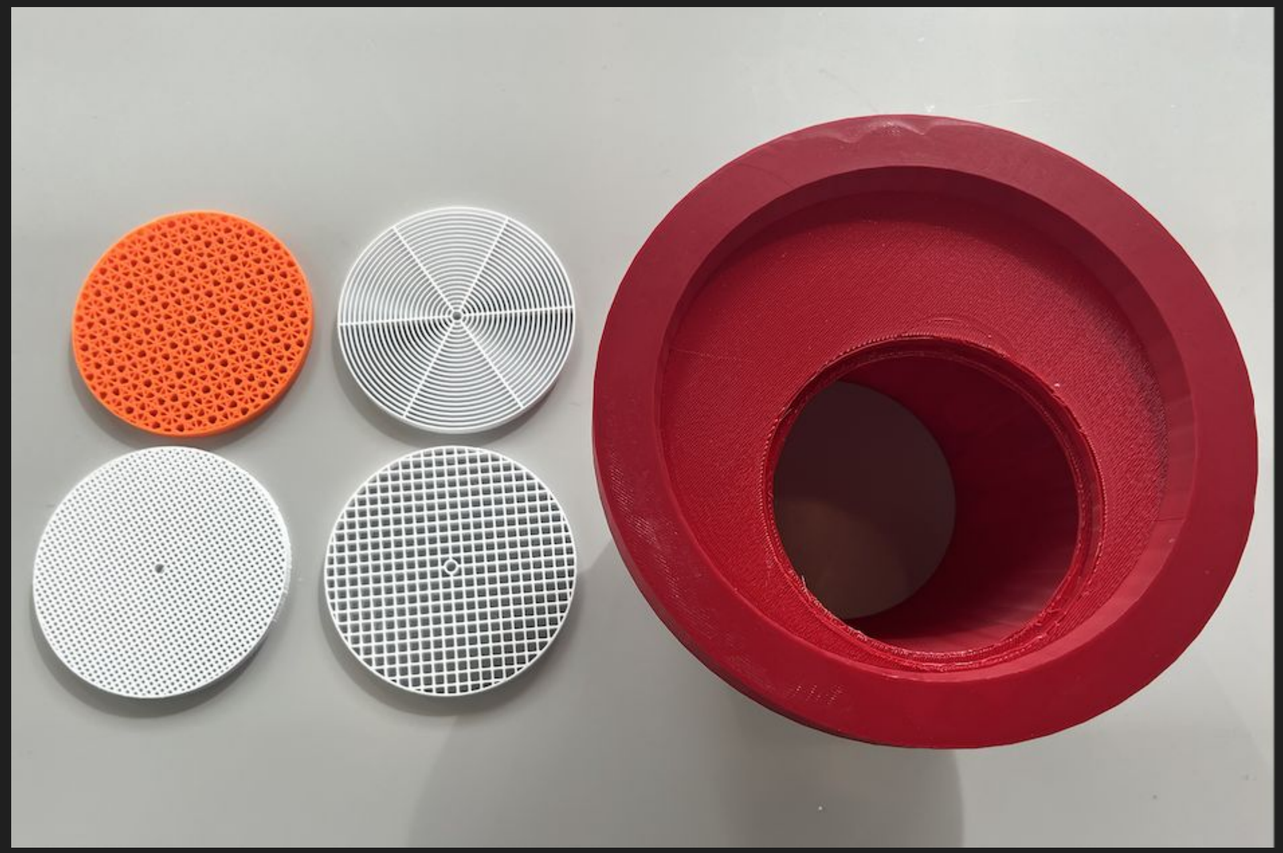
Tiffany Doan, Austin Kim, Erick Lopez, Dylan Olson

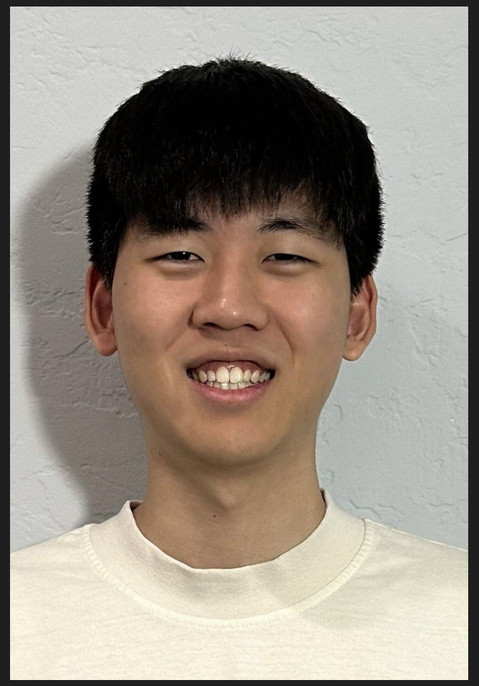
November 5, 2024



Forge Garden

Water Feature

The Team

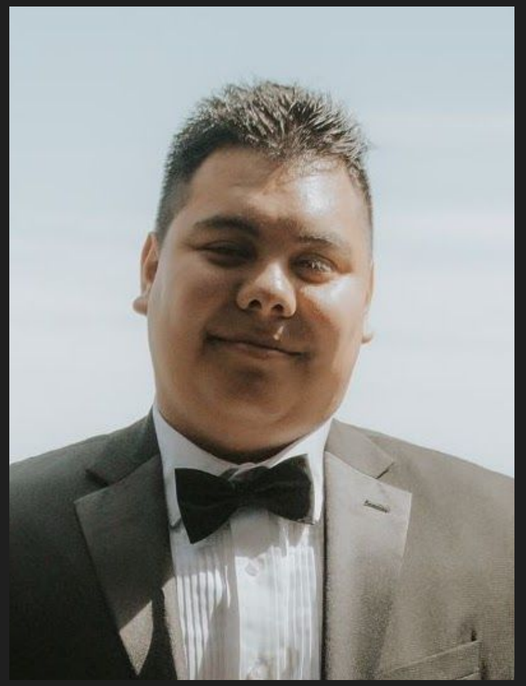


Austin Kim

Computer Science and Engineering

Dylan Olson

Electrical Engineering



Erick Lopez

Mechanical Engineering

Tiffany Doan

General Engineering

Presentation Contents

1) Project Description
2) Brainstorm
3) Research
4) Design
5) Remaining Steps
6) Challenges

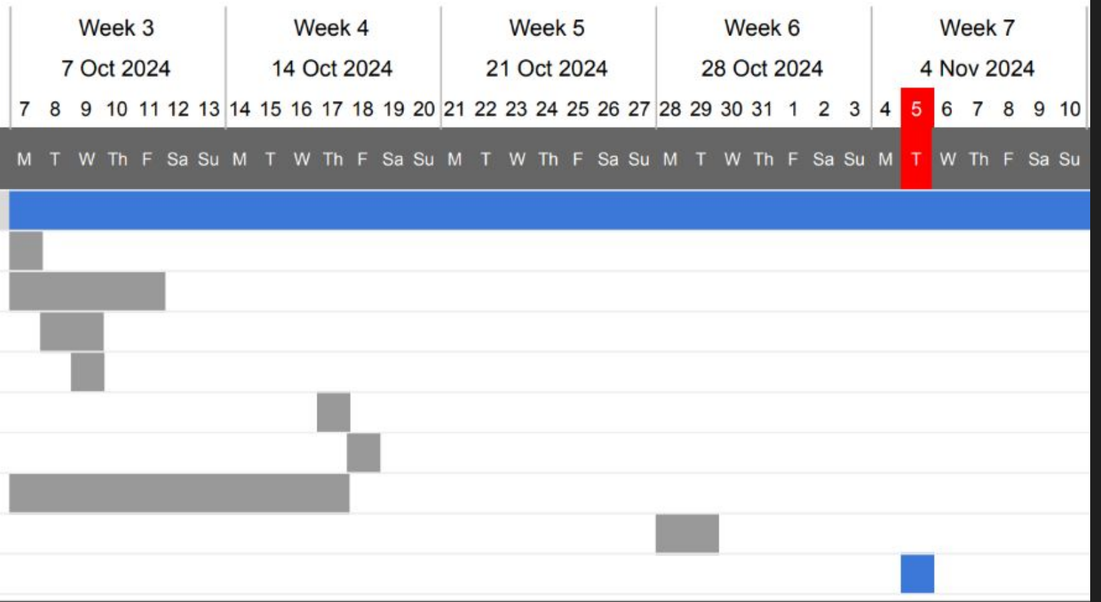
Timeline

Water Feature Gantt Schedule

Santa Clara University

Project Start Date: 9/23/2024 (Monday) Display Week: 3

WBS	Task	Lead	Start	End	Days	% Done	Work Days
1	**Water Feature Group**		Mon 10/07/24	Sun 12/01/24	56		40
1.1	Conduct Interview	All	Mon 10/07/24	Mon 10/07/24	1	100%	
1.2	Interview Minutes / Interteam discussion	All	Mon 10/07/24	Fri 10/11/24	5	100%	
1.3	Group Meeting: Project Research and Ideas	All	Tue 10/08/24	Wed 10/09/24	2	100%	
1.4	Design Meeting	All	Wed 10/09/24	Wed 10/09/24	1	100%	
1.5	Tour the Garden & Meet Rebecca	Tiffany	Thu 10/17/24	Thu 10/17/24	1	100%	
1.6	Weekly Minute Meeting	All	Fri 10/18/24	Fri 10/18/24	1	100%	
1.7	Research possible solar powered fountains (vertical)	All	Mon 10/07/24	Thu 10/17/24	11	100%	
1.8	Project Report Introduction		Mon 10/28/24	Tue 10/29/24	2	100%	
1.9	Check in with Dr. Jak (Week 7)		Tue 11/05/24	Tue 11/05/24	1		



Project Description

- **Collaboration** between Santa Clara University and The Forge Garden (Muwekma Ohlone Tribe)
- For the **Muwekma Ohlone Tribe** and the **general community**
- **Objective:** Create a **vertical free-falling** water feature, where the **sound** of running water could be heard. Integrate decorative features that resemble Muwekma Ohlone Tribe such as **abalone shells**

Project: Constraints

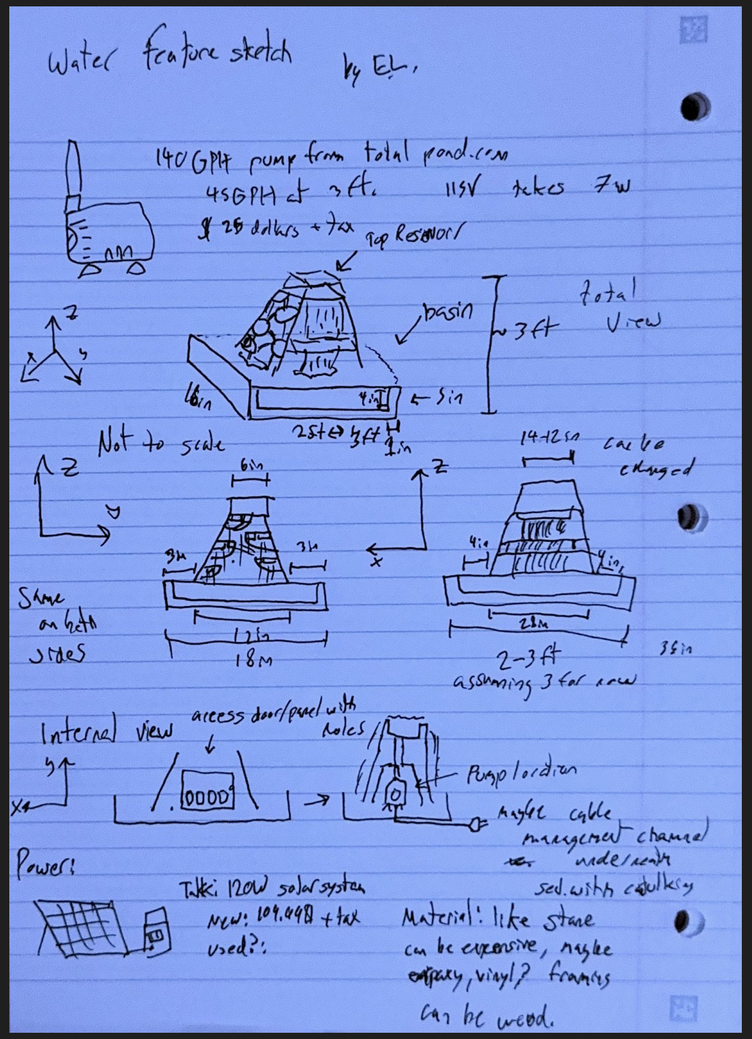
- 96x18x16 in. (L ,W ,H) sized planter box
- Run without wall power
- Run during the day (9 am - 6pm)
- Produce enough sound of water so that it can be heard throughout The Forge Garden

Project: Initial Ideas

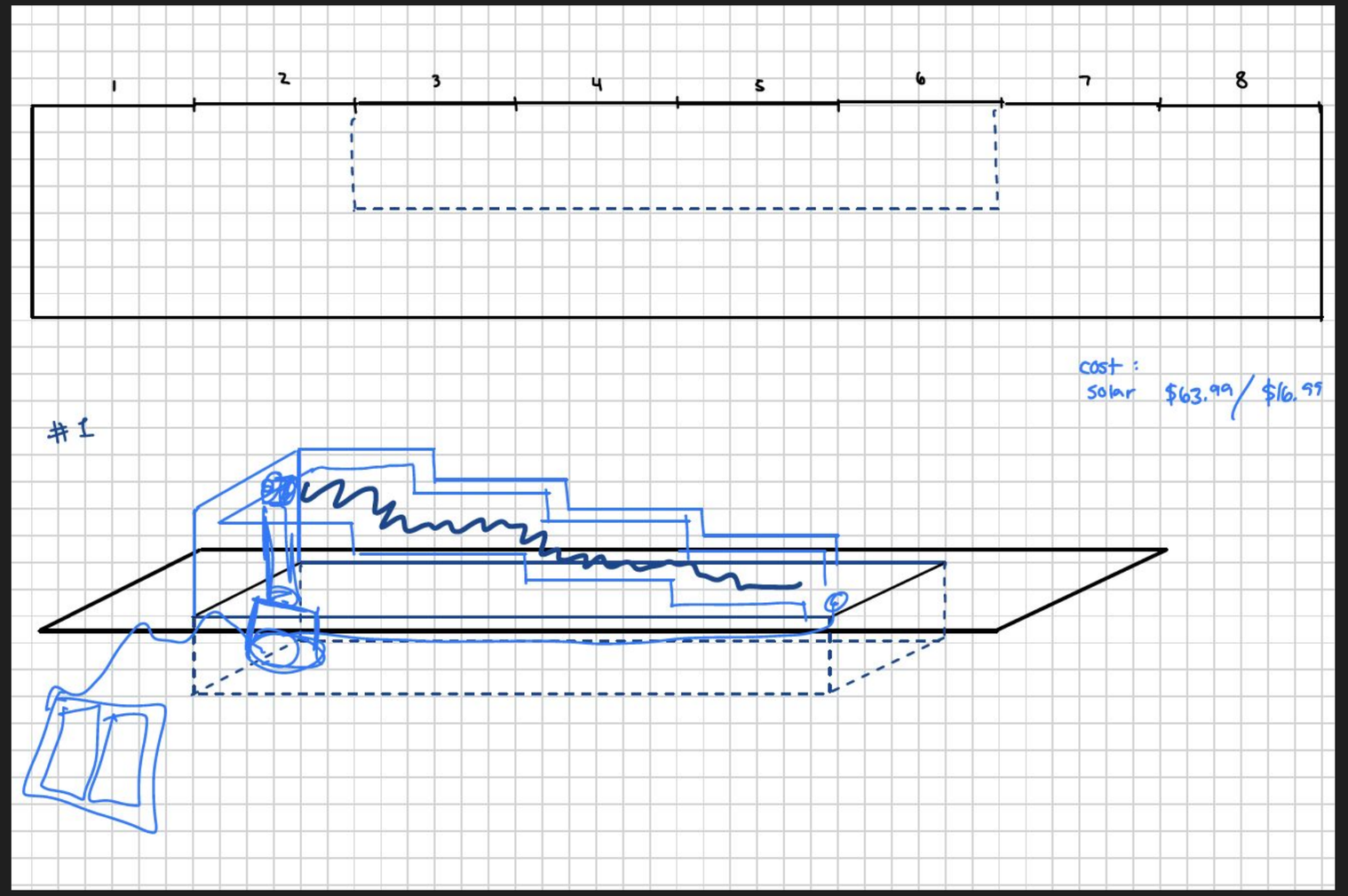
- **The Problem :**
  - The Santa Clara Forge Garden is creating a native plant garden, a water feature is needed to embody the importance of water to the Muwekma Ohlone Community and represent native culture in the native garden space.
- *Our Goal*:
  - produce a product that is culturally representative of the Muwekma Ohlone Culture
  - brings the sounds of flowing water to the area
  - fully self-sustaining through the use of solar power.
- **The critical customers :**
  - Muwekma Ohlone Tribe
  - Forge Garden workers
  - Forge Garden Patrons
  - Students and Community members
  - Ohlone Youth summer camps

Brainstorm: Concepts

Credit: Erick Lopez
Idea 1



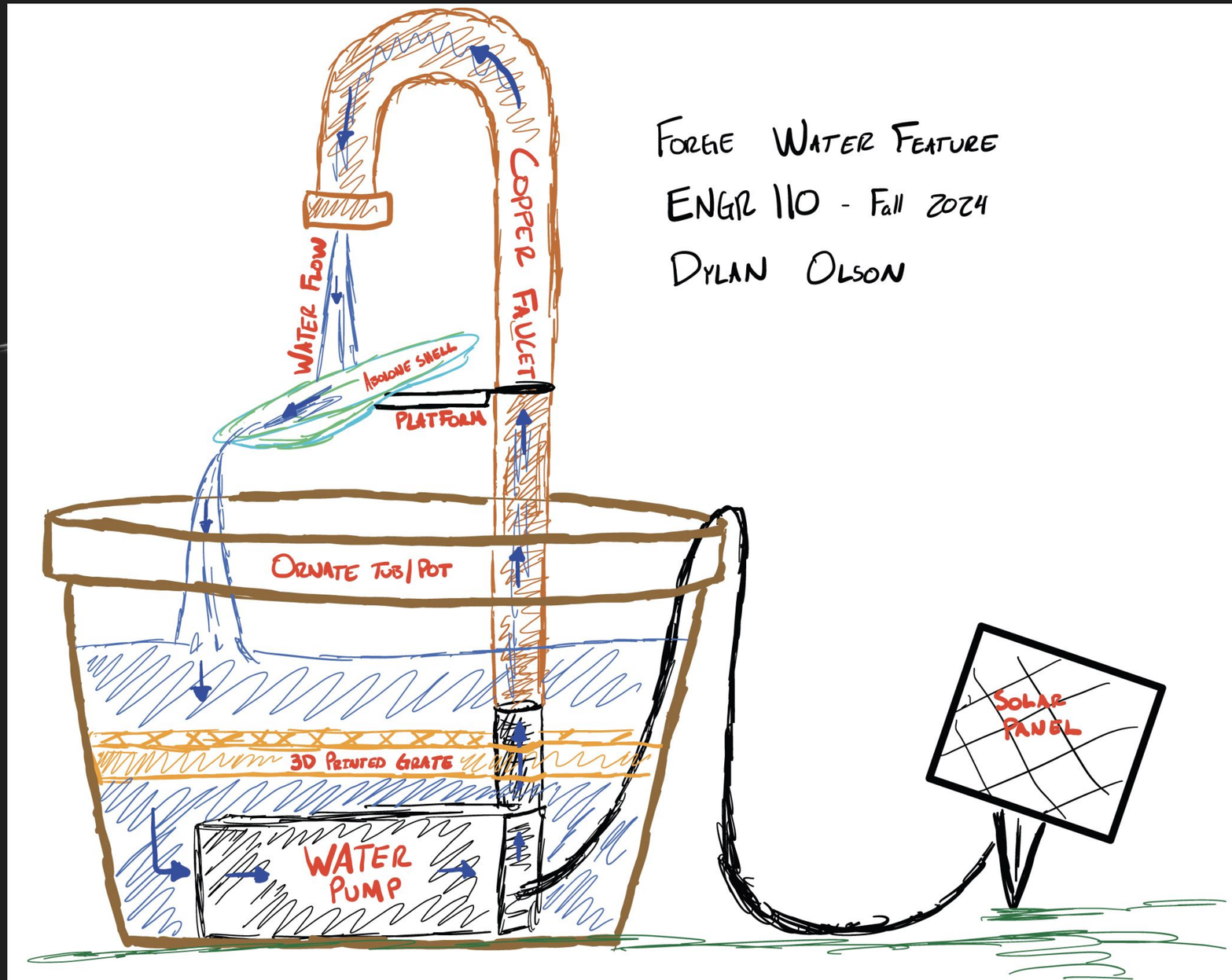
Credit: Tiffany Doan
Idea 2



Brainstorm: Concept

Credit: Dylan Olson

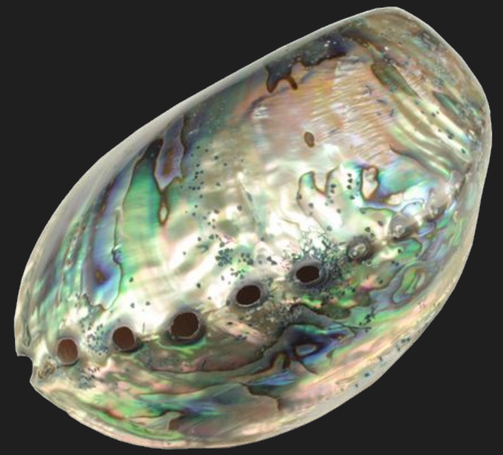
This is the idea we have collectively decided on. Forge Garden, Muwekma Ohlone Tribe, and us, all think this idea would be the most viable to implement.



Research: Part Analysis

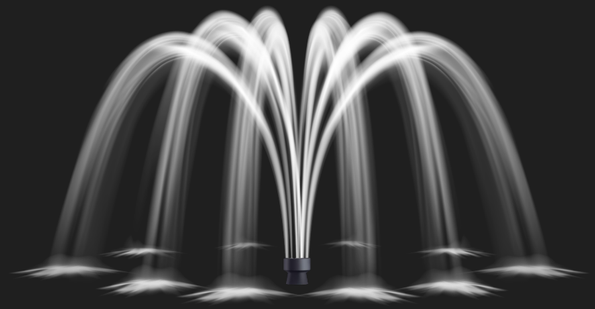
Forge Garden: Water Feature

Elements that are needed



Decoratives

Aesthetics



Water Feature & Catchment System

Core of Our Project

Some source of renewable energy

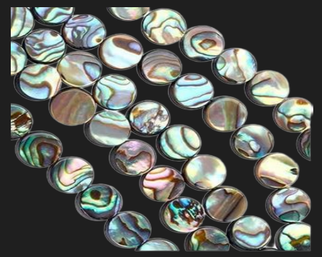
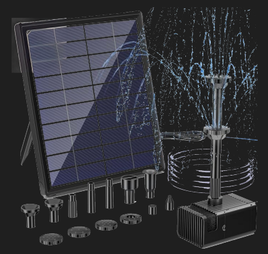
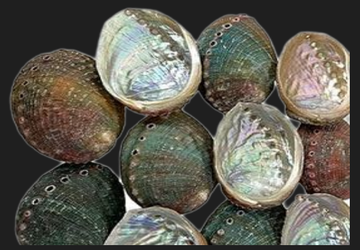
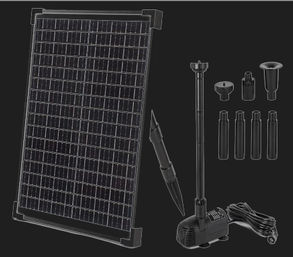
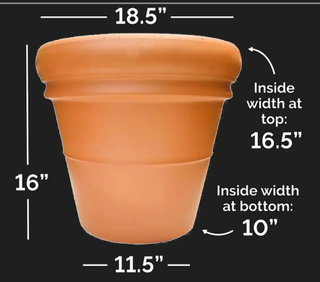
Additional Benefit

Plant Bed (provided)
What we are working with
18 in x 8 ft x 16 in

[1] [2] [3] [4] [5]

Research : Cost Analysis:

Forge Garden: Water Feature

Abalone Shell	Water Pump	Terracotta Pot
 $15.99 +Cheap +More reflections +More coverage	 $25.99 6 W, 80 GPH +3000 mAh Battery +Cheap	 $29.97 19.5” x 17” +cheaper
 $28.99 +Full shells -Pricy	 $64.99 25W, 410 GPH +Sound will be loud - No reserve battery	 $29.97 17” x 14.5” +cheaper
 $17.97 +Many Shells -Less like abalone -Less shiny	 $83.99 25W, 410GPH -No battery provided	 $39.97 18.5” x 16” Good dimensions - Low stock

Source: Hyperlinks linked to images

Research : Flow Calculation

For pipe of diameter of 0.50”
height of 0.61 m
80 GPH -> 0.64 m/s
180 GPH -> 1.47 m/s
200 GPH -> 1.63 m/s
410 GPH -> 3.35 m/s

For pipe of diameter of 1.00”
height of 0.61 m
80 GPH -> 0.11 m/s
180 GPH -> 0.35 m/s
200 GPH -> 0.40 m/s
410 GPH -> 0.84 m/s

Tap water has average speed of 1.5 m/s.
Source, adjustments will be made throughout the process and we will recalculate when needed

Flow Rate Calculation

$r = 0.25[in] \rightarrow 0.64\ [cm] \rightarrow 0.0064\ [m]$

$Q = \frac{V}{t}$ Volumetric flow rate equation

$A = \pi r^2 = \pi(0.0064)^2$

Pump claims to pump 410 GPH

Let X be my volumetric flow rate (in GPH)

$$\frac{X[G]}{1[H]} \cdot \frac{1\ [m^3/s]}{951022\ [g/h]} = \frac{X}{951022}\left[\frac{m^3}{s}\right]$$

$$\frac{X}{951022}\left[\frac{m^3}{s}\right] = \frac{V}{t} = \frac{A \cdot d}{t} = V$$

$$\frac{X}{951022}\left[\frac{m^3}{s}\right] = A \cdot V$$

$$V_0 = \frac{X}{951022 \cdot A}\ [m/s]$$

$$\frac{gal}{hours} = \frac{1\ gal}{3600\ seconds}$$

*note $1\ gal = 0.00378541\ m^3$

$$\frac{1\ gal}{3600\ s} \cdot \frac{0.00378541\ m^3}{1\ gal} = \frac{0.00378541\ m^3}{3600\ s}$$

Take inverse of constants to find $1\ m^3/s$

$$\frac{1\ g}{1\ h} = \frac{0.0037854\ m^3}{3600\ s}$$

$$\frac{3600\ g}{0.0037854\ h} = \frac{m^3}{s}$$

$$1\ \frac{m^3}{s} = 951022\ g/h$$

Bernoulli's equation

$$P_1 + \frac{1}{2}\rho V_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho V_2^2 + \rho g h_2$$

Pressures are same atmos, no ext

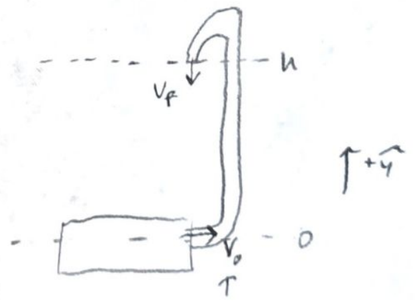
$$\frac{1}{2}\rho_{H_2O} V_1^2 + \rho_{H_2O} g h_1 = \frac{1}{2}\rho_{H_2O} V_2^2 + \rho_{air} g h_2$$

($h_1 = 0$)

$$\frac{1}{2}V_0^2 = \frac{1}{2}V_f^2 + \frac{\rho_{air}}{\rho_{H_2O}} g h$$

$$V_f = \sqrt{V_0^2 - 2\frac{\rho_{air}}{\rho_{H_2O}} g h}$$

$$V_f = \sqrt{\left(\frac{X}{951022 \cdot A}\right)^2 - 2\frac{\rho_{air}}{\rho_{H_2O}} g h}$$



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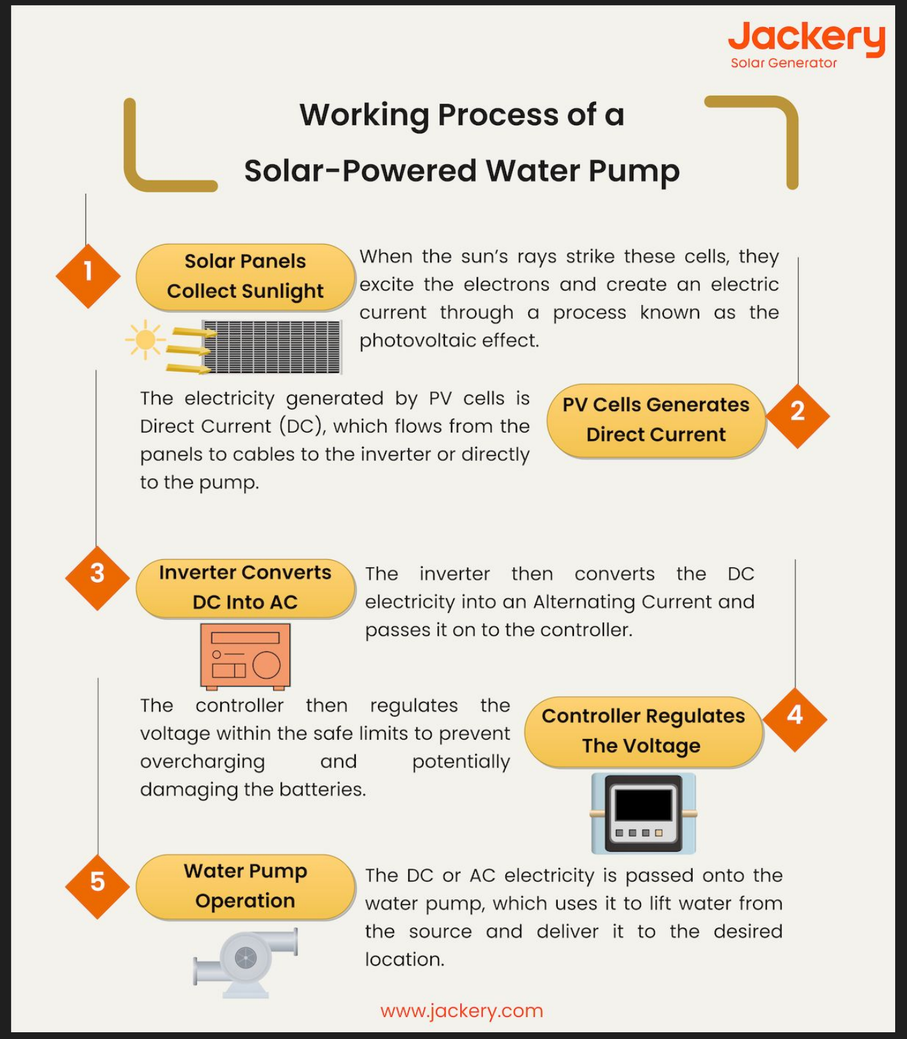
Research: Solar Pump

Battery Capacity in Wh x Battery Efficiency / Wattage = Total Time

Runtime Calculation will differ for each pump We will consider the efficiency, and power factor of the battery while selecting our parts.

The resulting calculation would differ based on the parts we choose. So we will compute to verify the power once we start purchasing to our specific needs.



Source

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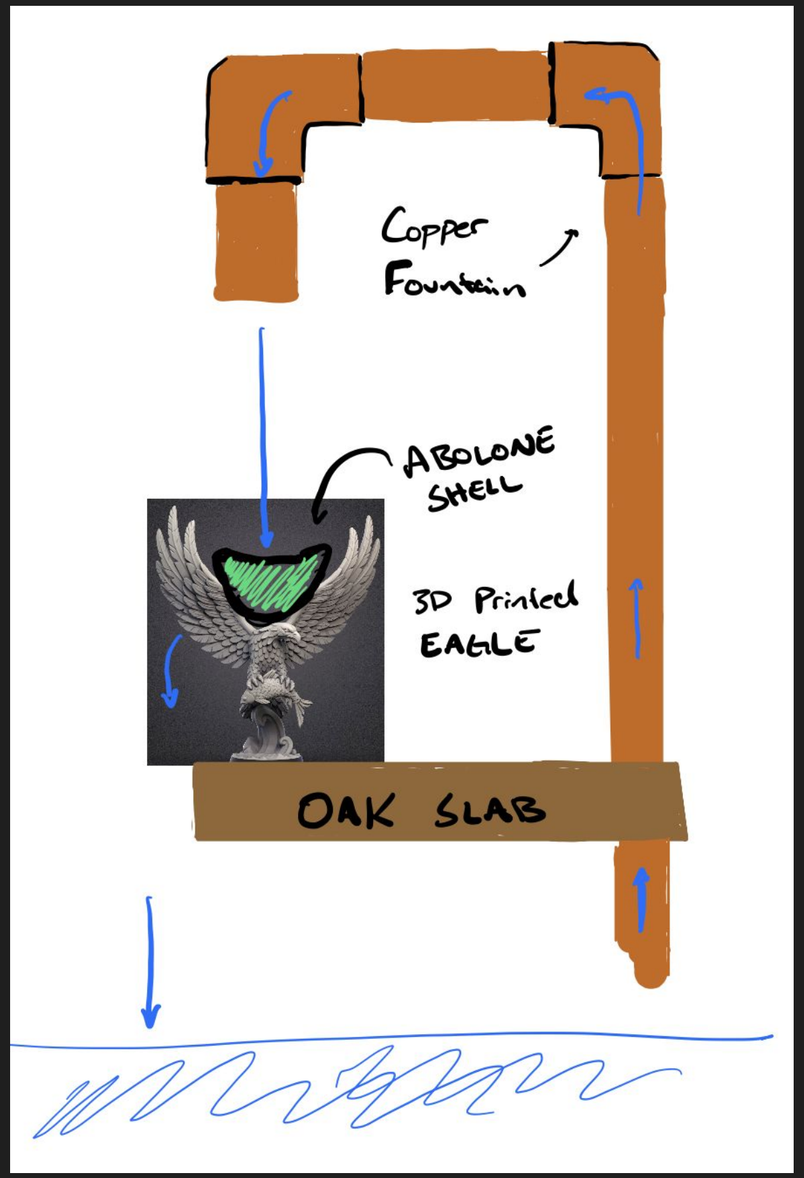
Research: Water Feature Pipe and Platform



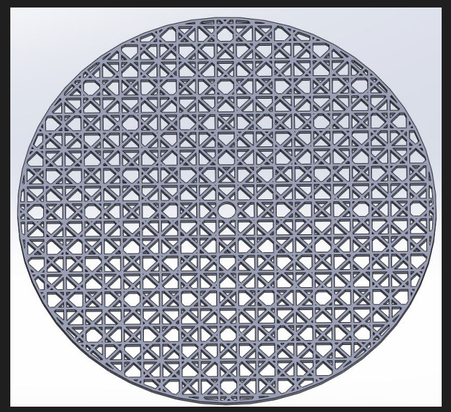
-Main pipe feature constructed from copper pipes

- 2x Soldered 90° joints
- 1x Soldered platform for slab

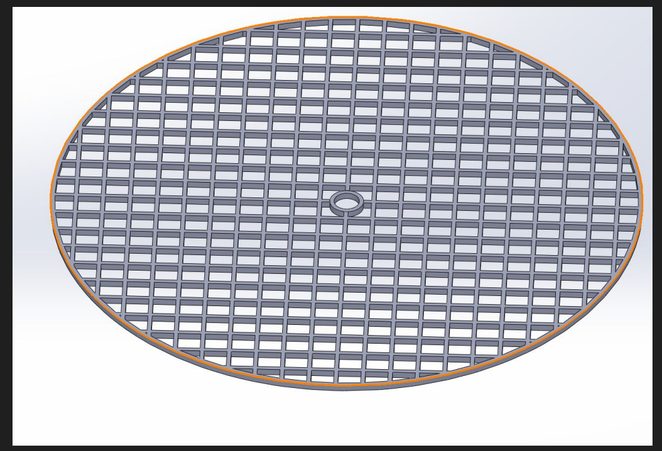
Platform created from sealed oak slab for cultural representation

3D printed eagle holding abalone shell for further cultural representation

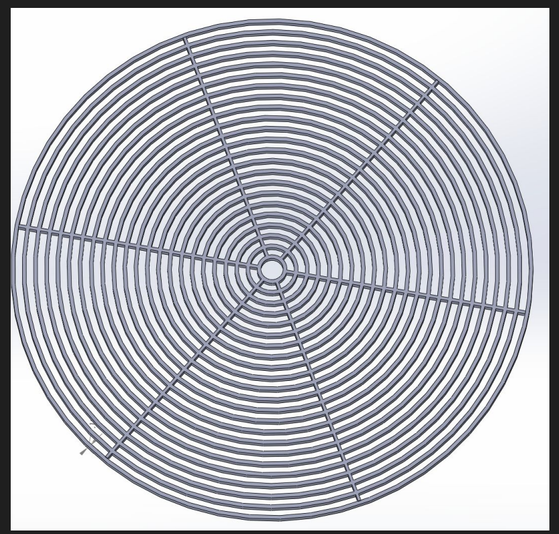
Design: Grate

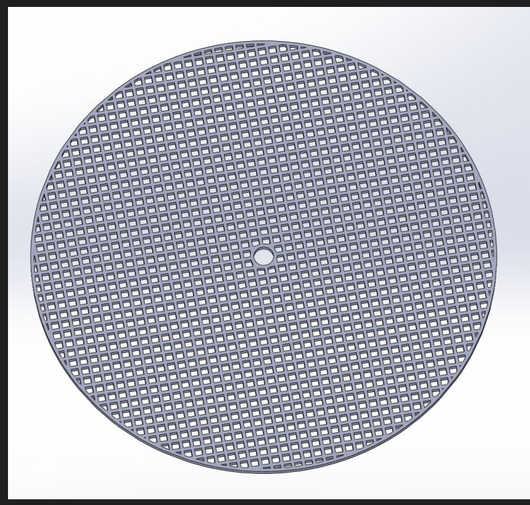


Why the grate?
Will keep large objects and debris from obstructing the pump.



What did we make?
-Multiple designs possible, created 4 designs for testing. We will be flow testing them to see which has the least obstructed flow.





Source: Erick Lopez

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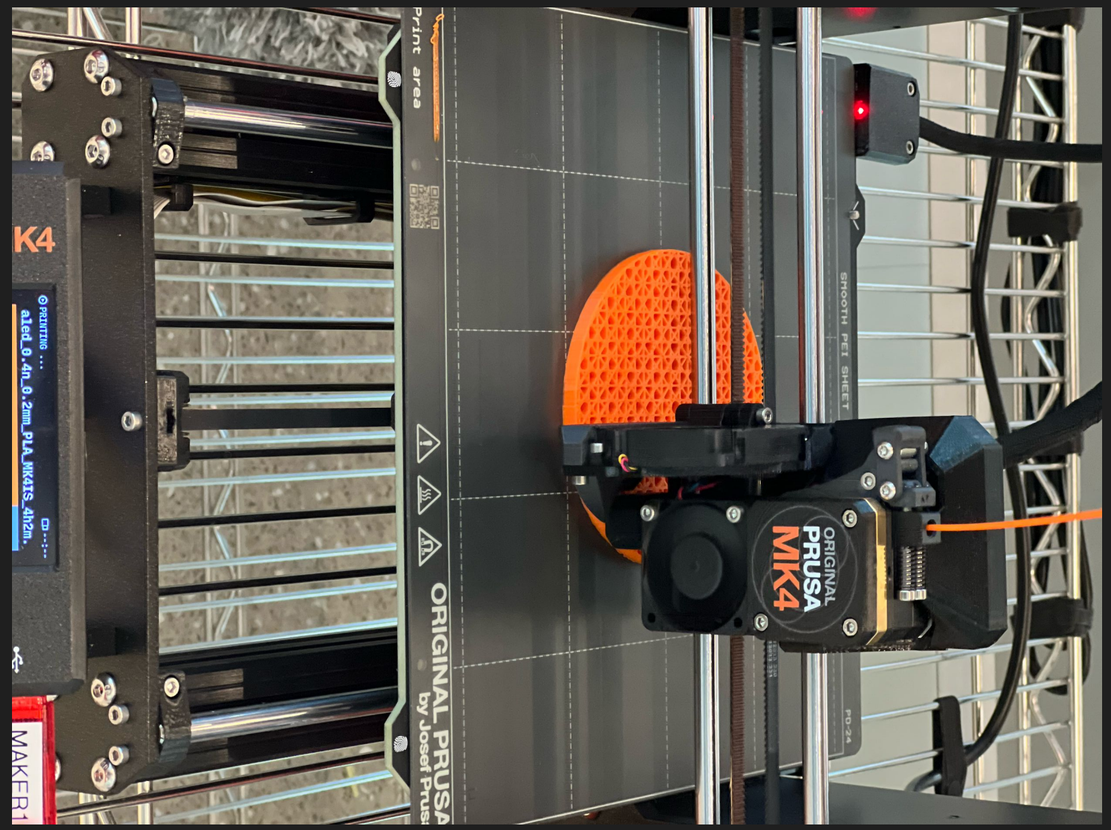
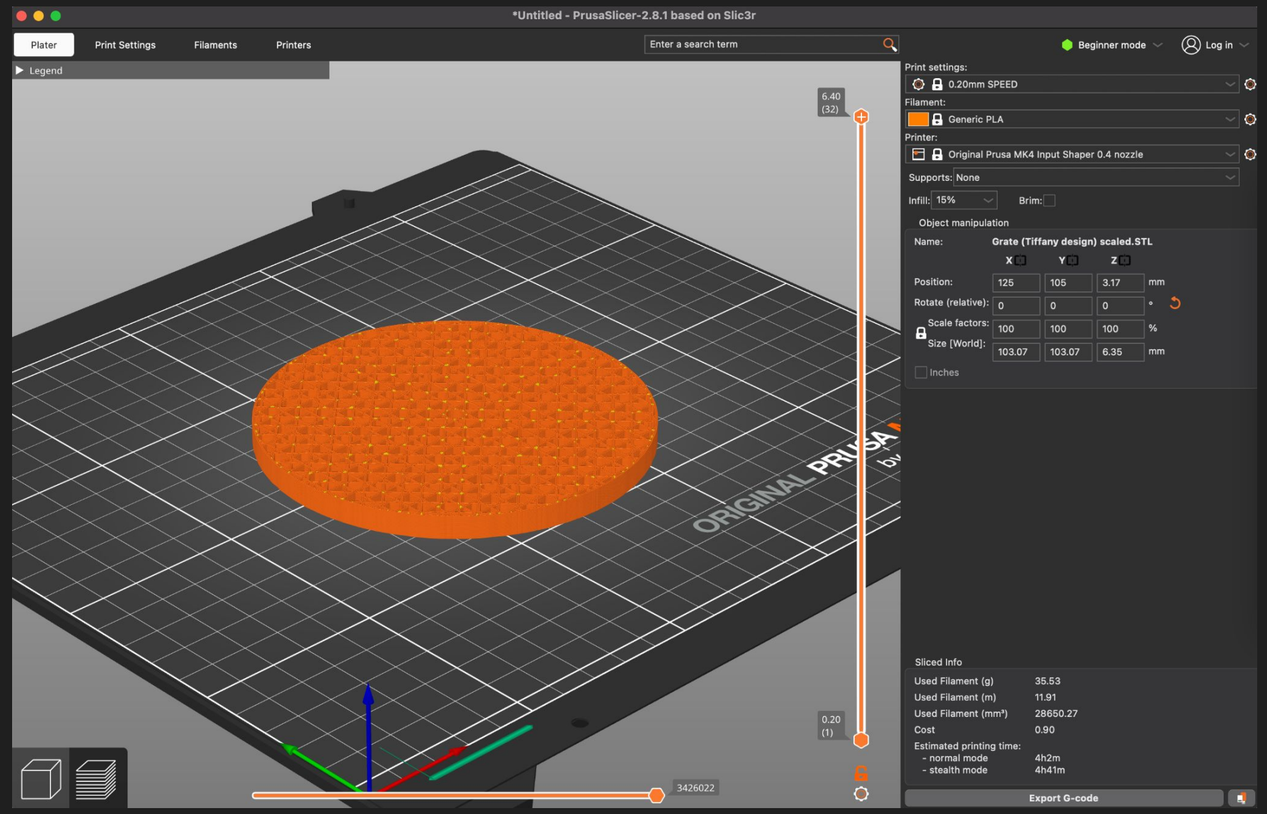
Design: 3D Printed Grates





Source: Tiffany Doan

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Design: 3D Printed Prototype

Printed a smaller scale pot, with space for the grate inserts. Chose not to make the grates larger to use less material.

Experiment to test the time it takes for water to pass through each grate design.

Source: Tiffany Doan

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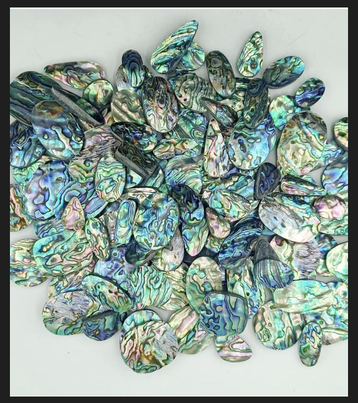
Updated Design

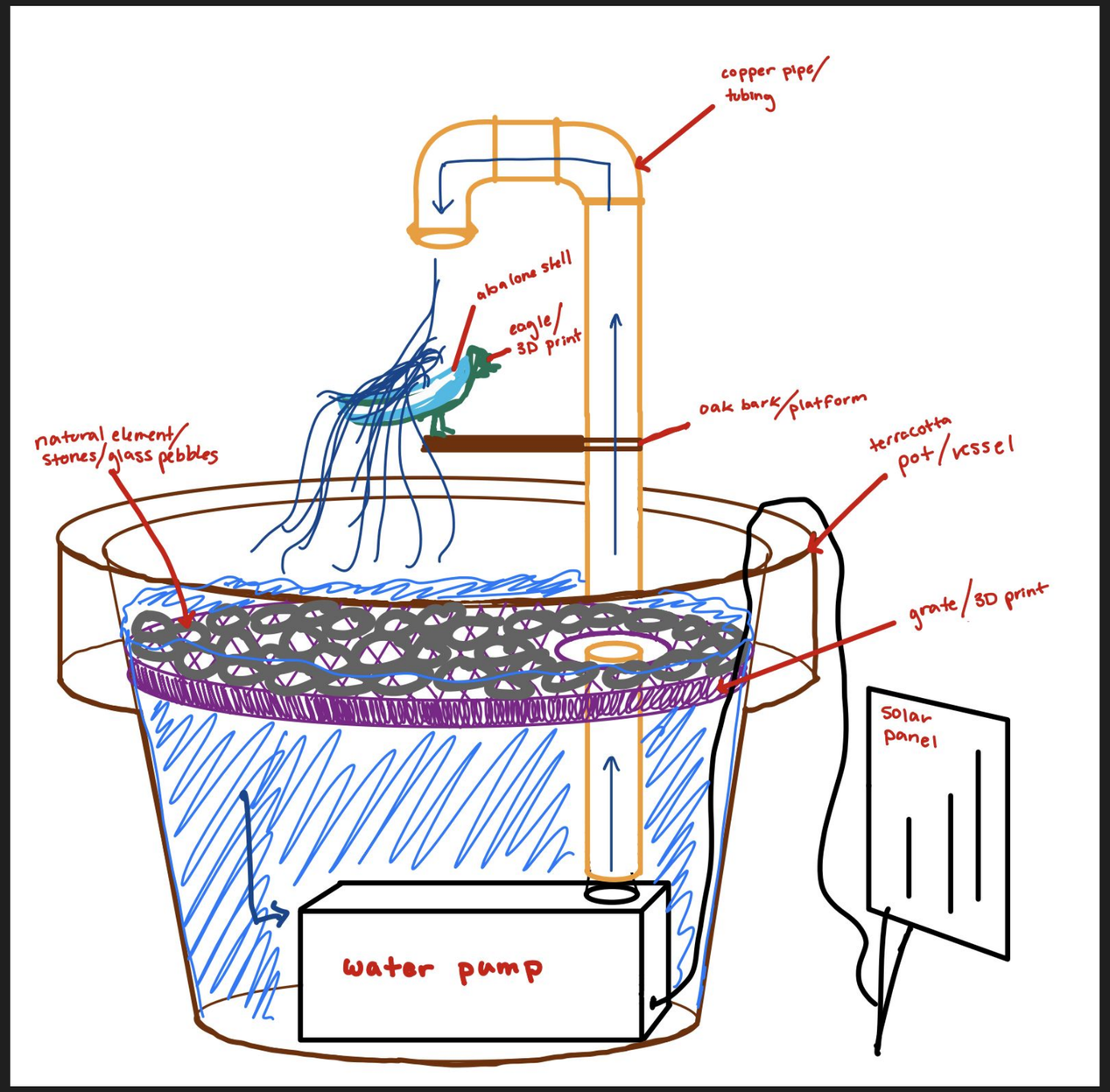
Adjustments after meeting with Becca:

+Including rocks/stones atop grate



+Faucet Attachment

- Current idea is a 3D printed eagle with an abalone shell along its wings/back standing on a wooden platform.



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Remaining steps

- ❑ Finalize Design
  - ❑ Expected within the next week
- ❑ Purchase materials
  - ❑ Expected shortly after we receive approval for design
- ❑ Testing
  - ❑ Water grates
  - ❑ Water pump
  - ❑ Maintenance Procedures
  - ❑ Sound Testing

    Expected when parts arrive (1-2 weeks)

Challenges

- Communication
  - Want to ensure we are culturally considerate with our design
  - Can’t move forward without definite approval
- Testing
  - Unable to test pump until design is final
  - Unable to test solar cell until parts arrive
- Production
  - Grates when scaled up will need to be printed in multiple interlocking pieces

Thank you for enduring this presentation!

Feel free to ask us questions!