



Santa Clara
Engineering

[Source \[1\]](#)

Water Feature X Forge Garden

By: Tiffany Doan, Erick Lopez,
Austin Kim, Dylan Olson

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THE TEAM

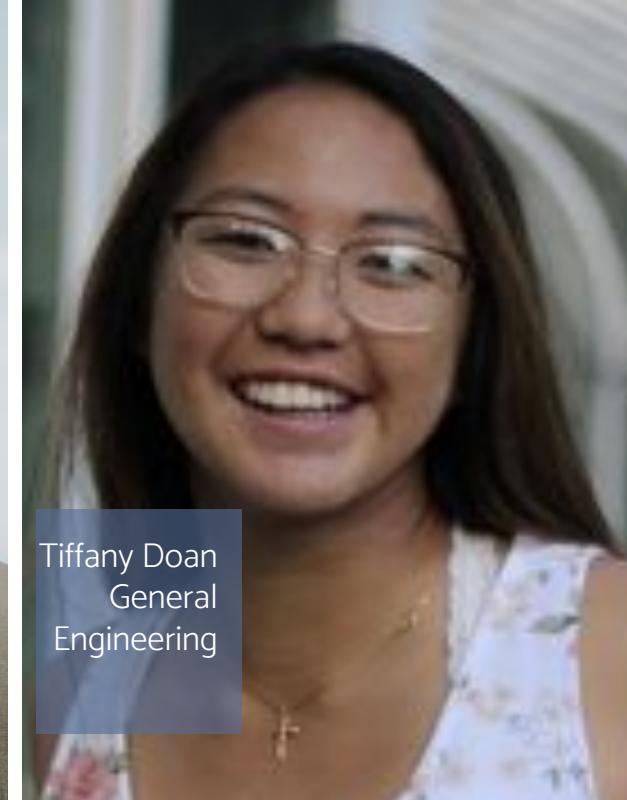
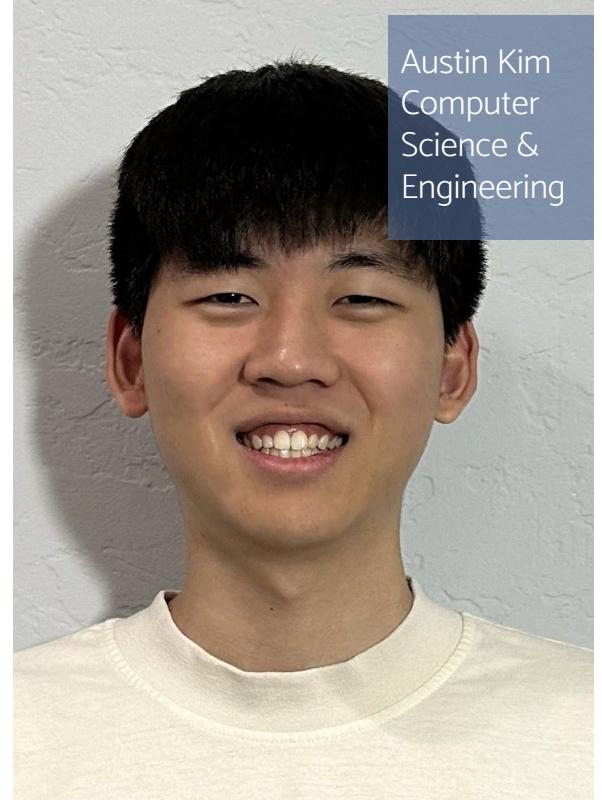


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ABOUT THE PROJECT

What is the purpose of our project?

INITIAL DESIGN

The first solution and how it has been iterated to become our final product..

ACCOMPLISHMENTS

What have we bought, and built?
Progress up to date.

CHALLENGES

What is left to do? The difficulties along the way.

ANALYSIS

Self-identified success of the project.

Our Project

- **Collaboration** between Santa Clara University and The Forge Garden (Muwekma Ohlone Tribe)
- For the **Muwekma Ohlone Tribe** and the **general community**
- **Objective:** Create a water feature,
 - Vertical free-falling
 - Sound
 - Culturally Representative (e.g. Abalone shells) of Muwekma Ohlone Tribe





PROBLEM STATEMENT

The Santa Clara Forge Garden is creating a native plant garden, a water feature is needed to embody the importance of water to the Muwekma Ohlone Community and represent native culture in the native garden space.

OUR GOALS

- Produce a product that is culturally representative of the Muwekma Ohlone Culture
- Brings the sounds of flowing water to the area
- Fully self-sustaining through the use of solar power.

CRITICAL CUSTOMERS

- Muwekma Ohlone Tribe
- Forge Garden workers
- Forge Garden Patrons
- Students and Community members
- Ohlone Youth summer camps

Current Solutions



41" Waterfall
\$182
[Source\[3\]](#)



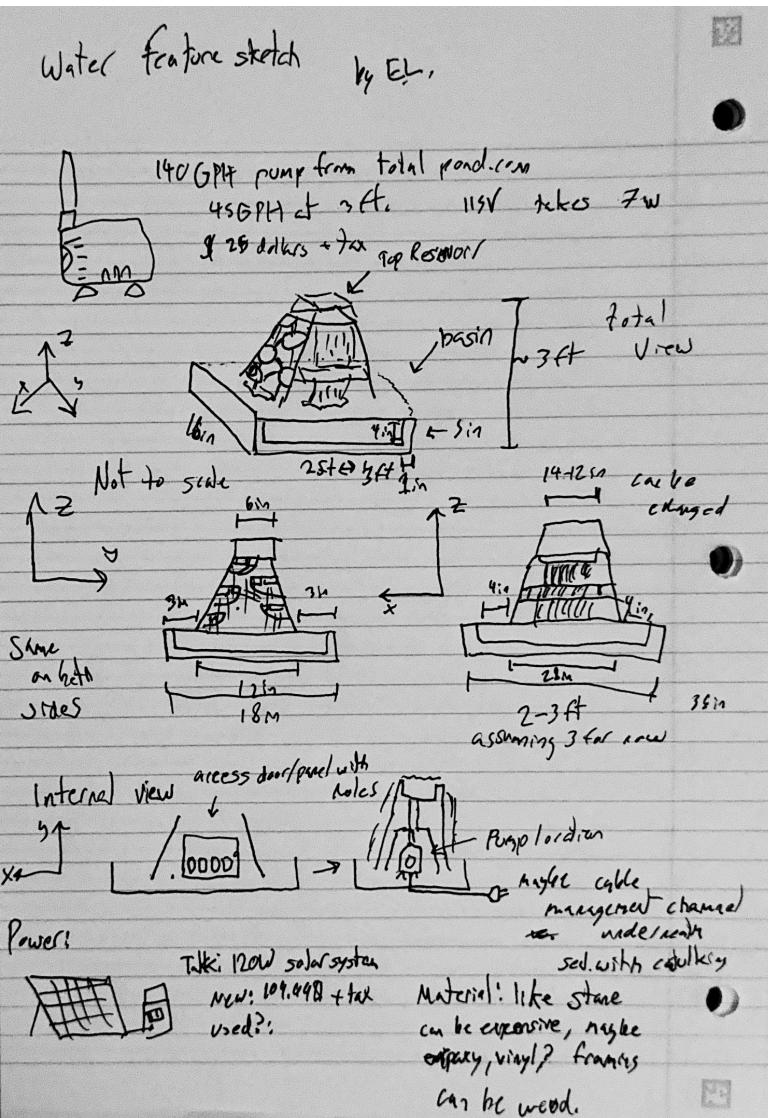
27" Rustic
\$48
[Source\[4\]](#)



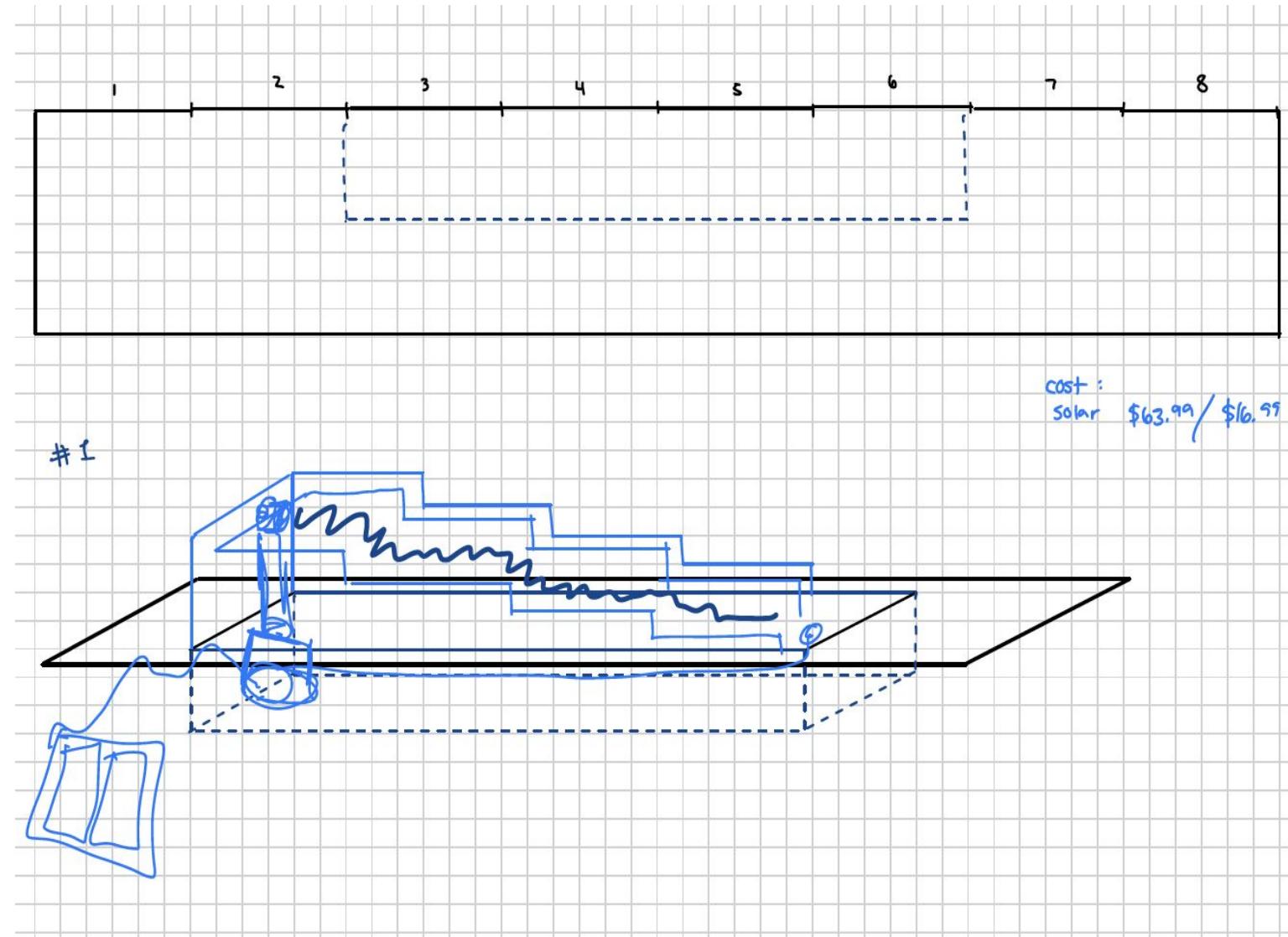
40" Rustic
\$224
[Source \[5\]](#)

Our Ideas

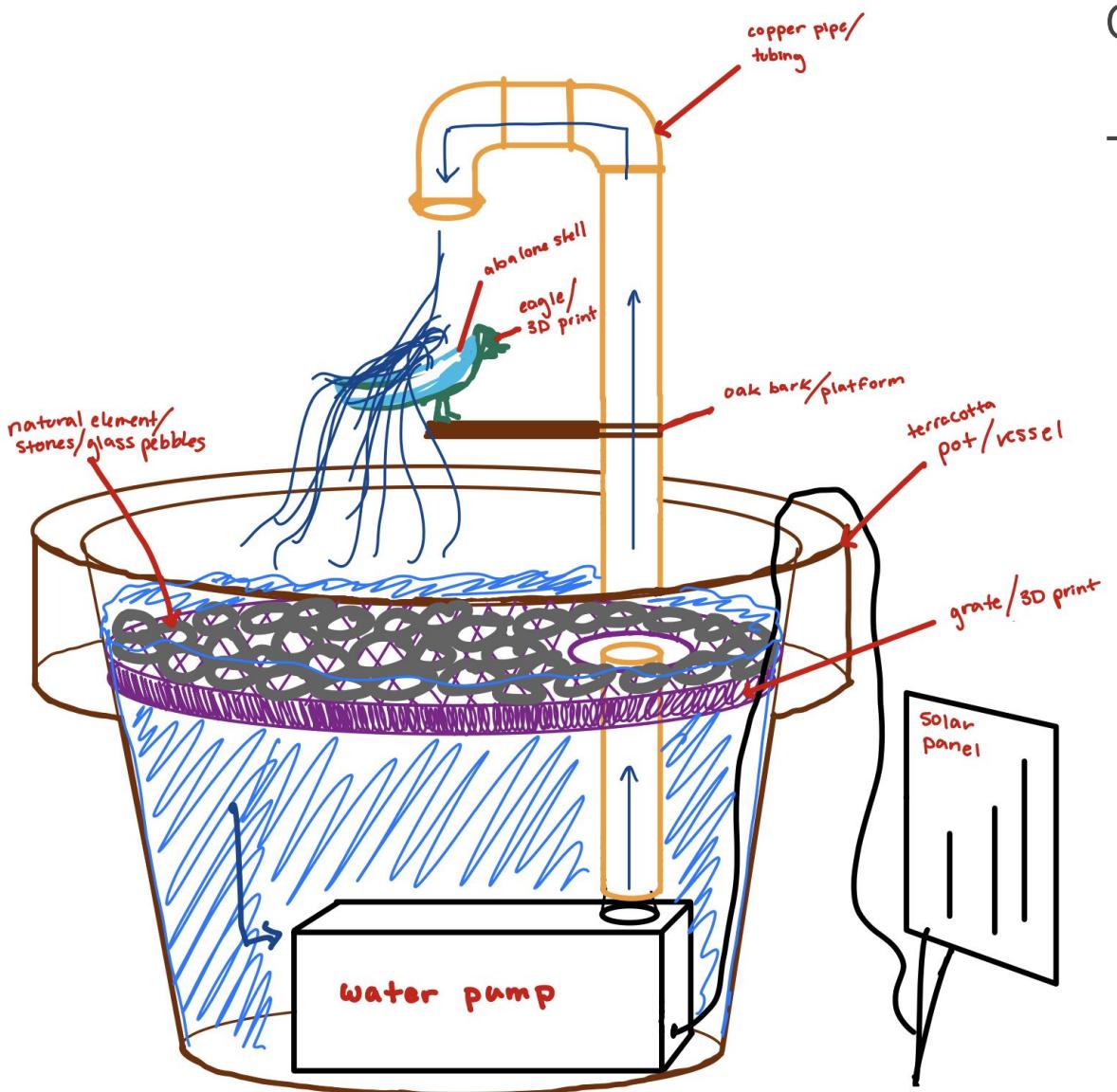
Credit: Erick Lopez
Idea 1



Credit: Tiffany Doan
Idea 2



Final Design



Credit: Dylan Olson

Total Expected Cost:
~ \$ 170

Flow Calculation

Radius/Q	120 GPH	320 GPH	<u>410 GPH</u>	480 GPH
0.5" diameter (0.0064 cm radius)	1.00 m/s	2.66 m/s	3.40 m/s	3.98 m/s
0.75" (0.0095 cm radius)	0.44 m/s	1.18 m/s	<u>1.513 m/s</u>	1.77 m/s
1" (0.0127 cm radius)	0.25 m/s	0.66 m/s	0.85 m/s	1.00 m/s

Optimal Water Flow Rate: 0.9-2.4 m/s; [Source \[6\]](#);
 Our target velocity: 1.2-1.5 m/s
 View [Source \[7\]](#) for full description of calculation

Equations:

$$(1) \quad Q = A * v$$

$$v = Q/A$$

$$v = Q [m^3/s] / A [m],$$

$$\text{where } A = \pi (r)^2$$

$$\text{GPH} = 0.00378541/3600 \text{ m}^3/\text{s}$$

Power Considerations:

Solar Panel Input W:	<u>10 W</u>	<u>25 W ✓</u>	
Battery Charging Time (38.48Wh) (100% Efficiency)	3 h 50 m	1 h 32 m	(1)
Battery Charging Time (When Pump is Power On)	33 h 28 m	2 h 23 m	(2)
Fall/Winter Daily Sun Energy	76 Wh	190 Wh	
Spring/Summer Daily Sun Energy	101 Wh	253 Wh	(3)
Seasonal Sunlight Charging Efficiency (Fall/Winter)	49%	80%	
Seasonal Sunlight Charging Efficiency (Spring/Summer)	62%	85%	(4)
Discharge Time (@ 100% Capacity)		4 h 49 m	

Santa Clara County Sunlight; Source [8]

Fall/Winter: Approximately 7.6 hours of sunshine per day

Spring/Summer: Approximately 10.1 hours of sunshine per day

We will use a 2600 mAh battery @ 14.8 V = 38.48 Wh (0)

Power rating of our chosen pump: 5W@12V - 21.5W@24W

Power at 14.8V = 8.85W; Battery Current: 540 [mAh]

Equations:

- (0) $\text{Charging Time} = \text{Capacity [mAh]} \times \text{operating volt}$
- (1) $\text{Time} = \text{Capacity [mAh]} / \text{Solar Panel Input [W]}$
- (2) $\text{Time} = \text{Capacity [mAh]} / (\text{Panel Input[W]} - 8.85 \text{ W})$
- (3) $\text{Charging} = \text{Panel Input [W]} * \text{Sunshine Hours [h]}$
- (4) $\text{Efficiency} = 1 - (\text{Battery [Wh]} / \text{Daily Sun [Wh]})$

Cost Analysis: Parts

Product	Product Hyperlink	Cost	Total Cost
Solar Panel w Battery	Amazon	\$ 98.99	\$ 108.02
Waterproof Patch Rubber Sealant	Amazon	\$ 14.95	\$ 16.31
Maritime JB weld	Amazon	\$ 7.28	\$ 7.94
Total Costs of this Sheet		\$ 121.22	\$ 132.28



[Image Source \[9\]](#)



[Image Source \[10\]](#) [Image Source \[11\]](#)

3D PRINTING

- Printed the grate pieces in PETG each taking around 8.5hrs



IN PROGRESS

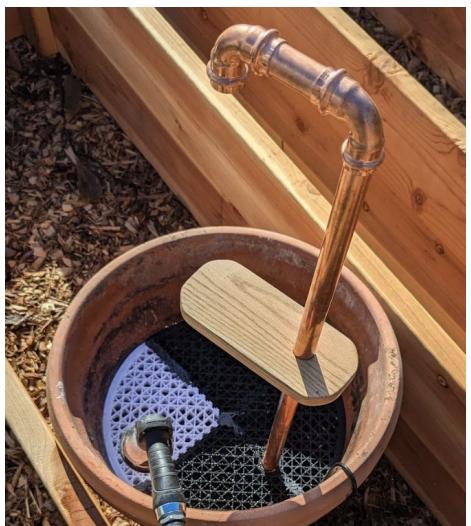
- 3D print the golden eagle
- Attach shell and eagle to platform
- Decorate space above grate
- Finalize the flow of water
- Gather sound metric
Target 70 dB @ 10ft



ASSEMBLY

- ¾ inch copper piping
- Oak Platform
- 3D printed PETG grate
- Terracotta Pot with sealant
- Solar Panel (25W) with Inline Battery (2600 mAh) to Pump (8.4W@14.8V) 410 GPH

CURRENTLY



WHAT WE HAVE COMPLETED SO FAR

CHALLENGES

COMMUNICATION

- Ensuring appropriate cultural representation.
- Maintaining contact with Muwekma Ohlone representatives.

TESTING

- Parts arrived broken and later than expected
- Testing will take place Wk 10



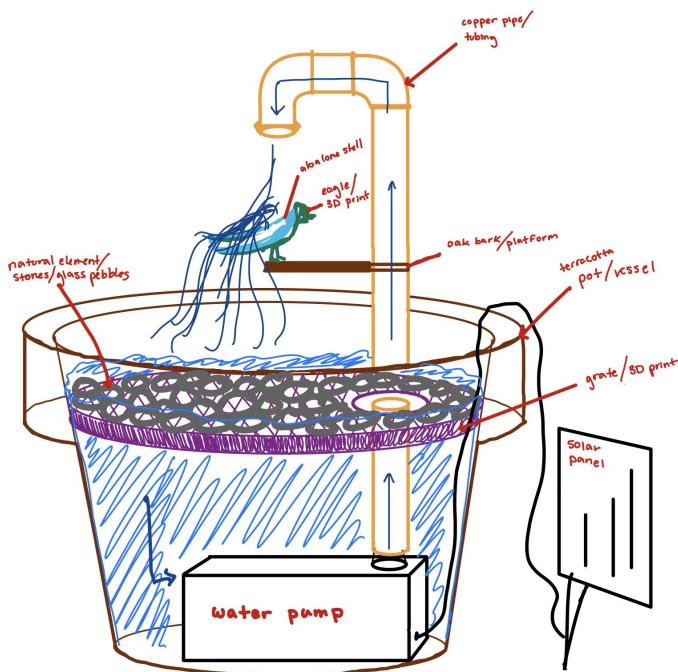
PRODUCTION

- Too much water loss due to high platform height and high water pressure.



ANALYSIS

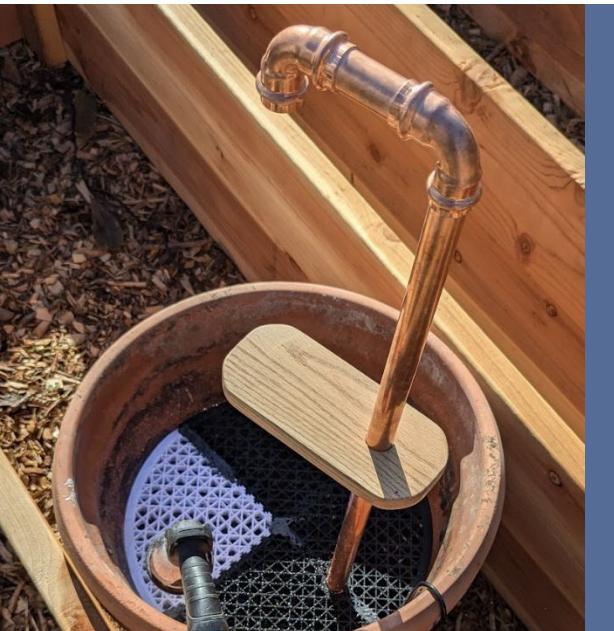
Did We Succeed?



Metrics:	Score:
Portability	80%
Acoustics & Sound	87%
Aesthetics	75%
Follows All Regulations	100%

- We are Calling this a Success! (Average: 86%)

What would we do differently?



- Improve grate tolerances
- Variable speed pump
- Modular Platform Placement
- Improve water retention
- Improve aesthetics
- Increase battery capacity



References

- [1]S. C. University, "Presentation Templates and Graphics - School of Engineering - Santa Clara University," Scu.edu, 2024. <https://www.scu.edu/engineering/current-student-resources/current-undergraduate-students/presentation-templates-and-graphics/> (accessed Dec. 03, 2024).
- [2] University, Santa Clara. "Forge Garden Programs." *Forge Garden Programs - Sustainability at SCU - Santa Clara University*, www.scu.edu/sustainability/forgegarden/. Accessed 3 Dec. 2024.
- [3] *Amazon.Com : Alpine Corporation 41" Tall Outdoor Rainforest Waterfall Tree Trunk Fountain with LED Lights : Free Standing Garden Fountains : Patio, Lawn & Garden*, www.amazon.com/Alpine-Corporation-3-Tier-Fountain-Lights/dp/B003E2LUHI. Accessed 3 Dec. 2024.
- [4] *Amazon.Com : Alpine Corporation TIZ194BZ Outdoor Floor Rustic 2-Tiered Barrel and Pump Water Fountain, Old-Fashioned Fountain, 27", Bronze : Indoor Fountains : Patio, Lawn & Garden*, www.amazon.com/Alpine-Corporation-2-Tier-Rustic-Fountain/dp/B00FR6SMG6. Accessed 3 Dec. 2024.
- [5] *Amazon.Com: Alpine Corporation WIN316 Outdoor Floor 4-Tiered Rock Water Fountain for Garden or Patio with Natural Stone Look, 40", Light Gray : Patio, Lawn & Garden*, a.co/d/9RxSFuY. Accessed 3 Dec. 2024.
- [6] Herasimovich, Ilya . "Typical Residential Water Flow Rate." Typical Residential Water Flow Rate, 10 Nov. 2022, filterway.com/blog/post/typical-home-water-flow-rate. Accessed 3 Dec. 2024.
- [7] A. Kim, Flow Calculations In-Depth. 2024. Accessed: Dec. 03, 2024. [Online]. Available: <https://drive.google.com/file/d/1--f9VHsOKm7VggqTyHHmjJPUhn6g-3Yw/view?usp=sharing>
- [8] Climate Data. "Santa Clara Climate: Weather Santa Clara & Temperature by Month." Climate-Data.org, 2021, en.climate-data.org/north-america/united-states-of-america/california/santa-clara-1431/?name=climate-table. Accessed 3 Dec. 2024.
- [9] *Amazon.Com: Eco-Worthy Water Fountain Pump Kit 25W with 2600mah Battery, 410GPH Submersible Powered Pump and 25 Watt Solar Panel for Sun Powered Fountain, Fish Pond, Pond Aeration, Garden Decoration : Patio, Lawn & Garden*, https://a.co/d/1sKFJz9. Accessed 3 Dec. 2024.
- [10] *Gorilla Waterproof Patch & Seal Rubberized Sealant Spray; Crystal Clear; 14oz (Pack of 1) - Amazon.Com*, https://a.co/d/4c0zr37. Accessed 3 Dec. 2024.
- [11] *Amazon.Com: J-B Weld 50172 25 ML. Marineweld Syringe : Industrial & Scientific*, https://a.co/d/6Y6zH3m. Accessed 3 Dec. 2024.