 Agriculture in Piñones

The tropical climate of Puerto Rico enables farmers to grow crops all year round. Historically, sugar cane was the most prominent crop grown in Puerto Rico; however, it has seen a decline because the small family farms that grew it could not compete with larger, more efficient farms in the continental United States (University of Illinois 2017). Coffee has since become a staple in the area as farmers started growing specialty coffee beans. These coffee beans require more attention and more shade to grow compared to the commercial coffee typically sold (Allen 2015). The growing popularity of coffee bean farming has led Puerto Rico to becoming the United States' leading producer in coffee (Allen 2015). Due to the tropical climate, Puerto Ricans are also able to grow many tropical fruits such as plantains and guava (Santos 2017). These fruits are staples in Puerto Rico and can be found in many local dishes.

## 2.4 Waste Reduction Practices

### 2.4.1 Municipal Solid Waste

Municipal solid waste (MSW) is defined as “everyday items we use and then throw away, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries (Environmental Protection Agency 2016) According to the United States Environmental Protection Agency, a person in the United States produces an average of 4.9 pounds of municipal solid waste per day (Environmental Protection Agency 2017). To put that number into perspective and show how quickly those few pounds a day add up, this is equivalent to the average person from the United States producing 1,788.5 pounds of municipal solid waste per year. While this number may be hard to connect to a size for comparison due to different materials being different shapes and weight, 1,788.5 pounds is about equivalent to the weight of a female giraffe (Public Broadcasting Service 2021). Comparatively, the average Puerto Rican produces 5.56 pounds of MSW per day; this is 10% more than the national average (GFX Solid Waste Management in Puerto Rico, n.d.). In addition, plastics typically account for 18% of MSW in the United States (Environmental Protection Agency 2021). To put that into perspective, “every 15.5 hours, Americans throw out enough plastic to fill the largest NFL stadium in the country, AT&T Stadium” (Environment America 2021); AT&T Stadium is 3 million square feet (Dike 2009).

### 2.4.2 Waste Minimization

The goal when it comes to waste management would be to eliminate all waste; unfortunately, that is not realistic. A more realistic goal is to reduce the amount of waste produced that can negatively affect the environment; this can be accomplished in several ways. One common and impactful strategy comes from the manufacturing process. Whether it is the product itself or the package it is placed in, there are always opportunities to redesign its structure which can greatly reduce the volume and weight of the materials being used (Fisher 2019). An additional strategy comes from humans and single use plastics. Single use plastics became popular in the 1970s as manufacturers used plastics as affordable and durable alternative to paper and glass (Lindwall 2020). The popularity of single use plastics has led to decades of

plastic litter piling up and contaminating ecosystems. If we as a society are able to reduce the number of single-use plastics, we could make a large impact on minimizing waste.

### 2.4.3 Composting

Composting is an effective way to naturally break down organic matter such as: food scraps, paper, leaves/grass clippings, nutshells, and coffee grounds. The process of breaking down the waste includes microorganisms and aerobic respiration (Sayara et al., 2020). The microorganisms only need four ingredients to start the composting process: organic waste, soil, water, and oxygen (Sayara et al., 2020). This process can be sped up significantly through the addition of worms, specifically the Red Wiggler (Payne 2010). The worms eat the organic waste that is provided in the bin and break it down. After decomposing, the result is soil that is full of nutrients that can then be used for activities such as gardening. This process helps reduce the amount of waste being disposed into landfills (Payne 2010).

### 2.4.4 Recycling

Recycling consists of three main steps: collecting and processing recyclables, manufacturing new products out of the recycled content, and consumers purchasing the products made from the recycled materials (Master Recycling Program 2020, p.75). The recycling process reduces waste produced because it allows for manufactured materials to be broken down and reused in new products. There is a wide variety of materials that can be recycled such as most metals, glass, aluminum, and paper products can be recycled. Plastics, on the other hand, are not as simple when it comes to recycling. Many plastic products that people assume are recyclable such as plastic bags, straws, and coffee cups are not recyclable (Sedaghat 2018). Additionally, any plastic that may have remnants of food on it cannot be recycled (Sedaghat 2018). Some products display the recycling symbol, as shown in Figure 2, to ensure the consumer is aware that the material can be recycled. In addition, there may be a number inside the symbol. These numbers are a resin identification code and indicate what type of plastic it is and how that plastic should be processed (Hunt 2018). Prior to 1990 recycling accounted for less than 15% of MSW generation, since then recycling grew to account for 32.1% in 2018 (Environmental Protection Agency 2021). This has led to a reduction of landfilling from 94% to 50% within the same

period (Environmental Protection Agency 2021). Due to this, natural resources such as timber and water are conserved, and environmental pollution is reduced because there is less of a need to collect new raw materials (Environmental Protection Agency 2021).



*Figure 2. Recycling Symbol (Environmental Protection Agency 2021)*

## **Chapter 3: Methodology**

### **3.1 What is LimPiaR Doing?**

In 2018, LimPiaR began their nonprofit by organizing two beach cleanups every month. Now they have begun additional initiatives including implementing a recycling program in Piñones and developing an online presence that promotes environmental education. LimPiaR aims to promote environmental awareness for a more sustainable Puerto Rico.

To gain insight on LimPiaR's mission and the role that each member plays within the nonprofit, we planned to conduct interviews with each team member. The questions we planned to ask were similar from person to person; however, we were prepared to make adaptations to the questions in order to cater towards the individual's role within the organization. Interviews were planned to be conducted in person or on Zoom depending on the schedule of the individual. The questions we asked each member of the LimPiaR team can be found in Appendix A.1: LimPiaR Individual Employees.

## 3.2 Community Perspective on Environmental Education

To understand the state of environmental education from a local point of view, we first planned to survey the residents of Piñones. Specifically, we focused on what topics were seen as most needed and how willing residents would be to have their children attend environmental education programs. The surveys were made available in both English and Spanish, and the full surveys can be found in Appendix A.2: Piñones Community Members. We also made the survey available in two forms: an online version and a print version.

In addition to surveys, we also wanted to interview several community members to get their opinions on environmental education. We looked for members who were educators or other workers at local community centers and environmental organizations. We interviewed these community members in-person with varying degrees of planning and preparation; to meet with them we had to be able to fit into their busy schedules. We also prepared our questions in both English and Spanish in case the interviewee spoke only Spanish. The questions we asked the community members can be found in Appendix A.3: Local Organizations and Individuals.

## 3.3 Environmental Education Organizations

Our team identified US organizations featuring environmental education programs for children. These programs include the Center for Ecoliteracy, Project Learning Tree, Cornell Waste Management Institute, Department of Crop and Soil Sciences Ocean Conservancy, and the Smithsonian. Within these organizations there are lesson plans focused on the environment that have already been found successful in regard to teaching children. Our team planned to take some of these lesson plans and adapt them, so they relate directly to the Piñones environment. Additionally, we planned to reformat the lesson plan into the 5E format that Auraluz Guzmán desired. Each lesson will be designed to last approximately 20-30 minutes; it would be hard to capture the children's attention for anything longer. Before these activities began, we planned to get the consent of the participating children's parents, see Appendix B.1: Parental Consent Form.

# Chapter 4: Findings and Results

## 4.1 LimPiaR's Mission

The goal for conducting interviews with LimPiaR was to get an understanding of how different members of their team saw the future of LimPiaR and understand their roles. We were able to interview Jami Claypoole, Roberto López, and Auraluz Guzmán.

### 4.1.1 Auraluz Guzmán - Co-Director of Education and Community Alliance

In Auraluz Guzmán's interview, we found that she is spearheading LimPiaR's environmental education curriculum. She focuses on delivering flexible lessons based on the materials that she brings for the day, such as a composting bucket or a diagram about how trash travels, as shown in Figure 3. She is skilled at engaging the children but does not reach a wide audience due to low participation rates and other activities happening concurrently at COPI. Auraluz Guzmán wants the curriculum to promote critical thinking in the children, as well as have it connect to the environmental issues in the Piñones community. The curriculum should have clear goals and instructions to follow so that volunteers can understand the objectives of each lesson and how to teach them without supervision of Auraluz Guzmán. She is looking into implementing the curriculum into a summer program at P.A.Y.E; however, the summer program will not be available until August 2022. Our interview questions for Auraluz Guzmán can be found in Appendix A.1.1: Auraluz Guzmán, Co-Director of Education and Community Alliance Interview.

Furthermore, Auraluz Guzmán took us on a bike trip along the beach and through the forest of Piñones. We learned about the different ecosystems in Piñones including the beaches and forests of Piñones. These ecosystems will be the focus in the environmental education program. She pointed out both native and non-native species along the ride and documented waste management issues along the way, see Figure 4. We stopped at Bosque Estatal de Piñones (State Forest of Piñones), a public area that is in the forest and overlooks the Piñones Lagoon. Auraluz Guzmán explained that the State Forest of Piñones is managed by Erminio, a biologist. According to Auraluz Guzmán the Piñones community has been unsatisfied with Erminio as he tends to close off the State Forest of Piñones to the public. Prior to his management children

could freely explore the State Forest of Piñones and the community could host social events in the area. More on the State Forest of Piñones can be found in section 4.2.2 Eniel Davilla - Bosque Estatal de Piñones.



*Figure 3. Auraluz Guzmán teaching children about composting.*



*Figure 4. Municipal waste was found littered in the forest along the bike path*

#### 4.1.2 Jami Claypoole– Founder of LimPiaR

During Jami Claypoole’s interview, we discussed the waste management issue in Piñones, businesses, and education. Jami Claypoole stated that the waste management issue stems from the Loíza municipality. MSW is supposed to be collected once a week along the beaches and every other week within neighborhoods. However, the municipality does not consistently follow the waste collection schedule. Furthermore, recyclables do not get collected at people’s houses and there are no separate recycling bins along the beaches. People must carry their recyclables to a large recycling bin in Piñones which is only open Mondays 4-6PM, see Figure 5. The recycling bin is managed by LimPiaR; they only open the recycling bin one day a week so that they can monitor what get placed in it. LimPiaR also monitors the capacity of the recycling bin and informs the recycling company that they are partnered with. The recyclables get processed and sold by the recycling company and LimPiaR collects part of the profit for their management. Furthermore, Jami Claypoole said that part of the MSW issue is that many Piñones residents make a living by owning local food carts which tend to be cash only. She believes that by dealing in only cash the municipality receives less income tax from their residents compared to other municipalities because cash transactions cannot be tracked by the IRS. With less taxes the municipality may not have enough funds for proper MSW management. She compared it to when she lived in New Jersey stating that the taxes in the area were high, but the MSW was always collected on time and public spaces were always clean. Finally, we talked about environmental education in the area. She noted that people cannot care about something that they know nothing about; thus, she sees education being important. Using the beach as an example, she pointed out the trash spread along the beach and in the parking area. Jami Claypoole’s hope is that La Posita de Piñones becomes a blue flag beach. This means that the beach is “administered in a way that is safe and environmentally conscious,” (PuertoRico Travel Guide. The goal for their education program is to educate the youth in hopes that they can bring these lessons back to their households and make educated decisions. Our interview questions for Jami Claypoole can be found in Appendix A.1.2: Jami Claypoole, Founder and Executive Director of LimPiaR Interview.



*Figure 5. A Piñones community member puts her recycling into the community recycling bin.*

#### 4.1.3 Roberto López– Director of Social Media

With Roberto López we discussed which social media platforms he uses, any difficulties with social media, and his plans to grow the LimPiaR brand. He told us that he is on YouTube and Instagram since he feels this is the best way to reach his target age group of 25-40 years old. He edits and creates video for both platforms. However, he found it difficult develop a strong following and consistent flow of viewers. He expressed that he does not understand the Instagram algorithm. When he posts multiple stories on the LimPiaR Instagram he tends to get less views than if he were to only have one post. The misunderstanding of the algorithm makes it difficult to reach potential volunteers for events like beach cleanups. In hopes of reaching a broader audience López is starting a podcast and is looking into starting a TikTok for LimPiaR. He believes he can reach more people on TikTok compared to Instagram because TikTok’s “For You Page” does not require users to be following each other to see content. This would allow him to reach audiences that have not heard of LimPiaR before and potentially find more volunteers. Our interview questions for Roberto López can be found in Appendix A.1.3: Roberto López, Social Media Director of LimPiaR Interview.

#### 4.1.4 Beach Clean Up

We conducted Jami Claypoole's and Roberto López's interviews during a beach cleanup event that LimPiaR hosted on March 26<sup>th</sup>, 2022, between 9:00 AM to 12:00 PM at La Posita de Piñones. At the beach clean-up there were eleven volunteers, plus the five team members of LimPiar, and a Cub Scout troop in attendance. The beach cleanup allowed us to see the issues which LimPiaR wants to address. While there was trash on the beach, a majority of the litter was found across the street in the parking area. Jami Claypoole described the area as an open dump. While we were there a car came by and threw trash into the forest and drove away; this made it clear that people see the area as an open dump site. Figure 6. below shows the MSW that volunteers collected during the event; Figure 6 does not include any recyclables we found. Volunteers placed the trash bags on the side of the road for the municipality to pick up that day. However, the municipality did not collect the trash bags until March 28<sup>th</sup>, 2022. Jami Claypoole transported all the recyclables to the recycle bin in the Piñones community.



*Figure 6. Above shows the trash collected from LimPiaR's beach cleanup on March 26th, 2022*

## 4.2 Organization Interviews

### 4.2.1 Julio César Carromero Albandoz – COPI

César Albandoz is an employee at COPI who oversees their environmental education program. On March 23rd, 2022, we conducted a standard interview with him at COPI. César Albandoz did not speak much English, so all our questions needed to be translated to Spanish. He was very understanding about the language barrier and answered our questions in a slow manner to give us more time to understand what he was saying. We were also allowed to record the interview so we could later go back and translate César Albandoz's responses.

From this interview we learned that César Albandoz's focus right now is on the effects of Hurricane Maria, and how the mangroves were affected from the hurricane. He is passionate about protecting the mangroves because without the mangroves, oils most commonly originating from ships spilling oil at sea, can travel into the lagoon which harms all the wildlife living there (Wilson et al., 2019). While one of his main roles within COPI is education, he has been putting more of his focus on replanting mangroves right now.

Beginning on April 2nd and every Saturday after that César Albandoz will shift his focus back to educating people about the environment. He teaches both locals and tourists, usually between the ages 5-12, but is open to teaching people of any age. César Albandoz does not utilize written lesson plans; he instead just utilizes a table full of small activities. One of the biggest challenges he runs into is keeping the attention of young children for longer than twenty minutes. To try to overcome this César Albandoz tries to make the activities as interactive as possible. The strategy that he finds most successful is by having the children paint. Painting and activities that are interactive tend to keep the children's attention span for longer periods of time. César Albandoz focuses most of his activities on the local ecosystem. An example of one of his activities can be seen in Figure 7 where César Albandoz is utilizing clay to represent the mountains, paint to represent rivers, and cans and bottles to show how trash can travel through the rivers. Our interview questions for César Albandoz can be found in Appendix A.3.1: Julio César Carromero Albandoz, Environmental Educator at COPI Interview.



*Figure 7. Set up on one of César Albandoz's activities utilizing clay and paint*

#### 4.2.2 Eniel Davilla - Bosque Estatal de Piñones

Eniel Davilla is an employee at Bosque Estatal de Piñones (Piñones State Forest). He began working there about a year ago. On April 5th, 2022, we conducted a standard interview with him at Bosque Estatal de Piñones. Our original plan was to conduct an interview with Erminio Díaz who is the main person that takes care of the Piñones State Forest. Erminio Díaz is out of the office until the end of April so we did not have the opportunity to speak with him. From Eniel Davilla we learned that he originally worked for an electrical company that was owned by the government, but the government moved him along with two others to work at the forest.

Our goal of this interview was to determine if LimPiaR could use the space to hold educational events and to learn more about what the space is used for. We found that Bosque Estatal de Piñones is open 7 days a week from 7AM - 3PM. Eniel Davilla informed us that the employees at the forest do not promote the space to be used because it is a wildlife refuge, and they believe that people will harm it. When asked if LimPiaR could use this space to hold meetings for the environmental education program, Eniel Davilla agreed. He added that the events would have to be organized with Erminio Díaz. In addition, if there are more than 11

people present, a permit from the government would be needed for the event to take place. If there are fewer than 11 people present, then Erminio Díaz can authorize the event. Our interview questions for Eniel Davilla can be found in Appendix A.3.2: Eniel Davilla, Employee at Bosque Estatal de Piñones Interview.

#### 4.2.3 Resident of Carolina

On March 26th, 2022, we attended a coastal cleanup at La Posita De Piñones. We had the opportunity to conduct a standard interview with a resident of Carolina who preferred to keep the organization the resident is a part or private. Carolina is the municipality to the west of Loíza, directly sharing a border. This person asked us to keep their name out of our report for privacy reasons. This individual has a platform which is helping them make a positive impact on the environment not just in Puerto Rico, but worldwide. They are also in school studying Environmental Infrastructure.

This person was born and raised in Carolina, so they are very familiar with all of the environmental issues in the area. They were inspired to get involved and try to make a difference because through their years of living in the area they have been able to first-hand witness the beaches deteriorate. During their years leading up to college they were not taught a lot about the environment. The Resident of Carolina believes the schools are supposed to have topics about the environment implemented into the curriculum, but most of the time it only gets brushed upon or the topics do not relate to the ecosystems in Puerto Rico. They felt that this was a major issue and the environmental education for children is in desperate need of improvement. Our interview questions for this Carolina resident can be found in Appendix A.3.3: Anonymous Carolina Resident Interview.

#### 4.2.4 Tanisha Gaspar – Foundress of P.A.Y.E

Tanisha Gaspar is the Foundress of P.A.Y.E at the Emiliano Figueroa Torres school. As previously mentioned, this school was closed and is still in the process of being renovated into a community center. Tanisha Gaspar's intentions behind this center is to help kids understand how the space was developed and the importance of community centers. Children from Piñones come

to this space for tutoring afterschool. There is no curriculum, rather the children just bring work from their classes that they need additional help on. There is a total of 20 children signed up to attend the tutoring sessions. For the past two years the sessions have been run by paid teachers. Previously, the tutors were all volunteers.

In the Summer of 2022, there will be a summer program at P.A.Y.E that runs from June 20<sup>th</sup> – July 9<sup>th</sup>. The program will be organized into the different age groups of kindergarten through 3<sup>rd</sup> grade, 4<sup>th</sup> through 6<sup>th</sup> grade, and 7<sup>th</sup> through 9<sup>th</sup> grade. The last week of the program will be dedicated to the topic of diversity. Our team presented the outline of LimPiaR’s curriculum to Tanisha Gaspar as shown in Figure 8. With the information on what Auraluz Guzmán plans to teach, Tanisha Gaspar said that it would be a great addition for Auraluz Guzmán to teach the topics of ecology and diversity and independence at the summer program from July 5<sup>th</sup> – July 9<sup>th</sup>. In addition to this, Auraluz Guzmán is welcome to attend tutoring sessions where she can present environmental activities to the children. Auraluz Guzmán hopes to attend the tutoring sessions every Thursday. Our interview questions for Tanisha Gaspar can be found in Appendix A.3.4: Tanisha Gaspar, Foundress of P.A.Y.E.



**ENVIRONMENTAL EDUCATION  
OUTLINE**

**ECOLOGY**  
Students will be introduced to the different ecosystems around them and the species that make up these ecosystems. After this unit, students will be able to identify different ecosystems and their components as well as be able to describe them in detail.

**DIVERSITY AND INTERDEPENDENCE**  
Students will learn about the different ways in which species interact through the food chain and about the flow of resources within ecosystems. At the end of this unit, they will be able to explain how diverse populations are connected with and depend on one another.

**WATER**  
Students will be introduced to water's essential role to all life on earth. The water cycle and how it relates to local ecosystems will be examined. Students will also gain an understanding of humans' use of water as well as be guided through the complex social and environmental issues surrounding water.

**SOIL & FOOD**  
Students will understand how food can be grown and the essential components of a vegetable garden. They will be introduced to soil and its role in the garden and other ecosystems. Students will be able to identify what resources are needed to cultivate food and the relationship between healthy soil and a productive garden.

**SOLID WASTE MANAGEMENT**  
Students will explore how solid waste moves through nature. Solid waste management will be critically examined. Waste management practices such as reducing, reusing, recycling, and composting will be discussed. After this unit, students will be able to describe how waste is negatively impacting the environment they live in and ways that they can help address this problem.

**CLIMATE CHANGE**  
Students will be introduced to natural and man-made climate change. The greenhouse effect and its impact on local ecosystems will be discussed, as well as possible actions to reduce greenhouse gas emissions from human actions.

Figure 8. Topics and macro-objectives for LimPiaR's environmental education curriculum.

#### 4.2.5 Environmental Education Programs

Our team reached out to the environmental organizations found in section 3.3 Environmental Education Organizations. Through emails, phone calls, and Instagram, we attempted to set up interviews with the organizations. Unfortunately, these attempts were not successful as we only received responses from Project Learning Tree and the Center for Ecoliteracy. Although we received responses from two organizations, we were not able to schedule an interview with them.

### 4.3 Community Surveys

We used the drumming and bomba classes taking place at COPI every Saturday from 10AM – 1PM to survey attendees. Before and after each class we asked participants to fill out our survey, found in Appendix A.2: Piñones Community Members. However, there were several people that were apprehensive about filling out the survey. This led to us only receiving three survey responses. One of the responses was from Maricruz Rivera Clemente, the head of COPI. To get more responses, we planned to go house to house within the Piñones community; however, Auraluz Guzmán advised us to not walk around the area by ourselves. We then worked with Paola Rolon-Díaz, a LimPiaR team member and Piñones resident, to get the surveys to community members through a community wide group chat. The group chat yielded four more responses for a total of seven responses. From these responses everyone ranked educating the youth on the environment “Very important.” Only one person did not have their child already involved in an environmental education program, but all seven people would consider enrolling their child into one. Furthermore, five of the responses ranked their satisfaction with the current environmental education in Loíza a three or less and only two responses ranked it a four. We then asked responders to pick 1-3 environmental topics which they thought kids should be taught. The top response was agriculture with four votes, followed by waste management, climate change, and ecology with three votes each.

## 4.4 Developing Learning Objectives and Lesson Plans

### 4.4.1 Learning Topics and Macro-Objectives

Through our research of organizations with environmental education programs and discussions with Auraluz Guzmán, we selected broad learning topics that would form the basis of LimPiaR's environmental education program. Previous guiding principles that Auraluz Guzmán had created can be found in Appendix C.1: Auraluz Guzmán's Guiding Pedagogical Principles. For each topic, we developed macro learning objectives that define what students should take away from these topics, as seen in Figure 8. We developed these by considering the most important aspects of each topic as well as our collective learning goals for the students. The main objectives for each topic were to introduce environmental concepts, provide them with an interactive experience, and promote critical thinking. With these objectives in mind, we adapted lesson plans from previously mentioned organizations in section 3.3 Environmental Education Organizations to relate to the environment of Piñones. While doing this, we made the lessons with interactive materials to engage the children.

### 4.4.2 Scavenger Hunt Lesson

The first lesson we created was a scavenger hunt that was modified to fit the Piñones environment. This lesson fits under our Ecology topic. To create this lesson, we researched environmental lessons from Cornell and found one titled "When It Is 'Wrong To Belong' - Scavenger Hunt" (Cornell Waste Management Institute 1991). We applied many of the instructions to our own activity; however, we had to adjust the items on the list as many did not fit the setting at COPI. To select fitting items for our hunt, we took a trip to the COPI community center to seek out several living and non-living things such as a mangrove, a lizard, and a trash can. We made sure that these items were easily visible from the walking path around COPI to ensure that children wouldn't need to venture into the forest to find them. The scavenger hunt lesson can be seen in Figure 9, and the full lesson plan can be found in Appendix C.2.1: Scavenger Hunt Lesson.



*Figure 9. Scavenger Hunt Lesson*

#### 4.4.3 How Trash Travels Lesson

We created a lesson with an infographic explaining how trash discarded by humans can go on to affect far away ecosystems. This lesson fits under our Solid Waste Management topic. To create this lesson, we researched the Ocean Conservancy to find an infographic depicting how trash can travel from a city store to wildlife in the ocean (Ocean Conservancy 2017). The infographic shows information succinctly with appealing visuals; however, the city setting is very impersonal and the children of Piñones may struggle to relate to it. To remedy this, we changed the subject to a child so that the students can identify with and better understand the problem being shown. Our updated infographic can be seen in Figure 10.

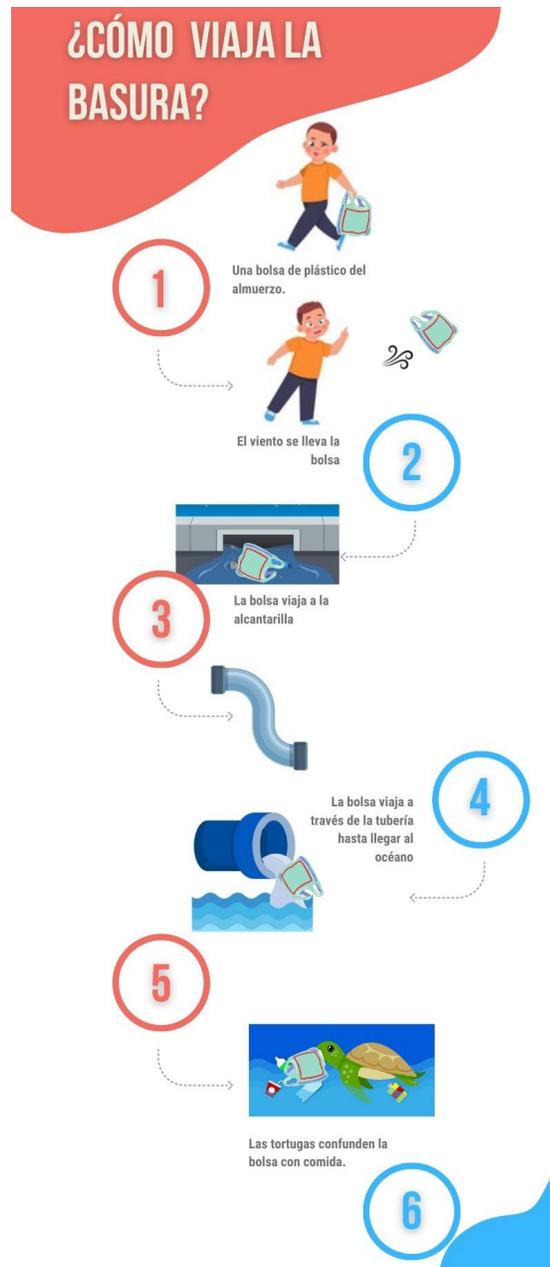


Figure 10. "How Trash Travels" Infographic

We then turned our infographic into a poster so that the children could interact with it. To make the poster more engaging, we added several components: more colors, different textures, and 3-dimensional objects. We used a poster board covered in fabric as the base, then wrote out captions and colorful drawings. Next, we added plastic bags, blue fabric, and a tube to replicate the trash and the path by which it reaches the ocean. Finally, we added the action figures and turtle as our subjects so that the child's action and its victim, the turtle, were more tangible.

These additional aspects gave students more to look at and touch as they were learning, thus garnering their interest more effectively. Our modified poster can be found in Figure 11. and our completed lesson plan can be found in Appendix C.2.2: How Trash Travels Lesson.

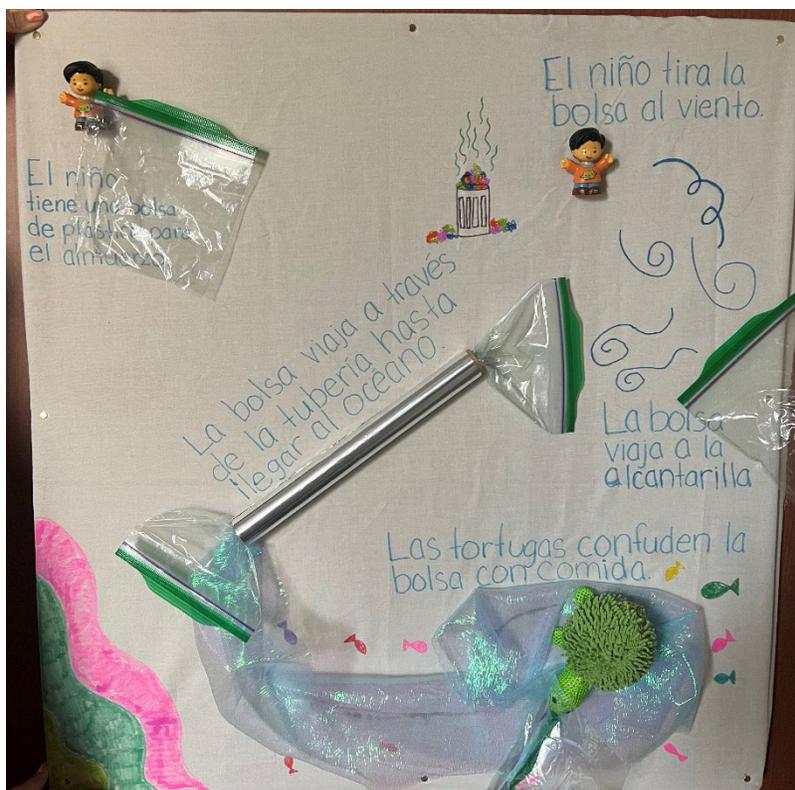


Figure 11. "How Trash Travels" interactive poster.

#### 4.4.4 Cycle of Organic Material Lesson

Our third lesson involved another infographic that showed how organic matter such as food can be part of a closed cycle through composting. Our sponsor, Auraluz Guzmán provided us with a similar infographic that she received through an urban gardening project at Sitopia (Sitopia 2020). This lesson fits under our Soil & Food topic. After redesigning the infographic with a mango, a locally grown fruit, as the organic matter, we decided to realize it as an interactive poster. The poster would have each element in the cycle be removable so that it can be presented as a game for the children to place each piece in the correct order. We started out with a poster board covered in fabric as our base, then drew arrows in a circle and colorful accents. We then printed and laminated each element in the cycle so that they were more durable and could withstand being played with. We also added Velcro strips to them and the poster so that they could be easily placed and removed. The learning through play element of this poster

makes it more interactive for the children and adds to their educational experience. Our finished poster can be seen in Figure 12 and our completed lesson plan can be found in Appendix C.2.3: How Organic Matter Cycles Lesson.



Figure 12. "Cycle of Organic Matter" interactive poster

## 4.5 Lesson Observations

### 4.5.1 April 9<sup>th</sup>, 2022, Observation

On April 9<sup>th</sup>, 2022, our team went to COPI to observe Auraluz Guzmán teach children about the environment. A total of fifteen children were in attendance, however six children interacted with the table Auraluz Guzmán was at. In addition to the LimPiaR table Auraluz Guzmán was running, there was also a table with a local artist who supplied crabs for the children to paint as seen in Figure 13. There was also a table run by Julio César Carromero Albandoz where he supplied a variety of items that the children could pick up and observe

including crab shells, coral reefs, and ocean wildlife action figures. A setup of Julio César Carromero Albandoz table can be found in Figure 14 and a layout of all three tables can be found in Figure 15.



*Figure 13. Table run by local artist with painted crabs*



*Figure 14. Set up of Julio César Carromero Albandoz at COPI*



*Figure 15. Layout of activities at COPI*

We supplied Auraluz Guzmán with the Scavenger Hunt lesson found in Figure 9. After seeing all the other activities that the children could participate in, we concluded that the scavenger hunt would need to be further developed in order catch the children's attention and make them want to participate in the activity. Instead of using the Scavenger Hunt lesson, we observed Auraluz Guzmán teach about composting. She did this through providing the children with gloves, so they had the opportunity to dig through her composting bin. The children stayed engaged as they listened to Auraluz Guzmán speak and dug through the composting bin searching for worms. A picture from this activity can be found in Figure 16. Additionally, Auraluz Guzmán ran an activity that taught about the difference between organic and non-organic materials. This activity was a matching game and two children participated in it. As the

children found matches, they would explain to Auraluz Guzmán if the image was depicting an organic or a non-organic item. A picture of this activity can be found in Figure 17.



*Figure 16. Auraluz Guzmán teaching about composting*



*Figure 17. Auraluz Guzmán teaching about organic and non-organic materials*

#### 4.5.2 April 23<sup>rd</sup>, 2022, Observation

On April 23<sup>rd</sup>, 2022, we observed Auraluz Guzmán at COPI again. In addition to Auraluz Guzmán, Julio César Carromero Albandoz was also there providing the same items which he brought on April 9<sup>th</sup>, 2022, see Figure 14. Since Earth Day was the previous day, Auraluz Guzmán and the same artist from April 9<sup>th</sup>, 2022, worked together and encouraged children to draw what they love about the environment as seen in Figure 18. The paper they drew was titled “Lo que amo del Planeta Tierra,” this means “What I love about planet earth.” In total there were 8 children and Auraluz Guzmán interacted with all 8.

Our group provided Auraluz Guzmán with the “Cycle of Organic Matter” and “How Trash Travels” lessons. During both lessons, children stayed engaged as Auraluz Guzmán explained each infographic. The “Cycle of Organic Matter” lesson was in tandem with the composting bucket. Auraluz Guzmán had children digging through the composting bucket as she explained the composting and the role of the worms. The infographic, as seen in Figure 20, was used to explain to the children the order of the composting process. After the explanation, Auraluz Guzmán disorganized the pictures and had the children put them back into the correct order. For this activity she taught 4 children and they worked together to successfully to put cycle back together. During the “How Trash Travels” lesson, Auraluz Guzmán explained they story line of the infographic; this showed children what can happen to sea life if they do not dispose of their MSW in the proper way. The children engaged with the infographic as they were able to grab and touch all aspects of the infographic it, see Figure 19.



Figure 18. Children draw different animals to show what they love about the earth



Figure 19. Children interact with the How Trash Travels infographic.



*Figure 20. Children work together to put the cycle of organic matter back in order.*

## Chapter 5: Recommendations and Conclusions

The goal of our project was to create the outline of an environmental education program so that a curriculum, specific to Piñones, can be developed in the future by LimPiaR. Additionally, we aimed to find new settings where the curriculum, when developed, can be implemented into. Our objectives to accomplish this goal were:

- Understand the overall mission of LimPiaR as well as each team member's role.
- Understand the state of environmental education through the community's perspective.
- Adapt lesson plans from organizations with environmental education programs to relate to the Piñones environment.

With the completion of our objectives, we were able to create four deliverables to present to our sponsor:

- An infographic that outlines the curriculum through displaying main topics and macro-objectives.
- A lesson plan that differentiates between living and non-living things through a scavenger hunt.
- A lesson plan that describes composting through an interactive infographic of the cycle of organic matter.
- A lesson plan that illustrates how trash travels from human hands to a turtle's mouth through an interactive infographic.

By testing our deliverables at COPI, we concluded that LimPiaR's plans for a comprehensive environmental education program are better suited to a more structured setting.

COPI has been an instrumental location for the development of LimPiaR's environmental education initiative. However, for LimPiaR to grow their program and influence, they need to expand their educational offerings to new organizations and spaces. This expansion will allow LimPiaR to cultivate additional environmental awareness throughout Puerto Rico.

From our observations and testing of our deliverables, we produced the following conclusions and recommendations.

**We recommend that LimPiaR continues developing interactive lessons for each main topic.**

The continuation of the development of lesson plans would enable LimPiaR to have a full curriculum that students can follow and progress their understanding of the environment. Including interactive materials captured the children's attention while Auraluz Guzmán discussed environmental topics. A developed curriculum would be more appealing to other organizations as LimPiaR expands their influence. Each topic should have between two to three lessons. Having two to three lessons per topic would allow for one to two lessons to be taught each week of a semester at P.A.Y.E.

**We recommend LimPiaR adapts their curriculum to be implemented into the P.A.Y.E after-school program at the abandoned Emiliano Figueroa Torres school.**

This new setting would allow for a structured lesson delivery and a focused student body in comparison to COPI. Since the program occurs weekly throughout the school year, it would also allow LimPiaR to build off previous lessons through a comprehensive curriculum that spans a school semester. They can also make each lesson adaptable for different age groups. The groups should be broken down into the grades of K-3, 4-6, and 7-9. If there is not enough demand to fill each age group, older kids can teach the younger students by using activities that they have previously learned. Grouping the grades would allow for easier integration into P.A.Y.E since this is how they plan on grouping the children for their after-school program and summer program.

**We recommend LimPiaR develops a way to evaluate the students' understanding of each lesson.**

Currently, LimPiaR does not have a system to evaluate the students' understanding of a topic that is taught. The evaluation of students' understanding of the lesson is crucial in knowing the effectiveness of each lesson. The method of evaluation can vary depending on the age group. For younger students, this can be done through listening to their use of key words. Key words can be found in the evaluation section of the 5E lesson plan. The correct use of key words may indicate a level of understanding for the student. On the other hand, older students can answer questions or explain an environmental topic to a peer.

**We recommend that LimPiaR develops a pamphlet or PowerPoint that defines their mission and outlines the macro-objectives that we developed.**

LimPiaR wants to implement their environmental education program into schools and organizations throughout Puerto Rico; this is a necessary step for LimPiaR to expand their influence. A pamphlet or PowerPoint can be used to handout and in the presentation of their environmental education program to the heads of organizations and schools.

**We recommend that LimPiaR updates their website with current projects and media.**

The LimPiaR website has not been updated since 2020 and does not reflect any new work. Updating the website would allow for people to gain an understanding of the work that LimPiaR is doing in 2022, including environmental education, and their goals for the year. An updated website has the potential to bring in new volunteers and donors to facilitate LimPiaR's mission.

# Appendix A: Interview Questions

## Appendix A.1: LimPiaR Individual Employees

This Appendix contains interviews of members of the LimPiaR team. We conducted standard interviews of three employees individually. The goal of these questions is to understand how each member of the team views their role and the outlook of the company. It will also allow us to see how each person fits into the big picture of LimPiaR. Additionally, it will allow us to advise LimPiaR on what needs to be done to reach their end goal.

### Appendix A.1.1: Auraluz Guzmán, Co-Director of Education and Community Alliance Interview

1. What are your roles and responsibilities in the organization?
2. What are you currently working on?
3. What are your goals in the next 6 months for the project you are currently working on?
  - a. How do you measure the success of your projects?
4. Where do you see this project going in the next 2 years?
5. Could you describe the natural aspects of Piñones, such as its ecosystems?
6. Could you describe the cultural aspects of Piñones?
7. Could you describe the waste management situation in Piñones?
8. From our understanding, businesses and tourists are the main contributors to beach pollution. What connections do you see between educating the children and the waste management problem or are these two separate issues?
9. Should we work on creating a curriculum infographic with broader learning objectives such as “how humans interact with the world”, “how humans negatively impact the environment”, and “how these problems can be addressed”?
  - a. Should each lesson we create contain all three topics, or can lessons be made for each category?
2. Could you describe children’s access to environmental education within Piñones?
3. Do you have any ways to get kids to come back to your educational sessions’ week after week?

## Appendix A.1.2: Jami Claypoole, Founder and Executive Director of LimPiaR Interview

1. What is your role within LimPiaR?
  - a. Are you involved in the environmental education program?
2. Where do you see the environmental education program going in the next 2 years?
3. Where are the biggest environmental education gaps for children in the Piñones community?
  - a. What do you feel are the most important topics to introduce the children to?
4. Was it your idea to create the educational component of LimPiaR's mission?
  - a. What inspired this?
5. Do you feel there is more help needed with creating lesson plans for this program or finding locations that will allow LimPiaR to run the program?
6. Do you see Auraluz being the only one that will be presenting these lessons or is the hope to eventually have volunteers present these lessons to the children and Auraluz have more of a director position?
7. Do you have any plans to expand your current projects or implement new ones?
  - a. Other forms of education?
8. Is the school in Loíza a running school or is it abandoned?

## Appendix A.1.3: Roberto López, Social Media Director of LimPiaR Interview

1. What are your roles and responsibilities in the organization?
2. What social media platforms do you mainly use?
3. Have you faced any difficulties when creating content and posting it online?
4. What are you currently working on?
5. What are your goals in the next 6 months for the project you are currently working on?
  0. How do you measure the success of your projects?
6. Where do you see this project going in the next 2 years?
7. What initiatives or actions seemed like a great idea, but didn't work? Why?
8. Do you have plans to branch out to other social media platforms?

## Appendix A.2: Piñones Community Members

This appendix is a survey of Piñones community members concerning environmental education. The data will help us understand what objectives should be implemented into the curriculum LimPiaR is developing, and how interested the community is in an afterschool environmental program. Since our group and LimPiaR will be working directly with the community, it will be important to consider their perspective when developing an education plan. It will give us an idea of what residents already know and what is important to them. It will also help LimPiaR to understand how well the community knows them, where they are lacking, and help us to point to how they can improve.

1. Are you from Loíza?
2. What is your role in the community?
3. Do you have any children, if so how old are they?
4. On a scale of 1 to 5 (1 being not important and 5 being very important), do you believe educating the youth on the environment is important?
5. Are your children involved in any environmental education programs?
6. Would you consider having your child attend an environmental education program
7. On a scale of 1 to 5 (1 being unsatisfied and 5 being very satisfied), are you satisfied with the current environmental education for children in Loíza?
8. What environmental topics do you believe should be taught to children between the ages of 5 and 12?
9. Do you know of any organizations within Loíza working to educate the public on environmental issues? If so, what are the names of the organization?
10. Would you be interested in volunteering within your community to help educate children about the environment?
11. If you are interested in volunteering, please provide us with your preferred form of communication.

## Appendix A.3: Local Organizations and Individuals

This appendix contains interviews with employees of organizations located within Puerto Rico that work to improve the environment. The information collected will help us better understand what the main environmental issues in Puerto Rico are. It will also tell us what other organizations are working to accomplish, have already accomplished, and what made their organization successful. With this information we can determine what environmental topics should be focused on in the program LimPiaR is working on implementing.

### Appendix A.3.1: Julio César Carromero Albandoz, Environmental Educator at COPI Interview

1. Please tell us about this organization and your role within it.
2. What environmental issues are you trying to address?
  - a. Which do you feel are most important?
3. What project(s) are you currently working on?
4. Where have your projects been implemented?
  - a. Why did you choose these places?
5. What age groups are your programs designed for?
6. What strategies do you find most effective for teaching students?
7. Do you have the contact information for the director of Bosque Estatal de Piñones (Piñones State Forest)?

### Appendix A.3.2: Eniel Davilla, Employee at Bosque Estatal de Piñones Interview

1. Please tell us about this organization and your role within it.
2. Can you tell us about your past projects or initiatives?
3. What project(s) are you currently working on?
4. The Bosque Estatal de Piñones is a public space. What is it generally used for?
5. Do you promote the area as a place where community members can come to visit?
6. How many people from the community visit this space every day?
7. Do families with children come here often?

8. Can organizations hold events here?

### Appendix A.3.3: Anonymous Carolina Resident Interview

1. What municipality are you from?
2. Are you familiar with the Piñones community?
3. Are you in school currently?
  - a. If you are, where do you go?
  - b. What are you studying?
4. What environmental issues are you most passionate about?
  - a. What inspired this passion?
5. How did you learn about local environmental issues?'
6. Could you describe the current state of environmental education in your municipality?
7. How do you use your social media presence to spread awareness about environmental issues or affect change?

### Appendix A.3.4: Tanisha Gaspar, Foundress of P.A.Y.E

1. Please tell us about this organization and your role within it.
2. How will your organization's building be used in the future?
3. Do you have any plans for an afterschool program during the next school year?
  - a. Any plans for a summer program?
4. How many students do you plan to educate in your program(s)?
  - a. How many educators/volunteers do you plan to have?
5. What age groups do you plan to educate?
6. Do you have plans to include environmental aspects/lessons into your program(s)?
7. Would LimPiaR be able to teach at any of your programs?
8. Have you partnered with any other local organizations?

## Appendix A.4: Outside Organizations With Environmental Programs

This appendix is for an interview with organizations who have already implemented an environmental education program. The information collected will help us better understand what has worked and what has failed in the development of other programs. It will also provide information on how the program should be organized and structured. With this information our team will have knowledge on how to structure LimPiaR's after school educational program and determine what type of activities should be implemented into the lesson plans.

1. Tell us about your organization and what you do.
  - a. What environmental issues are you trying to address?
2. What project(s) are you currently working on?
  - a. What are your goals within the next 6 months?
  - b. How do you measure the success of your projects?
3. Where do you see this project going in the next 2 years?
4. How have you made your program successful?
  - a. How do you measure success?
5. Where has your program been implemented?
  - a. Why did you choose these places?
6. Do you feel your program is organized?
  - a. If so, what strategy have you found to be most successful when it comes to organization and documentation?
7. Who are your programs designed for?
8. What strategies do you find most effective in teaching the students?

# Appendix B: Parental Consent Form

## Appendix B.1: Parental Consent Form

This appendix contains a consent form for parents of children who are attending lessons at COPI. It informs them that we will be observing the students and their interactions with Auraluz Guzmán as she teaches. It also informs them of the goals of our observations. This will ensure that the parents of children approve of our observational activities and give them the option to remove their child from these activities.

We are a group of students from Worcester Polytechnic Institute in Massachusetts. We are working alongside LimPiaR to assist in the development of their environmental education program for children. We are observing hands-on environmental education activities to improve their efficacy. We strongly believe this kind of research will ultimately enhance the development of our environmental curriculum and the long-term success and growth of environmental education in Piñones.

Your child's participation in these activities is completely voluntary and you may withdraw them at any time. No names or identifying information will appear in any of the project reports or publications.

This is a collaborative project between the LimPiaR and WPI, and your participation is greatly appreciated. If interested, a copy of our results can be provided at the conclusion of the study.

I, \_\_\_\_\_, grant permission for my child, \_\_\_\_\_, to participate in this observational study.

Signature:

Date:



# Appendix C: Educational Material

## Appendix C.1: Auraluz Guzmán's Guiding Pedagogical Principles

This appendix contains the initial principles that Auraluz Guzmán followed when creating her own lessons. These principles include both educational and ecological ideas that Auraluz Guzmán deems necessary for environmental education. We discussed these with her in order to form our own educational topics and macro-objectives.

- (1) expose children and youth to experiences of direct contact with the ecosystems that make part of their community; (mangrove forest, lagoons, coral reefs, sandy beaches)
- (2) facilitate hands-on learning experiences related to the current issues that concern them and their community; (solid waste reduction, water quality, sand dunes conservation, mangrove conservation, local agriculture-community gardens)
- (3) foster inquiry and critical thinking.
- (4) make space for their artistic expression and creative agency.

Ecological principles to draw learning outcomes from:

1. matter cycles continuously through the web of life, while living systems need a continual flow of energy.
2. diversity assures resilience.
3. one species' waste is another species' food.
4. human needs and achievements are both supported by and limited by the natural world.

## Appendix C.2: 5E Lesson Plans

This appendix contains lesson plans that we have created for LimPiaR to be a part of their environmental educational program. It includes pertinent information such as the materials, topics, and objectives. Additionally, it outlines how each of the 5E's are reflected in our lesson. The lesson instructions then define how it should be delivered to children. These plans were designed such that a volunteer could be given them and with minimal verbal training, understand and teach them.

## Appendix C.2.1: Scavenger Hunt Lesson

Materials: Check list (pictures), pencils, & clipboard
Location: COPI
Topic(s): Ecology, Interdependency
Objectives: Have students identify different living and nonliving aspects of an ecosystem
Concepts: What is a living thing? What is a nonliving thing? How do they interact?
Required Time: 20 minutes
<i>Engagement:</i> Step 2- Ask questions to get the children thinking about the wildlife around them
<i>Exploration:</i> Step 4- Scavenger hunt: students are free to explore the area behind the COPI building
<i>Explanation:</i> Discuss what has been found with the children, make connections, and answer clarifying questions
<i>Elaboration:</i> Ask questions to get children to make connections between items on list and in the environment
<i>Evaluation:</i> Note the use of key words: Names of various organisms, plastic, trash, relationship, interaction

### Lesson Instructions

1. Introduce the COPI community center building and surrounding mangrove forest ecosystem.
2. Ask children:
  - a. What is your name?
  - b. What is your favorite animal?
  - c. What is the last animal you have seen?
3. Give out scavenger hunt sheets, clipboards, and pencils to children. Optionally, children can work in groups.
4. Start scavenger hunt. Children are free to explore around COPI for 10 minutes.
  - a. Supervise and answer any questions they may have.

5. After the hunt is done, bring everyone together and discuss the items found. Also discuss the difference between living and nonliving things that they have found.
6. Ask children:
  - a. Can you think of a relationship between a living thing and a nonliving thing from the list?
  - b. Can you think of a living and nonliving thing that is not on this list and could be found in the forest(scavenger hunt location)?
7. Pay attention to student answers and their discussion of the questions, noting the use of vocabulary words related to the concepts mentioned above.
8. Collect all materials at the end of the lesson.

### Appendix C.2.2: How Trash Travels Lesson

Materials: “How Trash Travels” Infographic
Location: N/A
Objectives: Have students consider their actions and how they can affect the environment
Concepts: Solid Waste Management
Required Time: 10-15 minutes
<i>Engagement:</i> Step 1 and 2: Children are introduced to the topic of waste and the infographic
<i>Exploration:</i> Step 3a: Children can view and interact with different parts of the infographic
<i>Explanation:</i> Step 3b: Discuss the steps of the infographic in detail
<i>Elaboration:</i> Step 4: Ask questions to get children thinking about where trash goes when it’s disposed and how to reduce waste
<i>Evaluation:</i> Note the use of keywords: litter, single-use, plastic, improper disposal, trash

### Lesson Instructions

1. Ask children:
  - a. How do they dispose of waste?
  - b. What do they think happens to the waste if it is not disposed of properly?
2. Introduce the infographic to the children.

3. Explain each step of how the plastic bag travels from human hands to a turtle’s mouth.
  - a. Let the children touch the different components as you move along the trash’s path.
4. Ask children:
 

How can we ensure that trash doesn’t end up in the ocean?

Where does trash go when it is properly disposed of? (Think: landfills + the negative consequences involved)

What ways can we avoid producing this waste entirely? (Reusable bags/utensils, etc.)

### Appendix C.2.3: How Organic Matter Cycles Lesson

Materials: Organic Matter Cycle Infographic Poster, Composting Bucket
Location: N/A
Objectives: Students will be introduced to the topics of food, organic matter, composting, and solid waste management.
Concepts: Soil and Food, Solid Waste Management
Required Time: 20-30 min
<i>Engagement:</i> Steps 1 and 3- Introduce composting bucket and infographic
<i>Exploration:</i> Steps 1 and 4- Students can dig through bucket and interact with infographic
<i>Explanation:</i> Steps 2 and 3- Discuss composting and matter cycle with children
<i>Elaboration:</i> Step 5- Ask children about compostable items to deepen their understanding of composting
<i>Evaluation:</i> Note the use of keywords: organic, compost, cycle, nutrient-dense, worm

#### **Lesson Instructions:**

1. Introduce students to the composting bucket. With gloves, let them dig through the bucket to see its contents.
2. Explain how composting works, including the role of worms.
3. Introduce the infographic and explain the cyclical aspect of organic matter.
  - a. Go into detail on each step of the cycle.

4. Take each piece of paper off its Velcro spot and rearrange them in a random order. Make the children put them back into the correct order.
5. Ask children:
  - a. What different types of things can be composted?
  - b. What cannot be composted?
6. Throughout discussions, note use of pertinent vocabulary words and connections between concepts that students make.

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