

Warren J. Baker Endowment

for Excellence in Project-Based Learning

Robert D. Koob Endowment *for Student Success*

FINAL REPORT

I. **Project Title**

Water Fun at Exploration Station

II. **Project Completion Date**

This project was presented at the Cal Poly Senior Project Expo on June 2, 2017.

III. **Student(s), Department(s), and Major(s)**

(1) Nicholas Runyan – Mechanical Engineering

(2) Raymond Morales – Mechanical Engineering

(3) Heriberto Rodriguez – Computer Engineering

(4) Alejandro Gonzales-Smith – Mechanical Engineering

IV. **Faculty Advisor and Department**

Sarah Harding, Professor of Mechanical Engineering

V. **Cooperating Industry, Agency, Non-Profit, or University Organization(s)**

Exploration Station in Grover Beach, CA

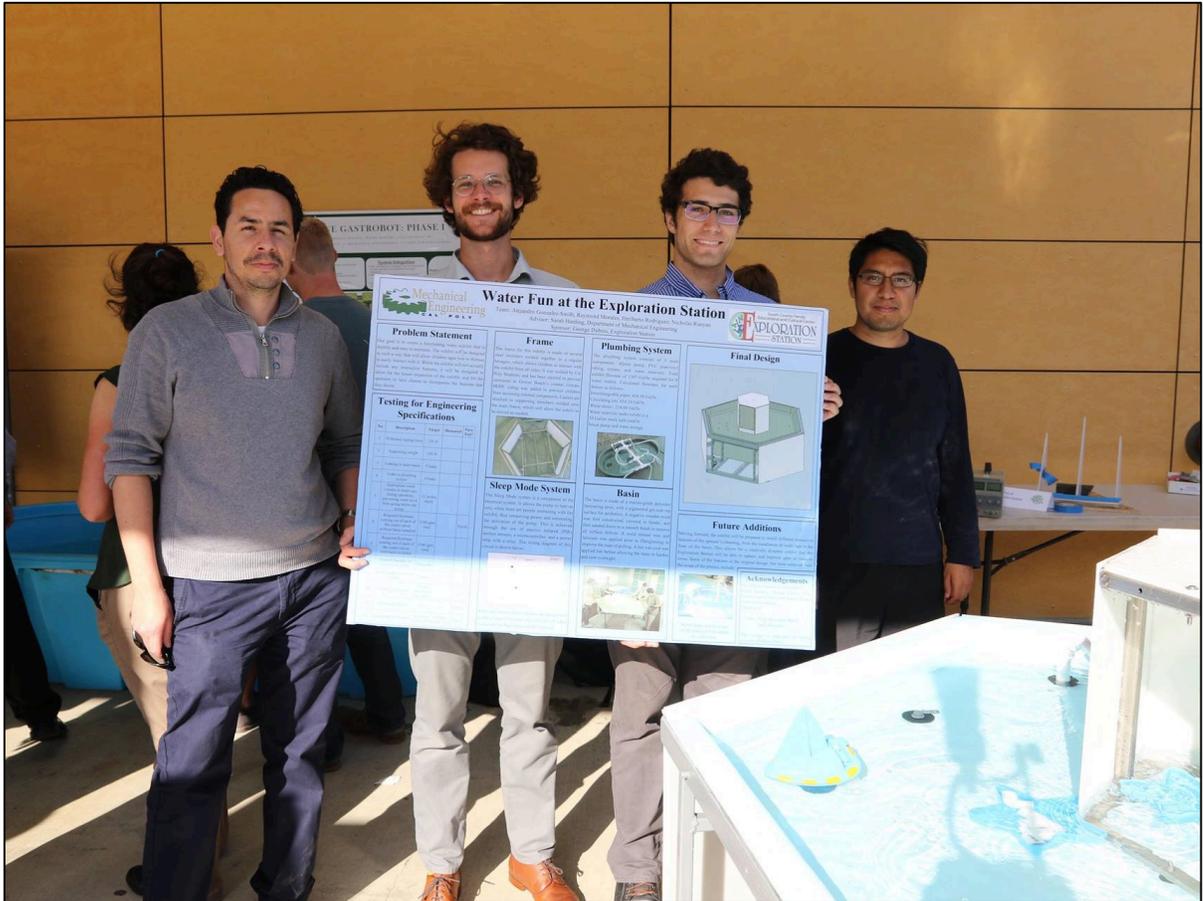
VI. **Executive Summary**

This report is a final follow up for the Water Fun at the Exploration Station project that received funding from Baker-Koob in December 2016. This project involved the design and fabrication of an interactive science exhibit for the Grover Beach Exploration Station. This is a student-led senior project advised by Sarah Harding, professor of mechanical engineering, as a part of California Polytechnic State University in San Luis Obispo's mechanical engineering program. The final product is a fully functioning, durable system that is capable of pumping and recycling water throughout use when users are in its vicinity.

The exhibit is to be considered in 4 main subsystems: basin, plumbing, frame, and sleep mode systems. A fiberglass basin that holds all the water in the exhibit sits recessed inside a welded steel frame. Water is pumped through the bottom of the basin from within an enclosed storage area inside the frame, and is recycled back into the water reservoir by placement of two weir valves. A submersible pump powers the exhibit, and is controlled by passive infrared sensors that activate

when human presence is sensed within 15ft. While the manufacturing process did reach completion, testing and verification did not. However, proposed testing plans were developed and if given more time then

This report will document some of our team's major accomplishments during the design process, as well as how we allocated the funds received from Baker-Koob. Finally, a reflection on how this project has impacted our student learning can be found at the end of the report.



Shown Above: Team Water Fun presenting the science exhibit at the Cal Poly Mechanical Engineering Senior Expo on June 2, 2017.

VII. Major Accomplishments

(1) Almost all of our manufacturing was completed in the machine shops on-campus. We are providing a watertight basin with eight outlets installed so that our sponsors can build upon the basin by adding more fiberglass layer and features over time if desired. Prior to this project none of the team members had ever worked with the fiberglassing process. The mold was created from scratch, using wood and bondo putty, and our team members completed the fiberglass layup in-house. Additionally, we are giving our sponsors a durable frame made of carbon steel and stainless steel that will last many years. Our team completed all of the welding ourselves, (except for the stainless steel, due to skill level required), despite our initial plans to outsource all of these processes.

(2) We embraced the interdisciplinary nature of this project by implementing a microcontroller sleep mode system that allows the pump to turn on when the sensors in the exhibit to detect

motion and turn off when no motion has been detected for some time. Tasks still required for this system to be completed include creating a waterproof housing for the high voltage elements used to power the exhibit, as well as casings for the passive infrared sensors.

(3) At the senior expo on June 2, we had many children in the target age group come with their parents and interact with the exhibit. In an almost accidental field-testing experiment, all of the children stayed at the exhibit for a minimum of 10 minutes to play and responded very positively with the general aesthetic of the exhibit!

VIII. Expenditure of Funds

The final cost of the exhibit ended at approximately \$400 more than what we had originally been granted through Baker-Koob. The extra cost was covered by members of our team and from our sponsors at the Exploration Station. These additional expenditures were required due to our team wanting to deliver the highest possible quality exhibit to deliver to our sponsors. During the original pricing process, our team did not develop accurate estimates for the amount of materials required, which led to the over expenditure. Also, there were many design changes that occurred late in the critical design process, like switching from an acrylic basin to one made of fiberglass. This immensely increased the cost of our project, as the resin materials required are very expensive. The breakdown for the cost for each subsystem is shown below.

EXHIBIT TOTAL COST		
SUBSYSTEM	SYSTEM DESCRIPTION	COST
Electronics	Components comprising the sleep mode system as well as anything used to power the exhibit.	\$147.65
Basin	Main body of the exhibit, where all features will be held. Price includes the cost of creating a relief for the fiberglass	\$885.28
Plumbing	Pump and water routing system. Any component between the storage reservoir and outlet spouts in the basin.	\$595.75
Frame	Structural form of the exhibit. Includes all raw steel material and anything that directly connects to it.	\$1,168.39
Outsourced Service	Any work that we paid someone else to perform (i.e. welding,)	\$150.00
	Total Cost	\$2,947.07

IX. Impact on Student Learning

One of the main impacts on our learning during the mechanical engineering senior project was the way that it challenged our skills in project management and scheduling. For many of us, this was the first time that we had completed a ten month long project, and the skills required for this is far different than those required for a ten week long class project. The most profound learning experience of this project, however, was being able to work with students from other majors on the same project. We all were able to learn and grow in uncomfortable content areas, because of having at least one other person in the group that had experience with those things. Having this blend of backgrounds and skill sets made for a much more holistic learning experience, and helped enhance both the complexity and quality of our final project.