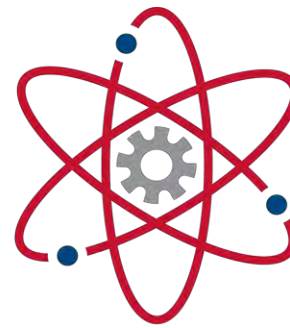


# Lunar Bamboo Greenhouse NASA Hunch project

Members: Aden Vance, Matthew Schmidt,  
Ranen Mihandoost

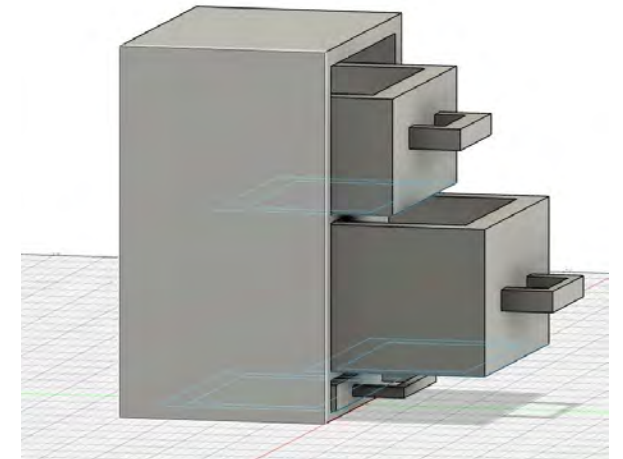
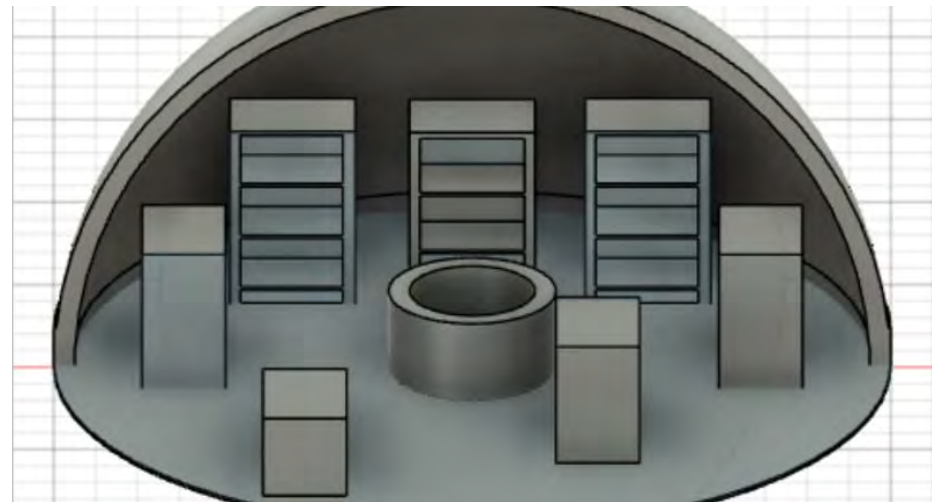
Teachers: James Mantooth, Debbie Short



PROJECT LEAD THE WAY  
**PLTW**



The Lunar Bamboo Greenhouse Project consists of creating a greenhouse on the moon that will be connected to the lunar base, which will provide fresh fruits and vegetables for the astronauts to eat. The bamboo will take in carbon dioxide from inside the greenhouse and will also provide fresh oxygen for the lunar base.



## ABOUT OUR DESIGN

Our greenhouse was designed with ease of use and functionality in mind. It provides airflow to the other modules while also removing vast amounts of carbon using the *Phyllostachys edulis* bamboo specifically chosen for this. It provides the astronauts with a spacious environment to lounge around and escape from the vast emptiness of space while also providing them with different vegetables to eat and bamboo to build with.

## MEET THE TEAM



### Team Members

Tajwar Ornob, Eyamin Rahman, Dev Rana

260413@pcti.mobi

271658@pcti.mobi

260777@pcti.mobi

Passaic County Technical Institute  
45 Reinhardt Rd, Wayne, NJ 07470

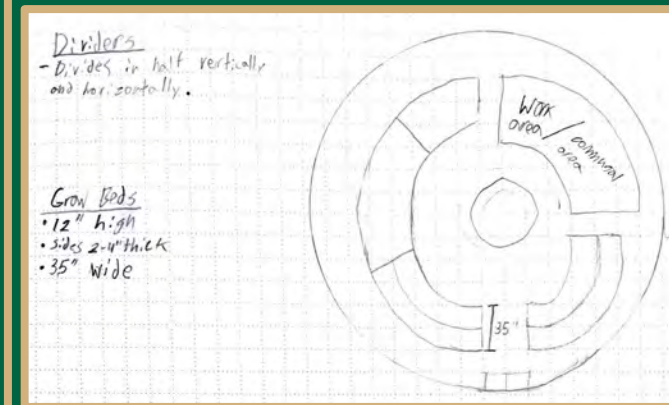
Ms. Mujovic, Mr. Sloane

smujovic@pctvs.org

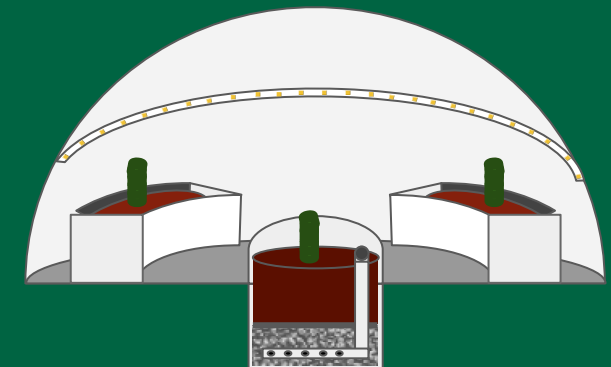
jsloane@pctvs.org



## LUNAR GREENHOUSE



Floor Plan



# SCORING RUBRIC

# WHY US?



## Innovative Lighting System

Lighting will be set up on the ceiling and walls for more coverage of the area. Lighting can also be placed on or around grow-beds for certain situations. The colors blue and red provide stimulus for optimized bamboo growth.

## Escape From Space

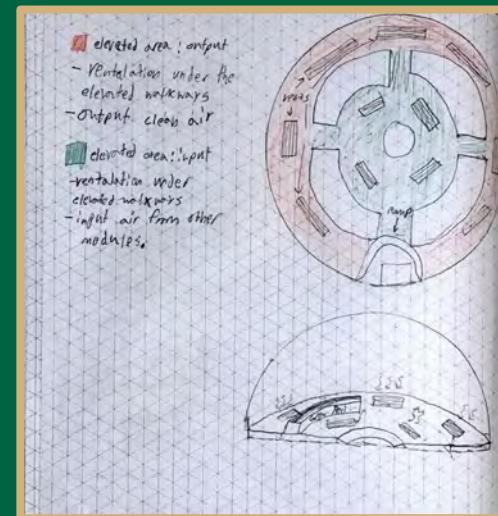
In addition to maximizing bamboo growth, we also provide an option to customize lighting to something fitting for inhabitants needs.

## Fresh Produce

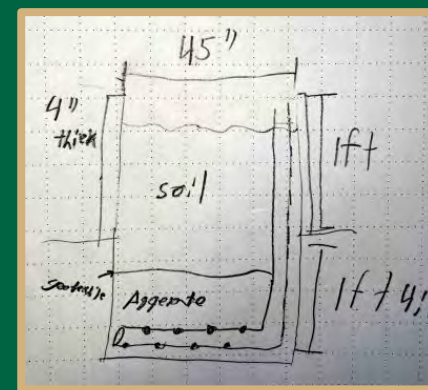
In addition to growing bamboo, grow-beds can be divided to grow smaller vegetables such as potatoes, tomatoes, and types of berries.

## Filtration

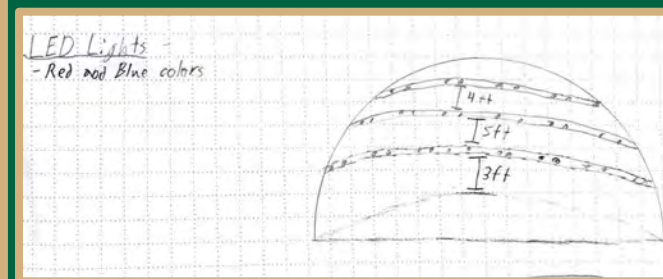
The filtration system implemented will be similar to a wicking bed. Where water will evaporate at the bottom, moisturizing from the bottom up.



Ventilation System

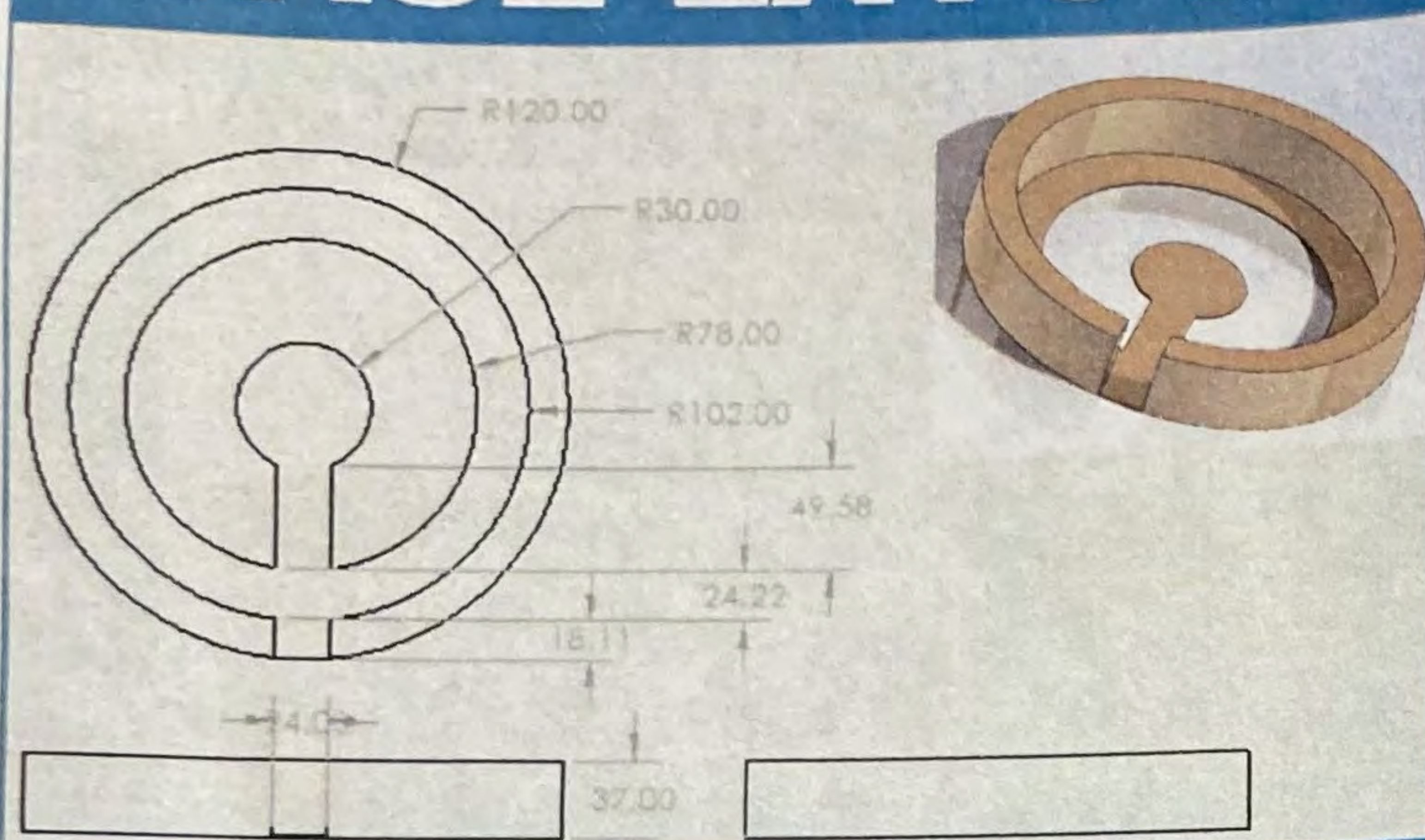


Filtration System



Lighting System

# BASE LAYOUT

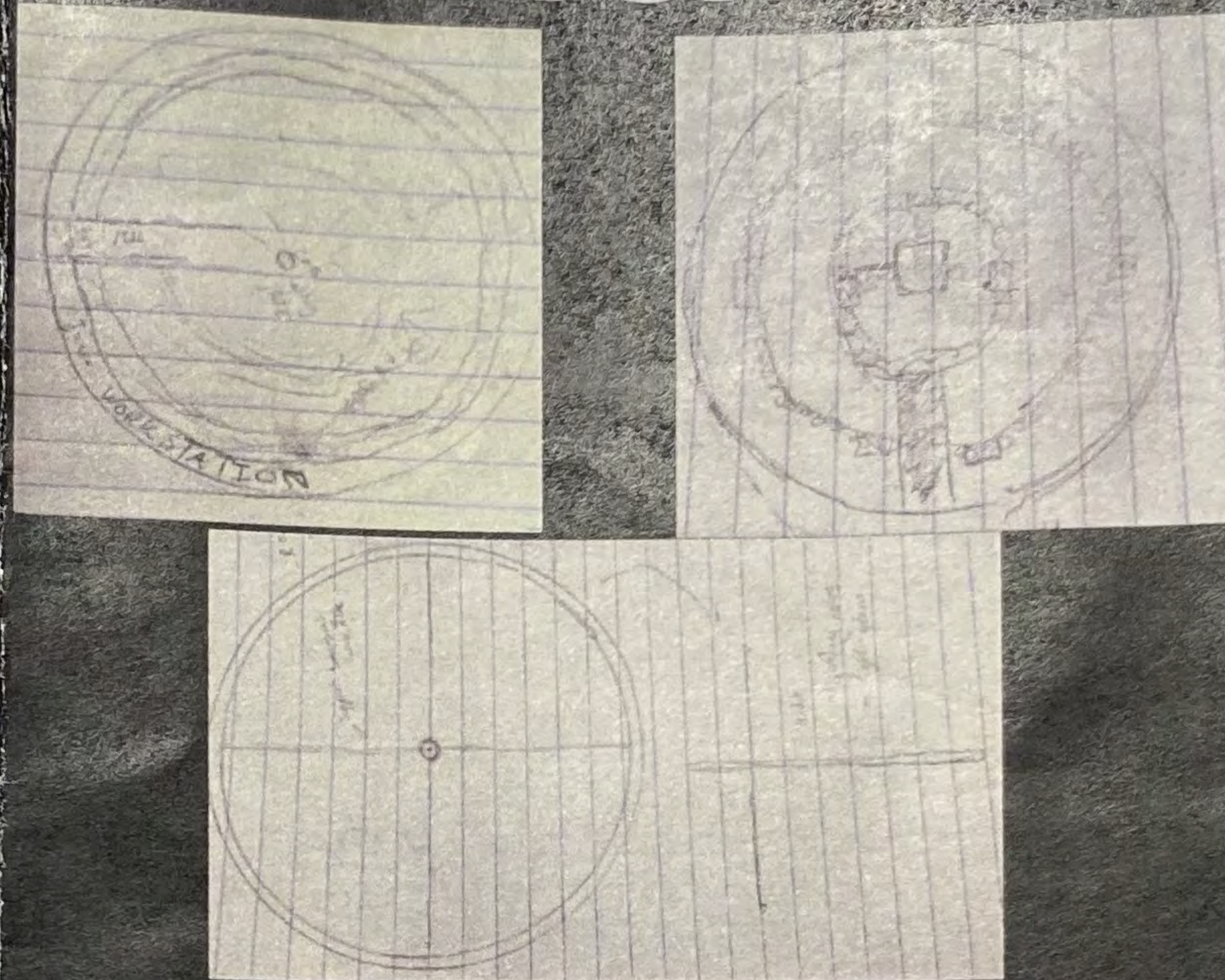


- Circle growing chamber
- Center HVAC system
- No wasted space

# MATERIALS

Material	Weight
Bamboo Seeds	0.02 lbs
Potato Sack	N/A
Wick Cord	N/A
LED light strips	1.2lbs
HDPE plastic	.0415 lbs/in <sup>3</sup>

# SKETCHING



Green Mountain High School,  
Mrs. Flores

Luke Quinn:

[2095972@jeffcoschools.us](mailto:2095972@jeffcoschools.us)

Preston Tateyama:

[2095470@jeffcoschools.us](mailto:2095470@jeffcoschools.us)

Lathyn Myers:

[2060858@jeffcoschools.us](mailto:2060858@jeffcoschools.us)



Our Website

# Lunar Bamboo Greenhouse

By: Luke Quinn, Preston  
Tateyama, Lathyn Myers



# SCALE MODEL



# TESTING



**BLUE LIGHT**  
-APPEARS TO KEEP PLANTS AT OPTIMAL TEMP.

**SUN LIGHT**  
-APPEARS TO DRY OUT PLANTS TOO MUCH, BLUE LIGHT MIGHT BE BETTER

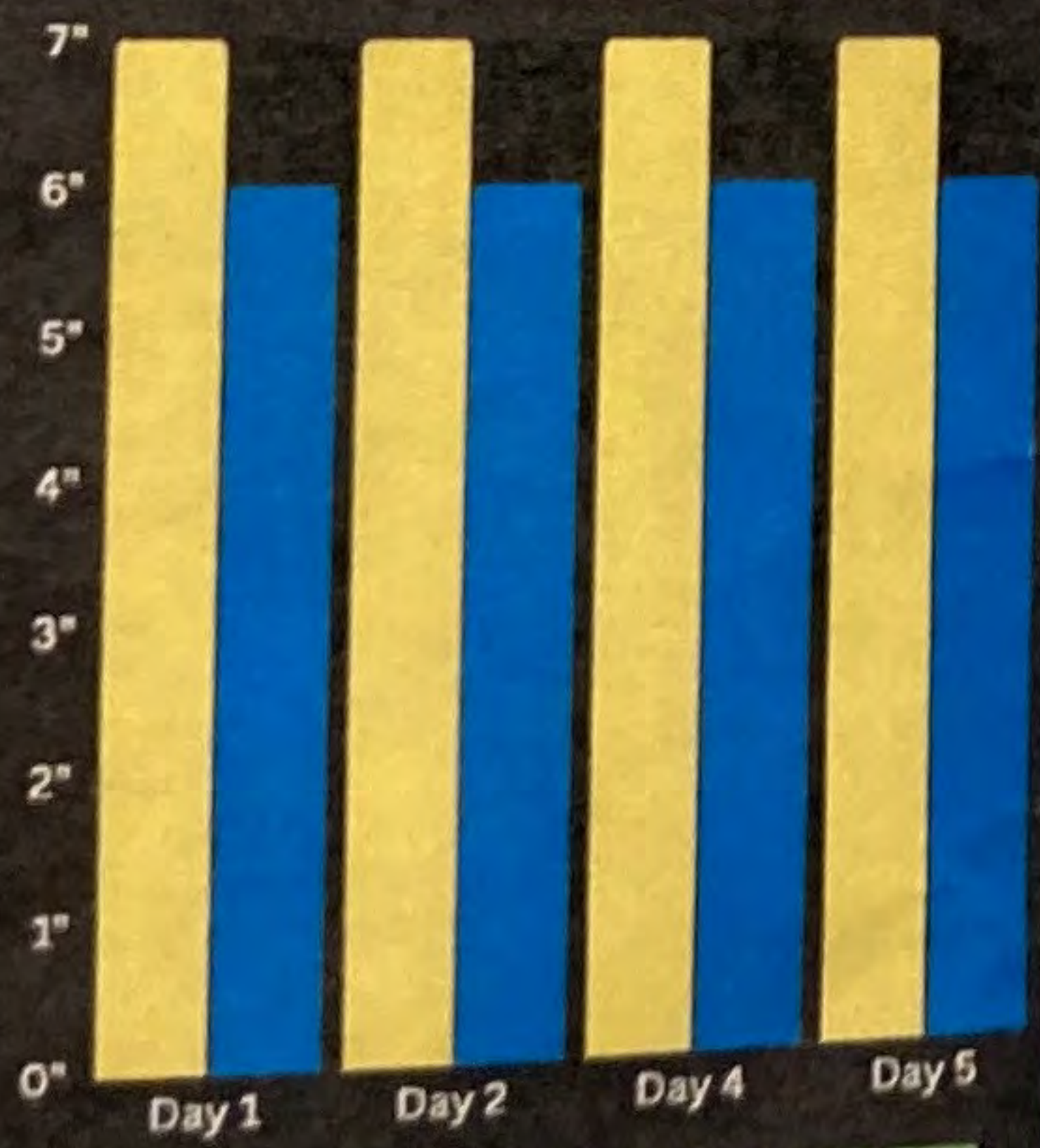


# DATA

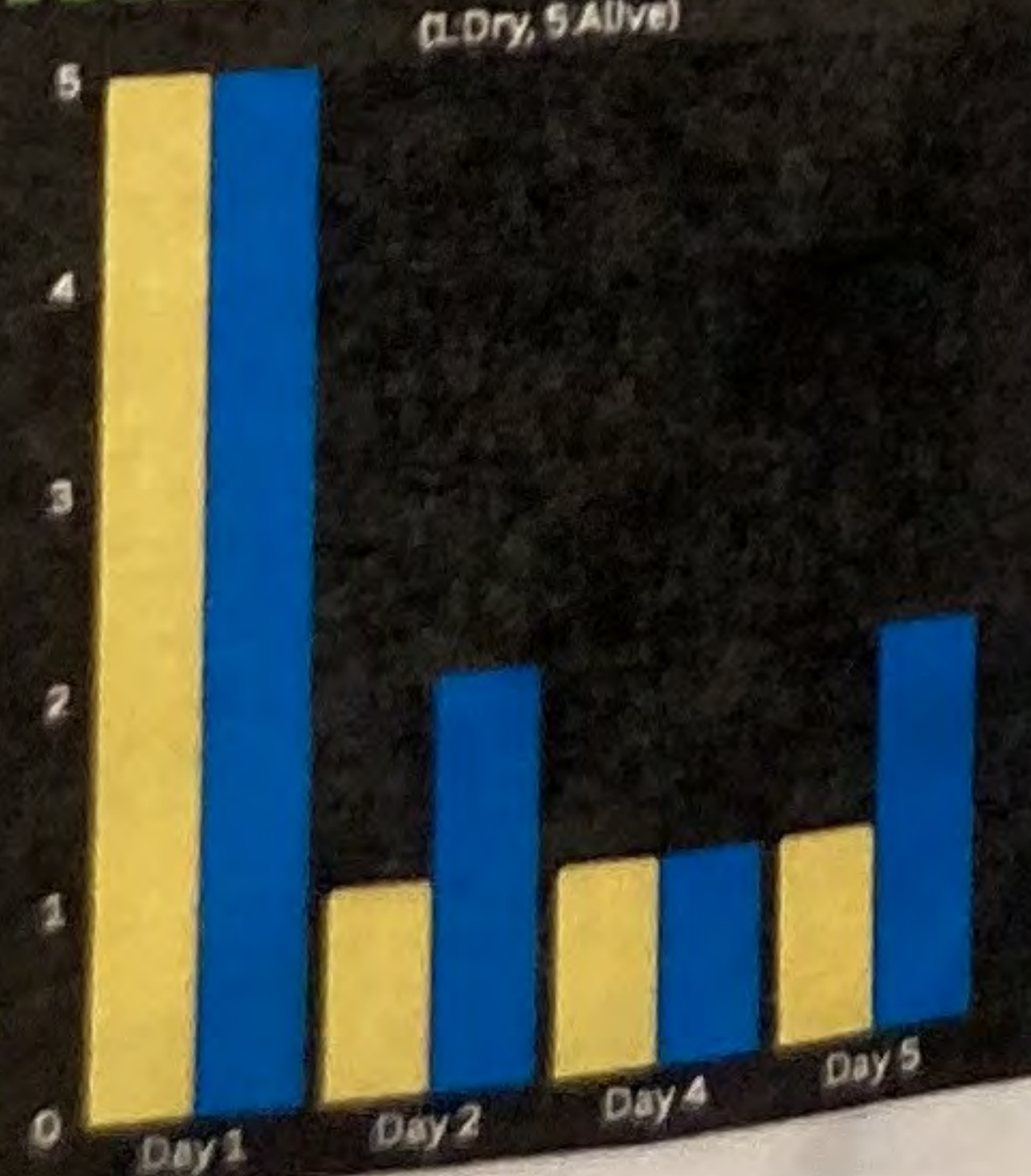
## STATUS OF PLANT



## HEIGHT



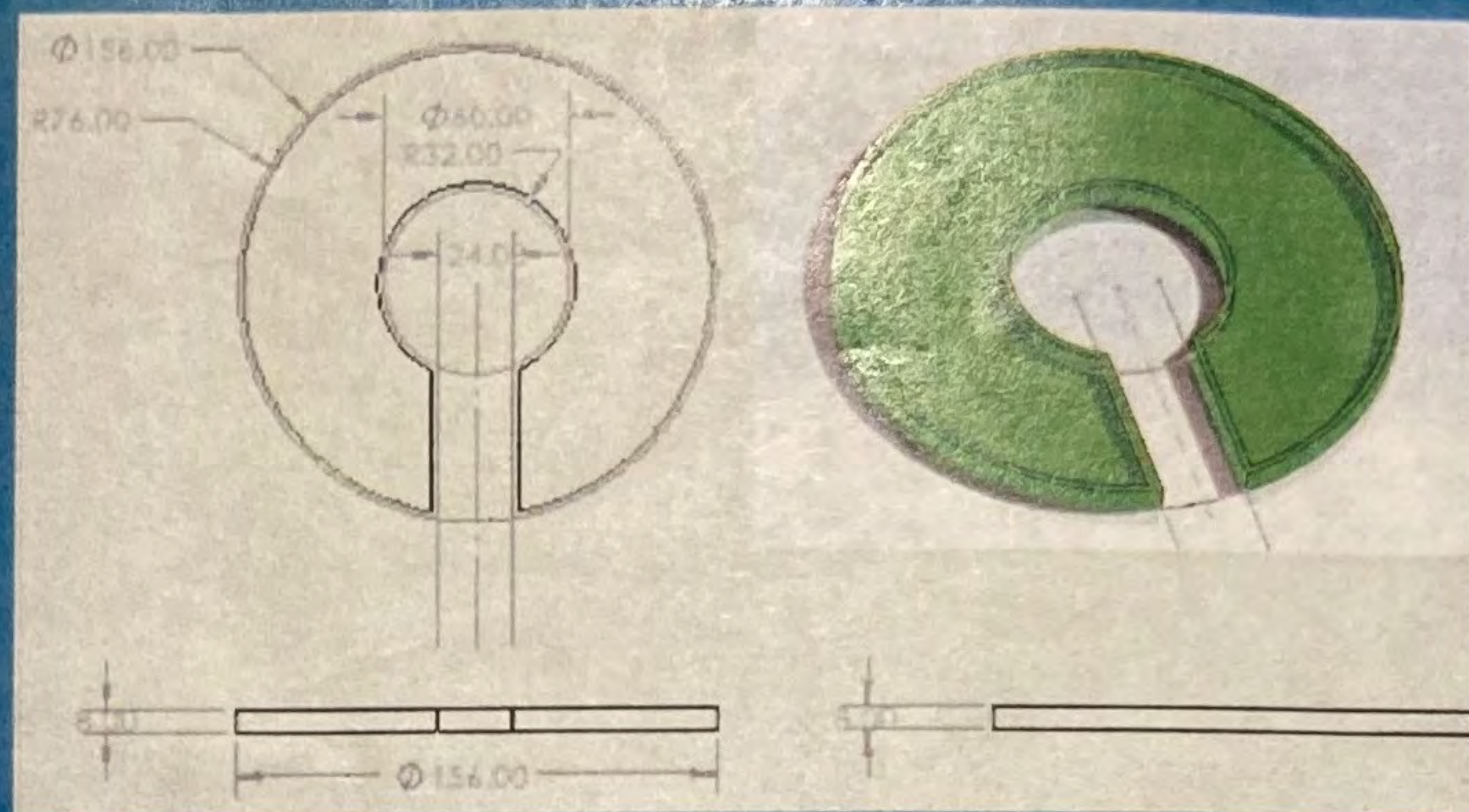
## MOISTNESS



All Data is for Horsetail Regolith #1

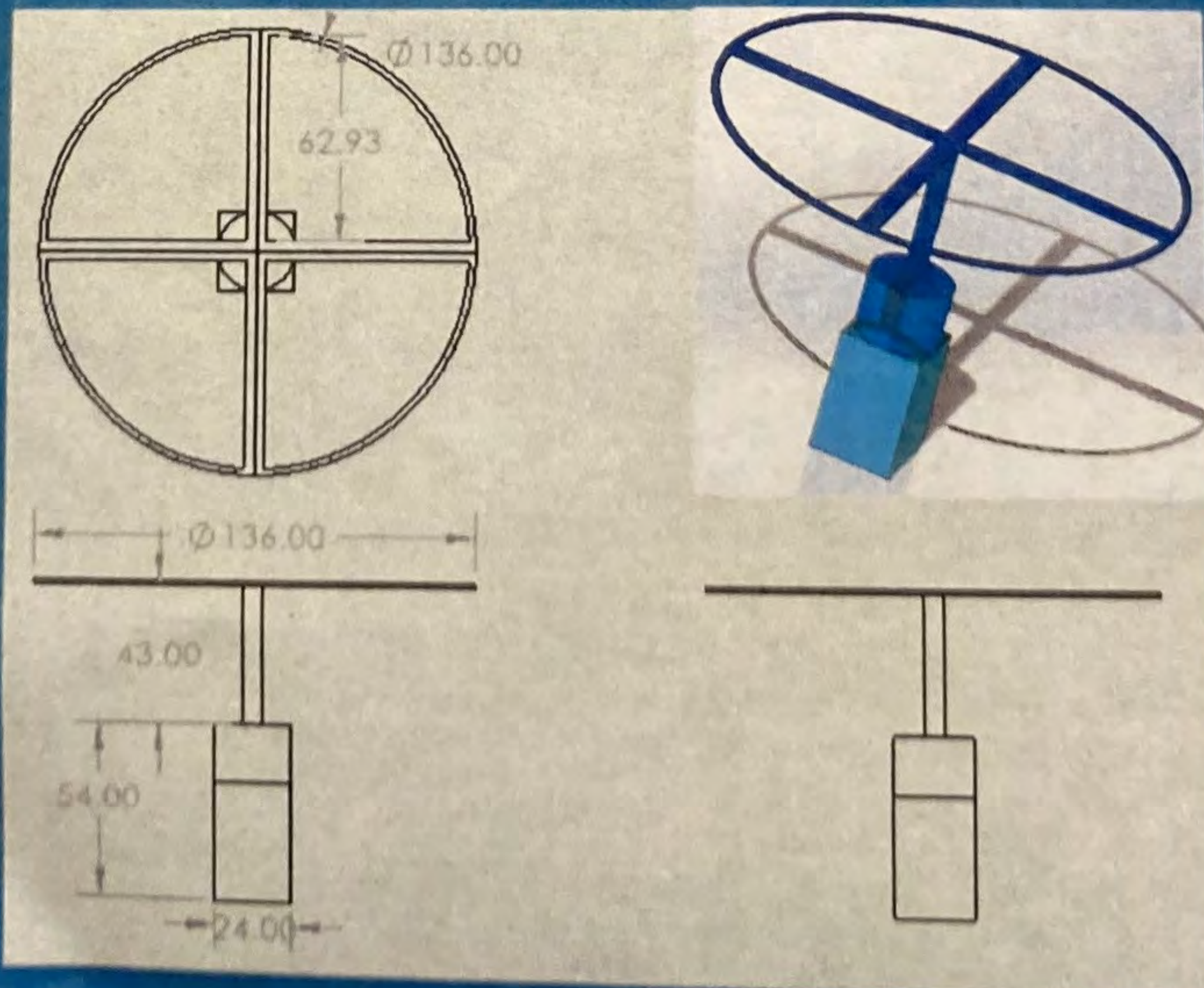
BLUE LIGHT SUN LIGHT

# GROW CHAMBER/ WATERING



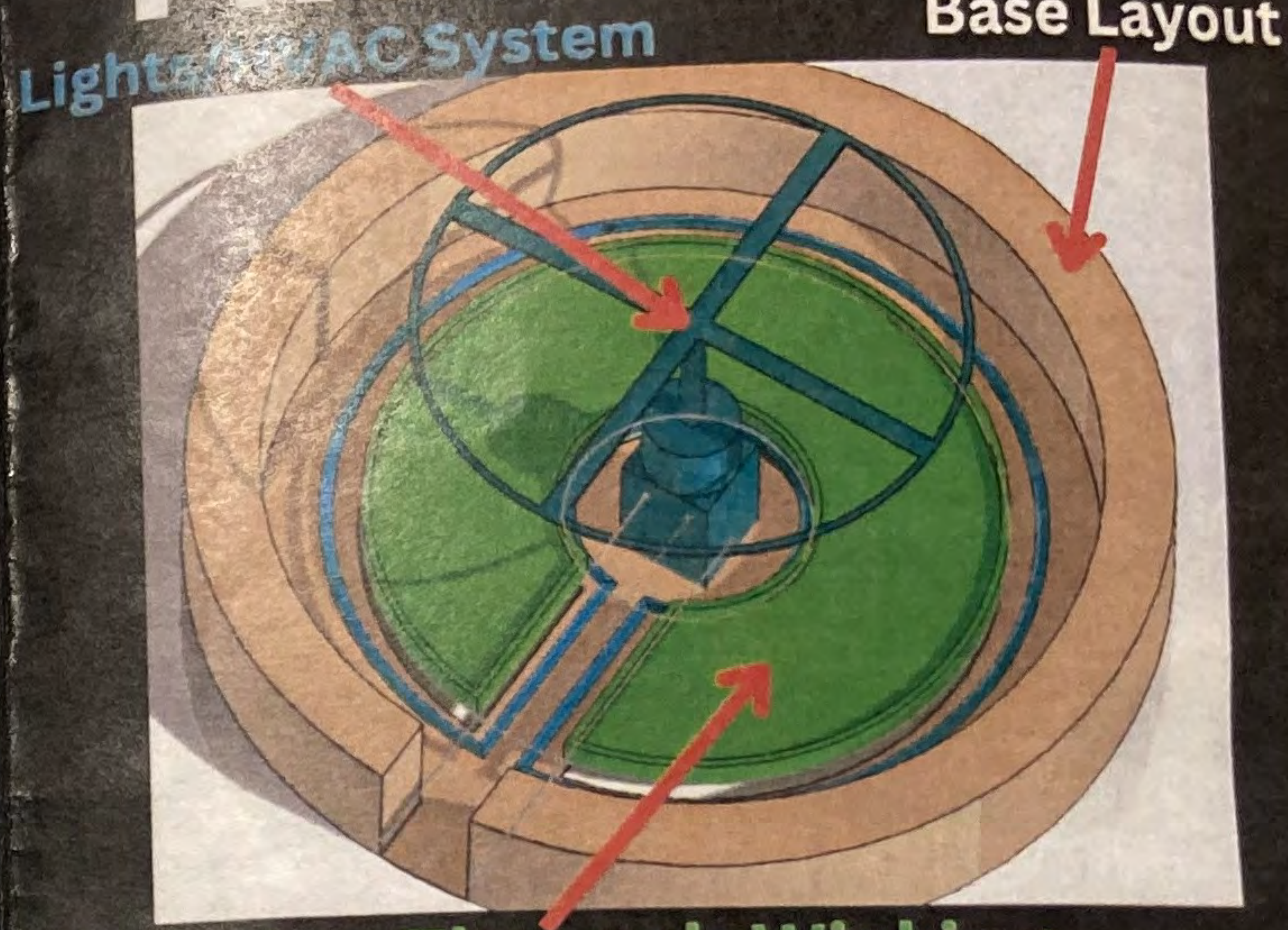
- Watering through wicking
- Indirect, no external energy needed

# LIGHTING/ HVAC



- Overhead blue lights
- HVAC/Dehumidifier, recycles and distributes oxygen through base

# FINAL PROTOTYPE



Watering Through Wicking

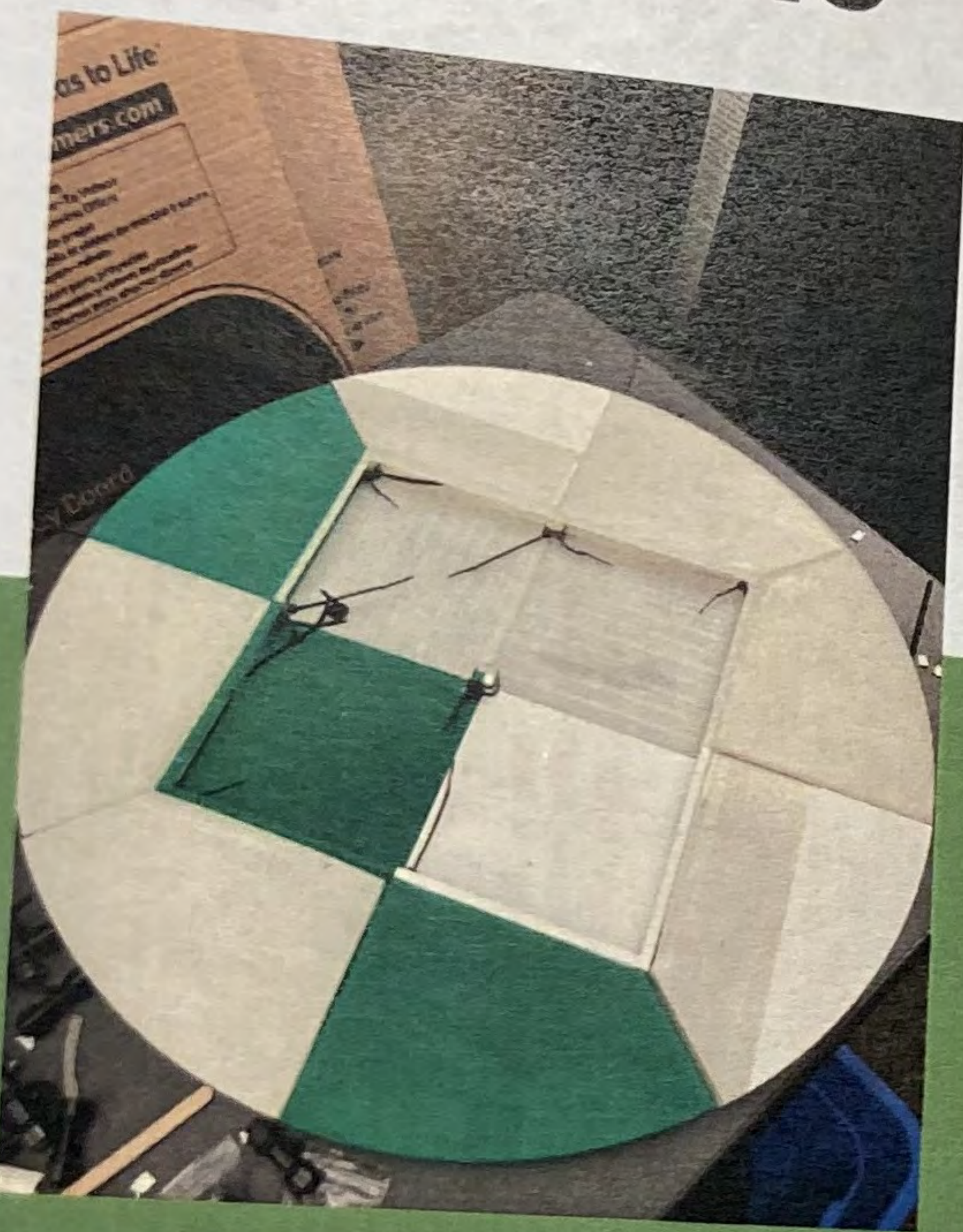
# DESIGN CRITERIA

Demonstrate Bamboo Growth On Moon	Water wicking and lighting systems ✓
Include: Grow Beds, Plumbing, Air Mixture	Entire scale model layout ✓
Grow Bamboo (Now Just Plants)	Horsetail and Dracula Testing ✓
Ensure no damage of bubble base	Maintaining bamboo height ✓

# NEXT STEPS

- Make the growing chamber more modular to allow for more plants
- Make light fixture height adjustable

# CURRENT ITERATIONS



Our initial design was scrapped due to changes in the requirements, so we had to start from scratch, we decided to create a false floor to the habitat/Greenhouse, where everything can fit into place and not have any cables lying around all over the place.

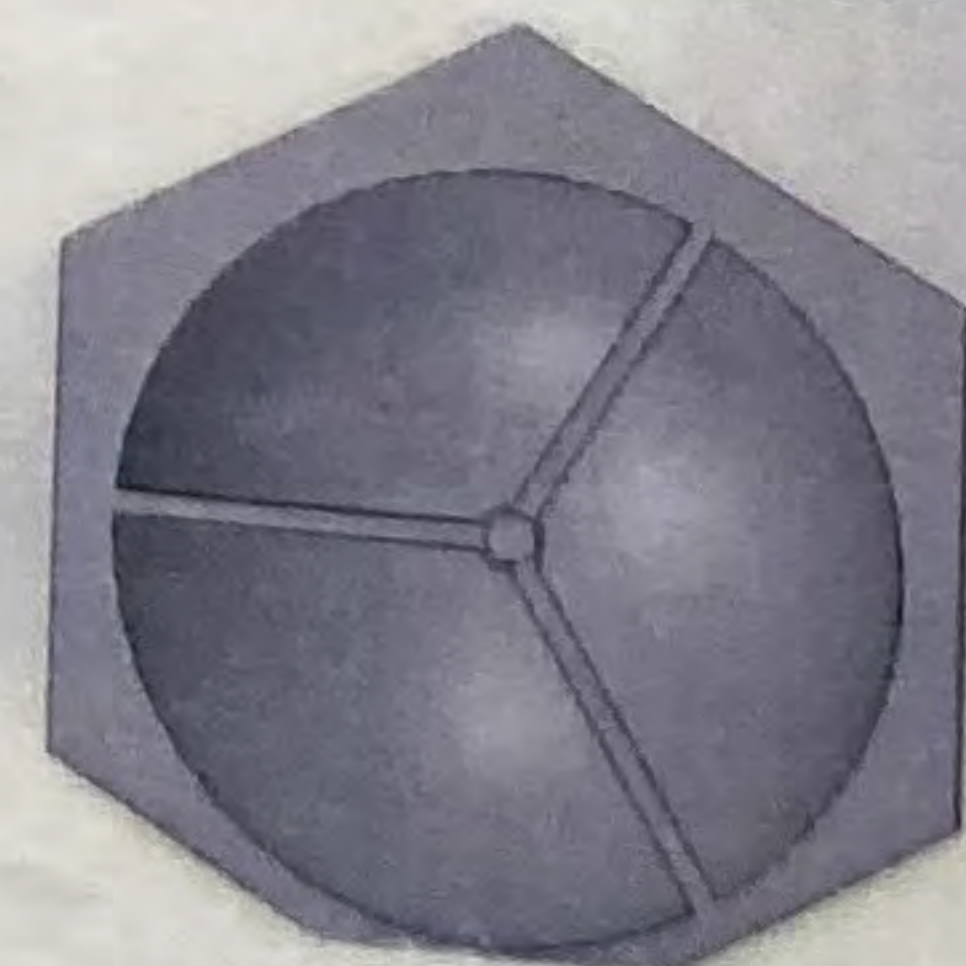
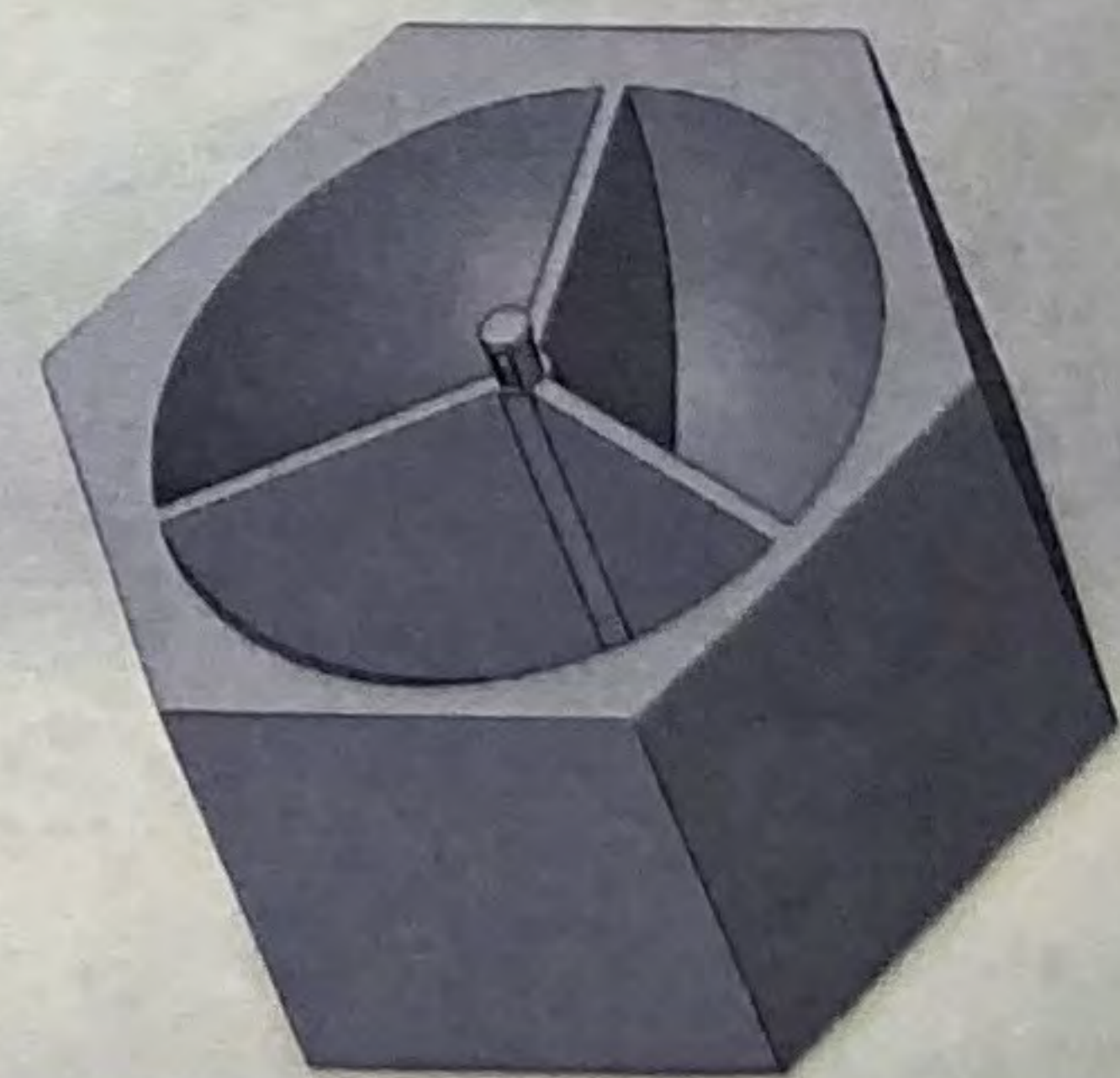
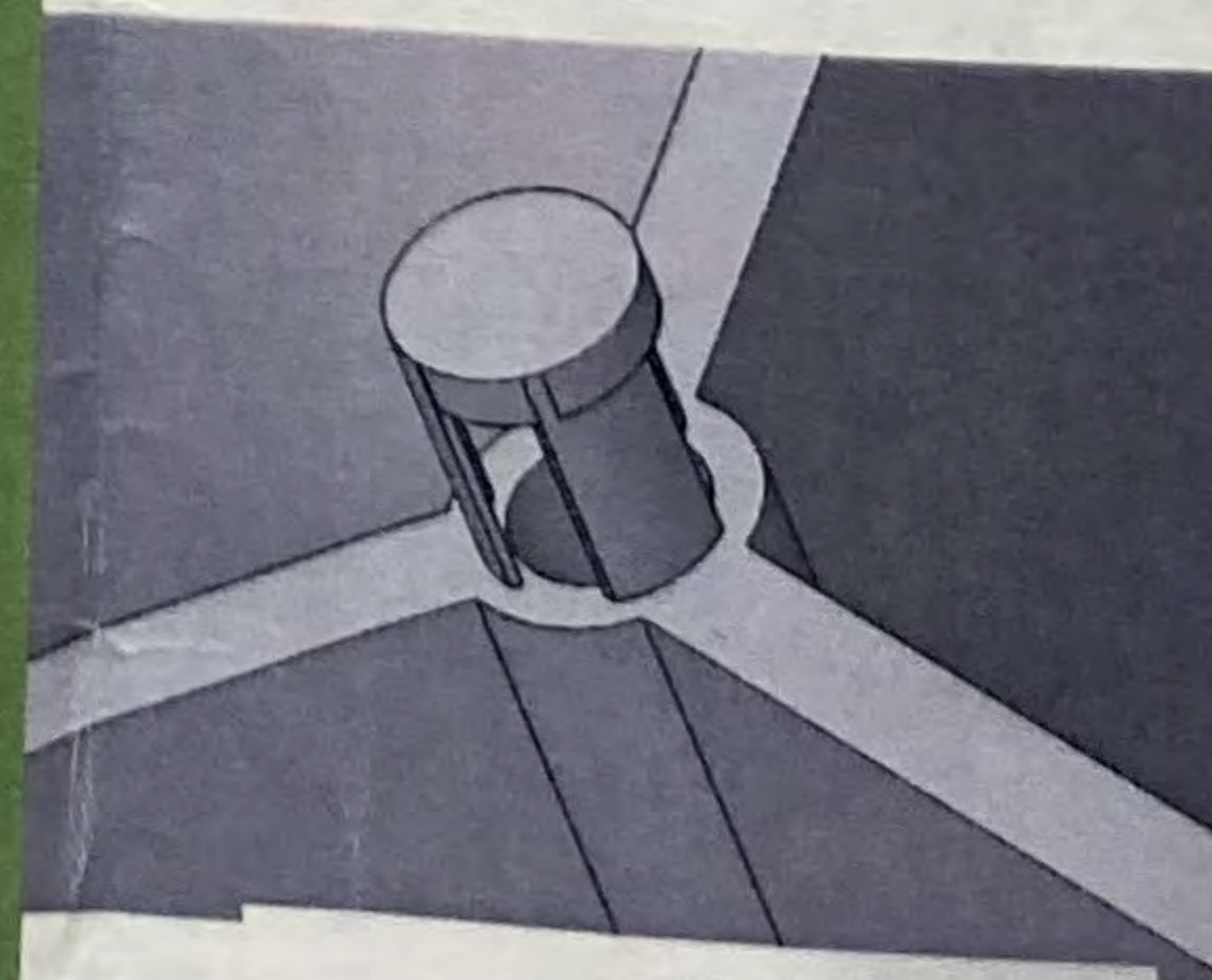
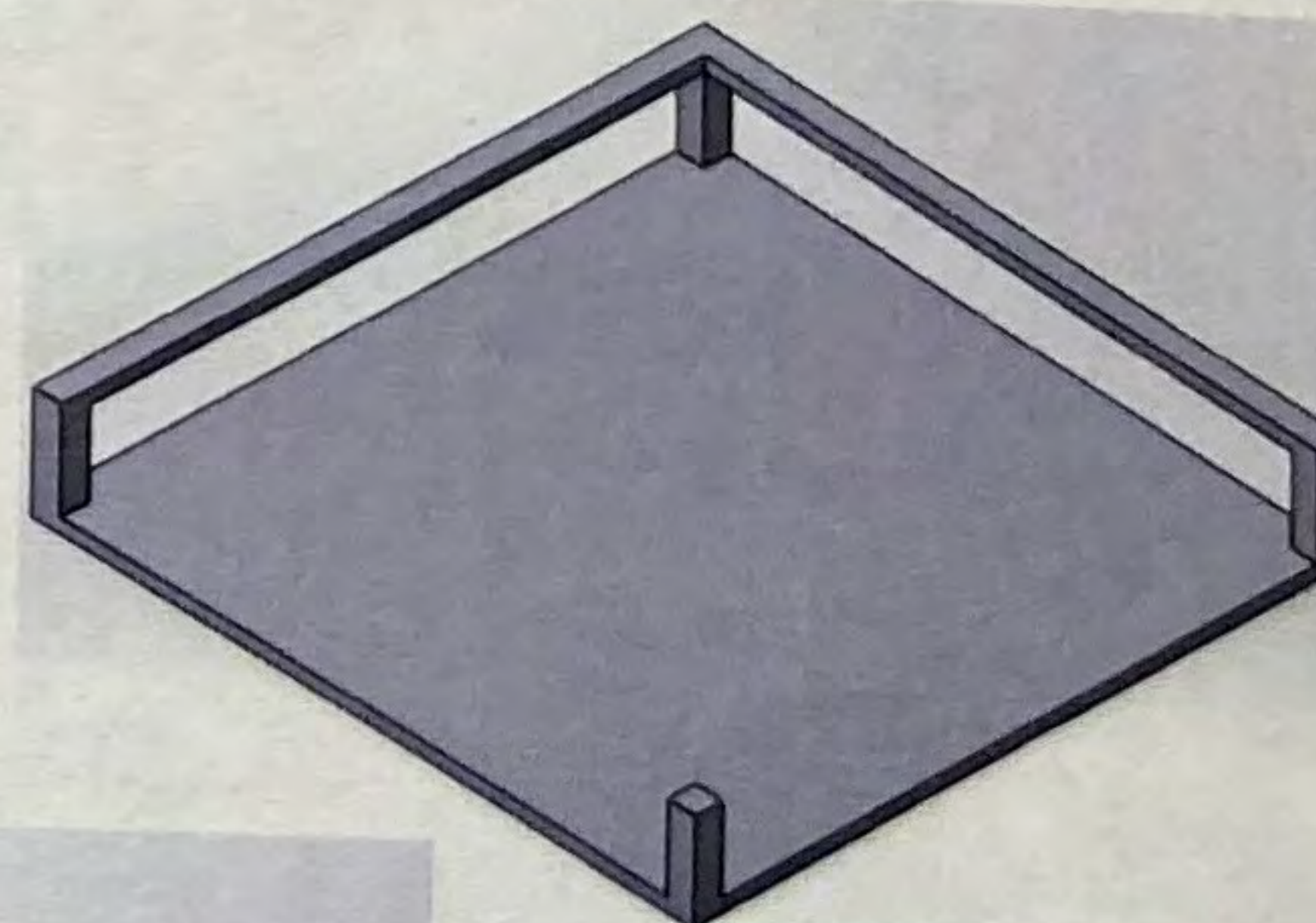
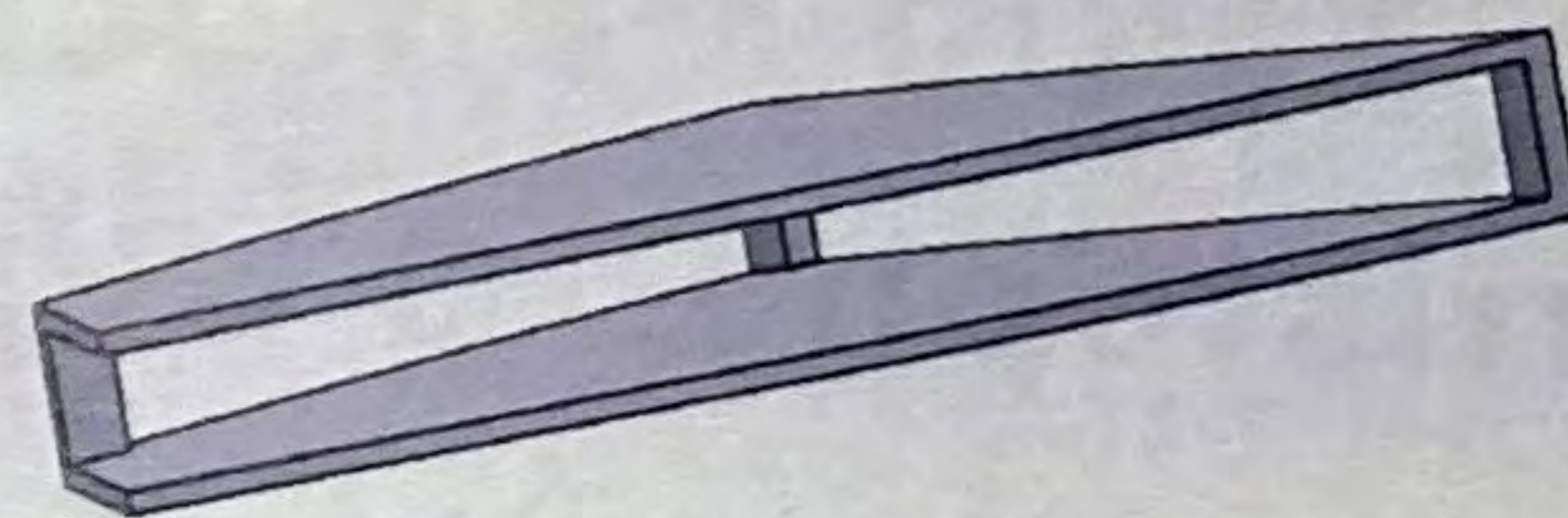
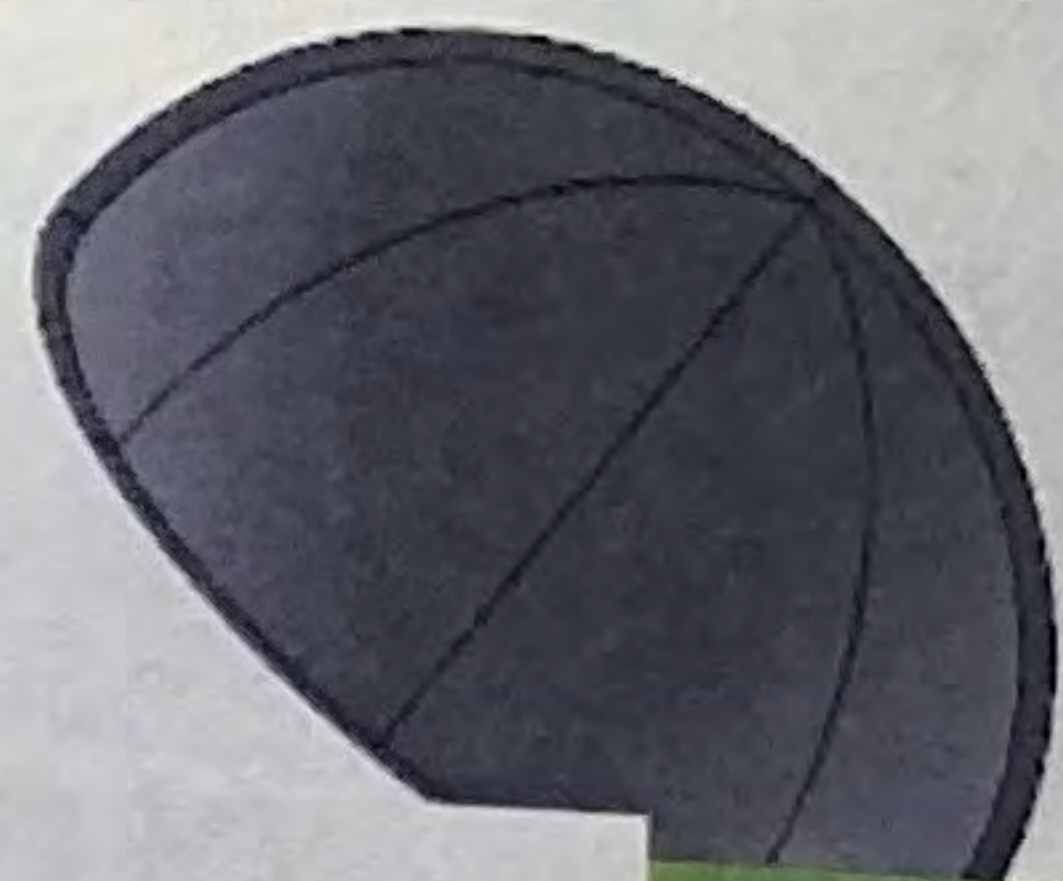
Not only being capable of housing plants but small organisms as well.

We also decided to use human waste and other trash from around the lunar base.

## The Works

The base will be made of an aluminum alloy to conserve heat and avoid rusting due to the humidity. The functionality of the spray heads is to keep the water within a limited used amount. The water container is for temperature control and water recycling. It will also be included with a dehumidifier to keep the humidity from entering other rooms. Two fans will be placed at the entrance of the green house to circulate the oxygen from the habitat to the green

## CAD Design



Lunar plant Greenhouse  
Lakewood High School  
NASA HUNCH  
Team Members  
Christopher O'Neill  
Marcus Cedillo-Ramon  
Tyler Williams

Lunar Bamboo Green House Module



## TEAM INFORMATION

Get in contact if you want to know more!

Lakewood High School

**CHRISTOPHER O'NEILL** 2136393@jeffcoschools.us

**TYLER WILLIAMS** 2103889@jeffcoschools.us

**MARCUS CEDILLO-RAMON** 2068924@jeffcoschools.us

**ASHLEY PEDERSON** 173409e@jeffcoschools.us

Please contact about further questions or concerns.





# LUNAR BAMBOO GREENHOUSE

SOFI SIRGO & YASMIN MARTINS  
LEGACY CHRISTIAN ACADEMY | FRISCO, TX



Check out our website!



## CONSTRAINTS

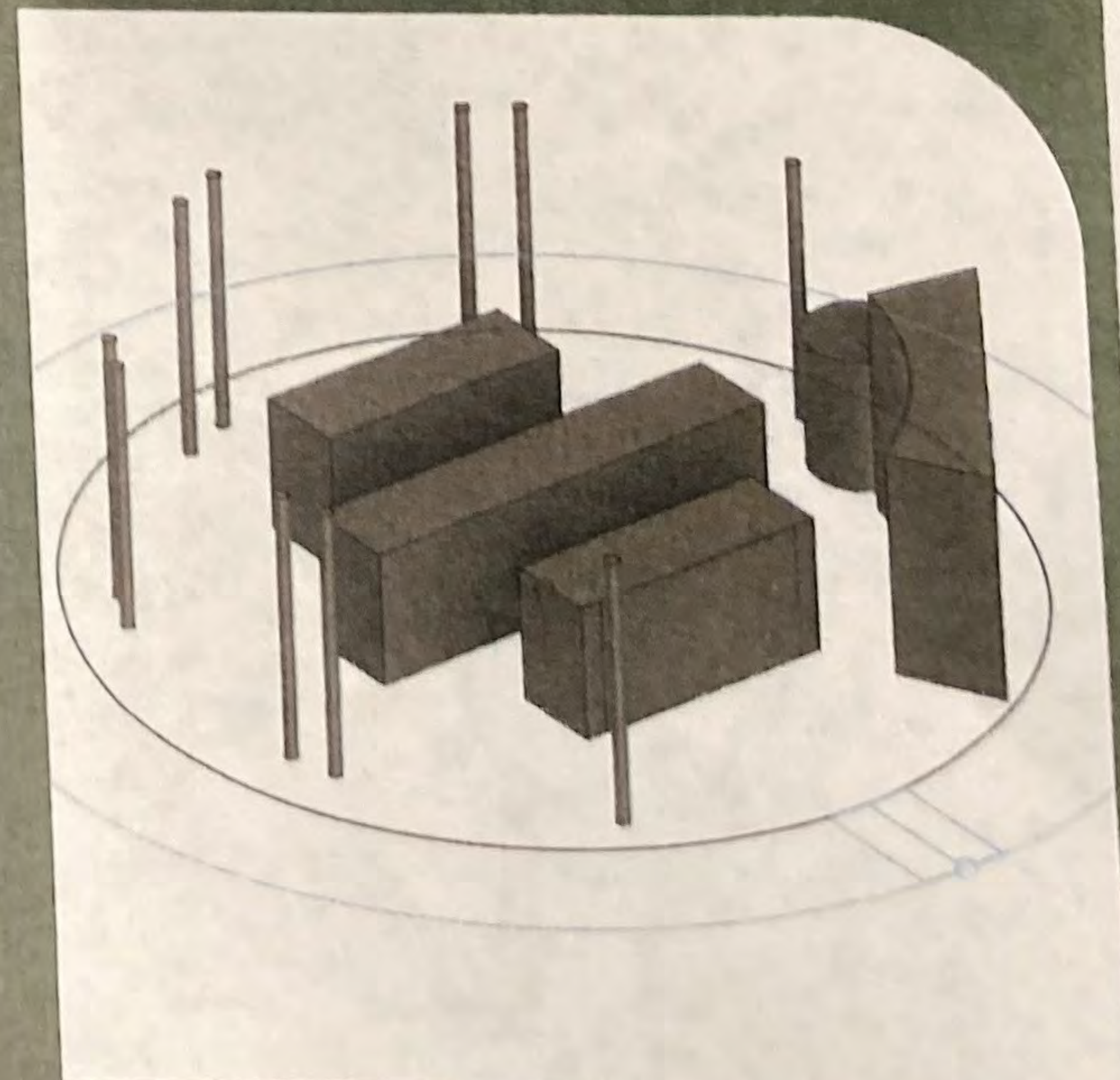
Can bamboo be used to remove carbon dioxide from the air, supply oxygen and be a structural material on the moon?

What would the greenhouse look like when built for the moon?



## CONSTRAINTS

Lighting, temperature, humidity, CO<sub>2</sub> consumption, and O<sub>2</sub> production





# BAMBOO GROWTH

After analyzing our first design, the 4:1 soil:regolith ratio (trial 3) is what successfully sprouted a Bamboo Bambusa seeds. However, there is a greater chance of success if bamboo sproutlings are brought to space.



## "BAMBOO-PONICS"

### VERTICAL FARMING

Reduces water waste and pesticides by 92%.

### WHY BAMBOO?

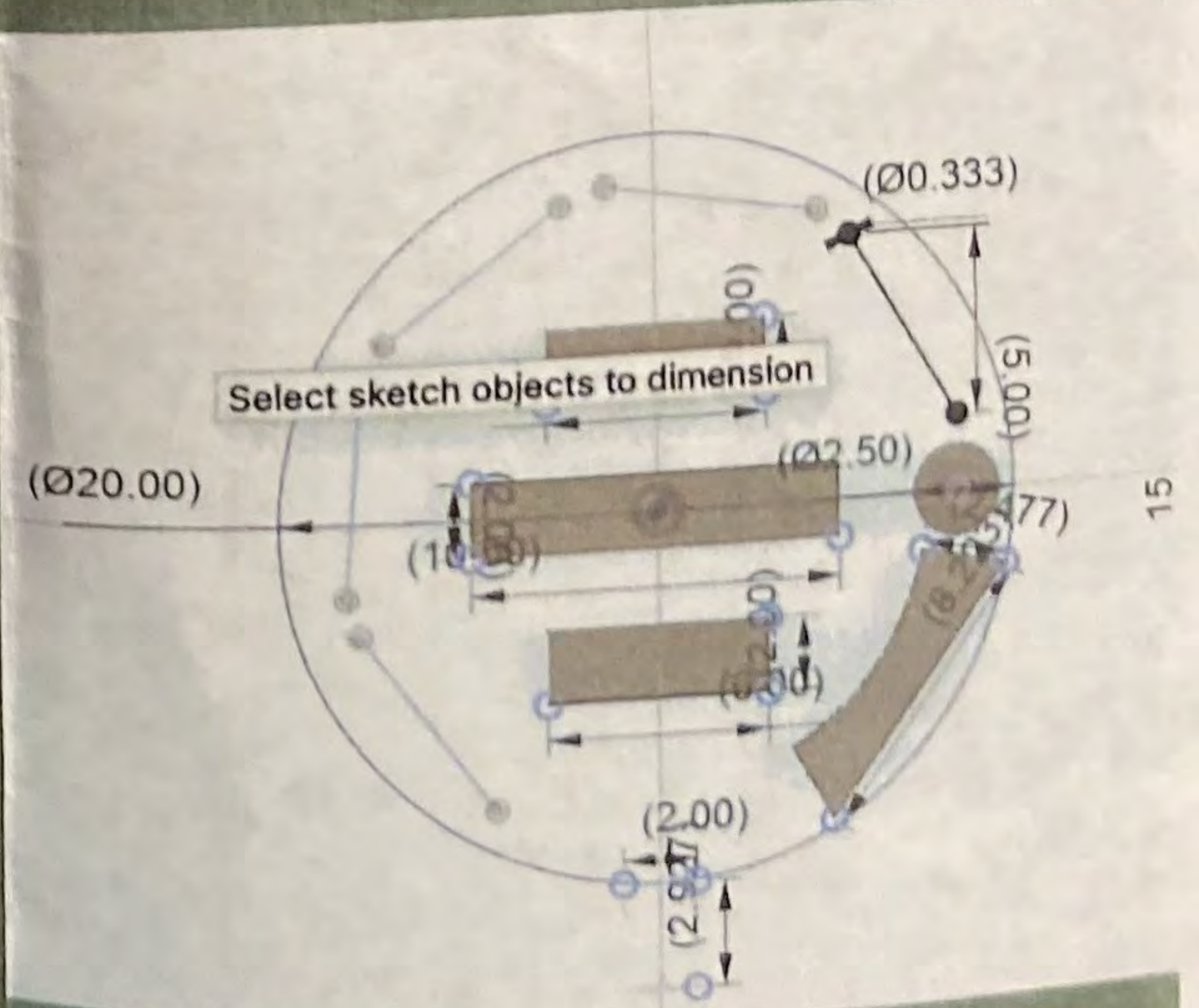
Bamboo has natural water-resistant properties, mold resistance, and bendable.

### SUSTAINABILITY

Using the bamboo grown is extremely cost effective, since bamboo will already be growing. If a problem appears in the hydroponics, it can easily be replaced by using the grown bamboo.

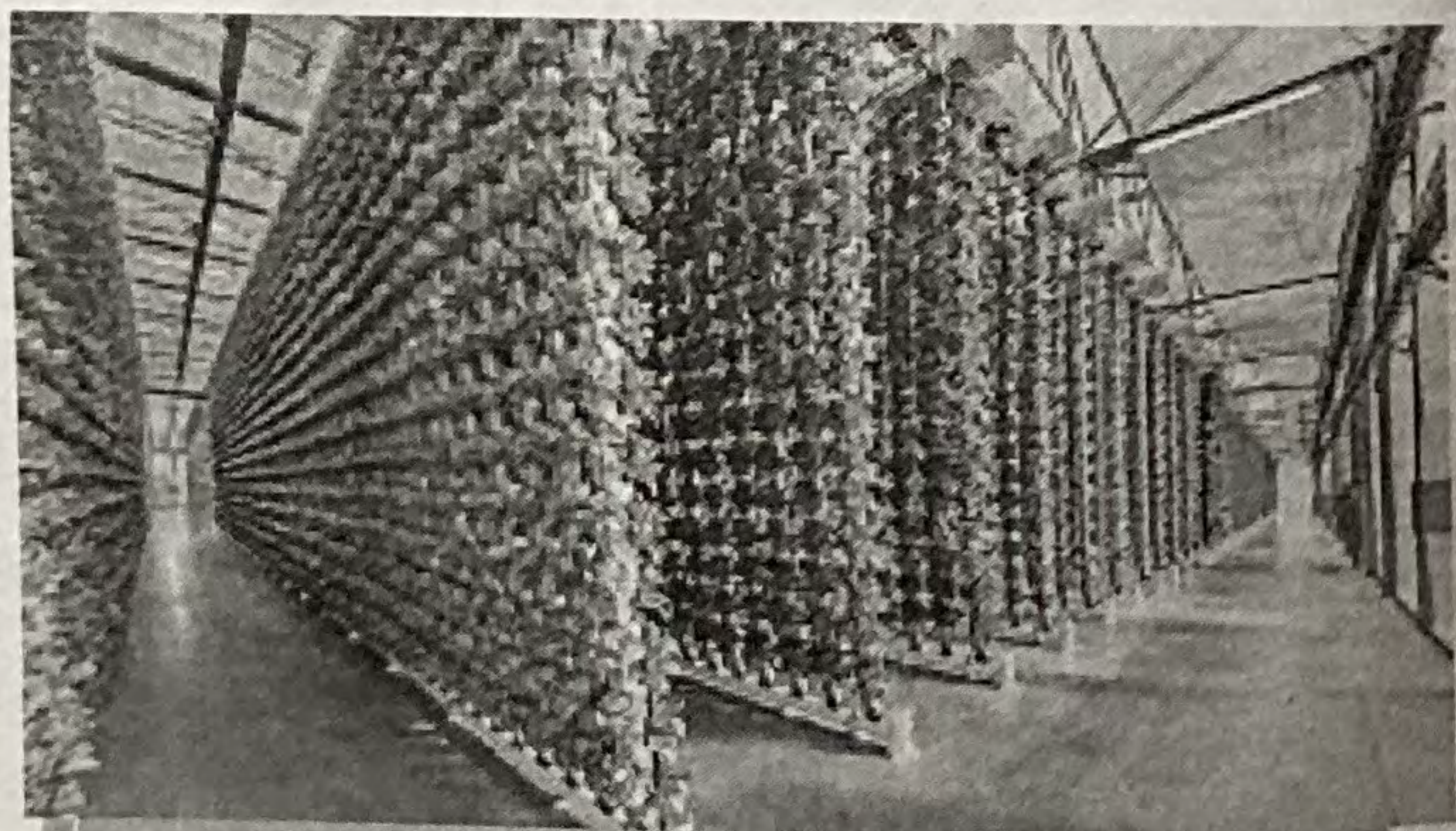
# LUNAR GREENHOUSE

We built a model that optimizes the greenhouse space, by growing the bamboo toward the center while having the other crops grown near the perimeter.



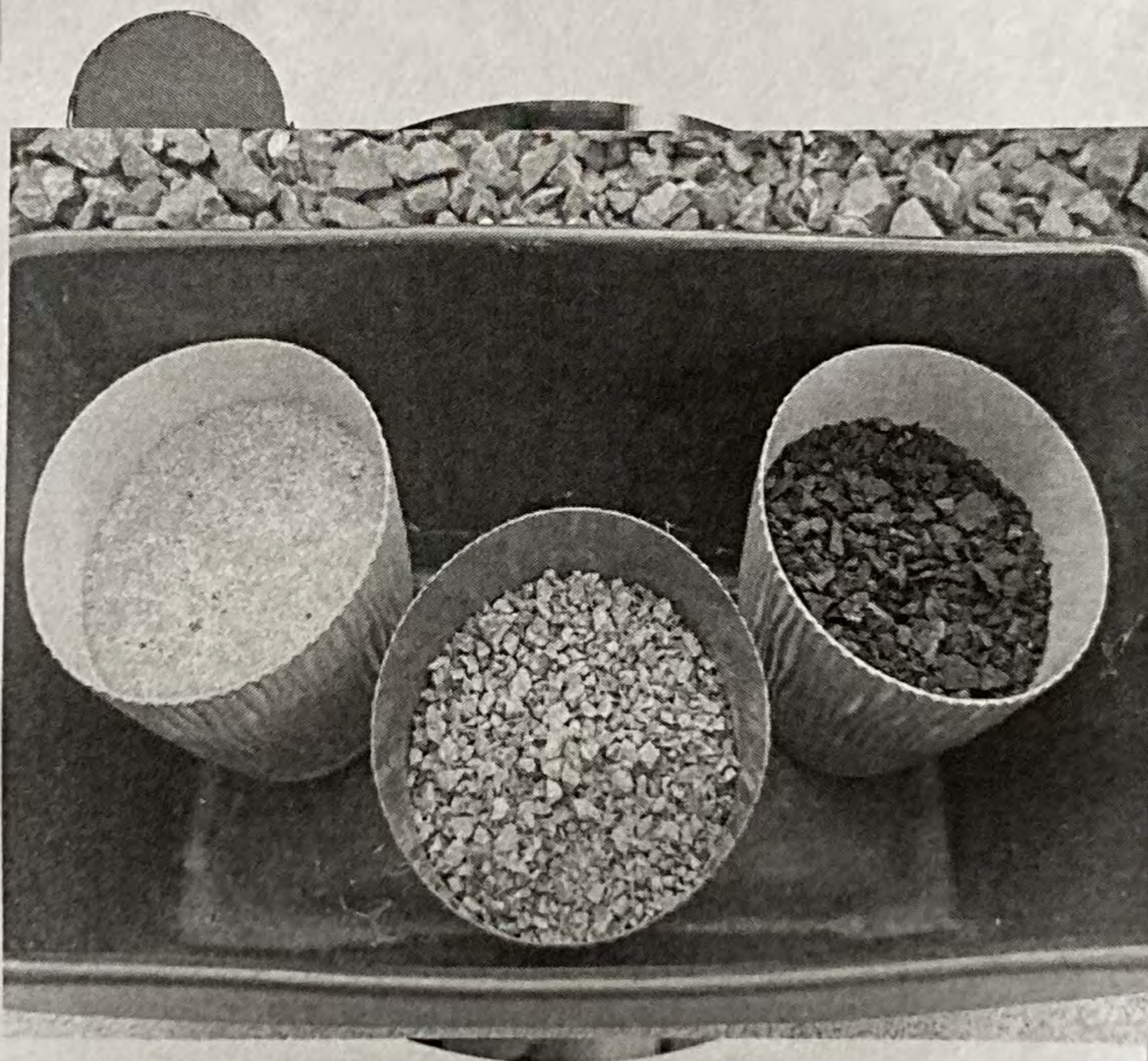
## Main Goal and Problems:

The Lunar Bamboo Greenhouse's main goal is to have a way to get rid of the Carbon Dioxide that's on the Moon. Most plants don't release enough oxygen, but Bamboo is one the most efficient plants that can get rid of Carbon Dioxide. Not only is it good for making Oxygen, but it's also edible and a good construction material. The dome will also have to be able to grow some other type of food source like carrots or tomatoes. The greenhouse will also need to have a source of lighting, plumbing, and a way to mix the air from the other modules. It will also need to have a form of controlling moisture and temperature.



## Testing Data:

Our data told us that bamboo didn't grow in 5 months so the optimal idea to have bamboo at the moon would be to bring it already grown. We grew these bamboo in things like dirt and sand because there's no nutrients on the moon.



## Lunar Bamboo Greenhouse



Bridgeland High School  
Constanza Imbern, Cayleigh  
Muallem, Valeria Allison  
Mr. Laughlin

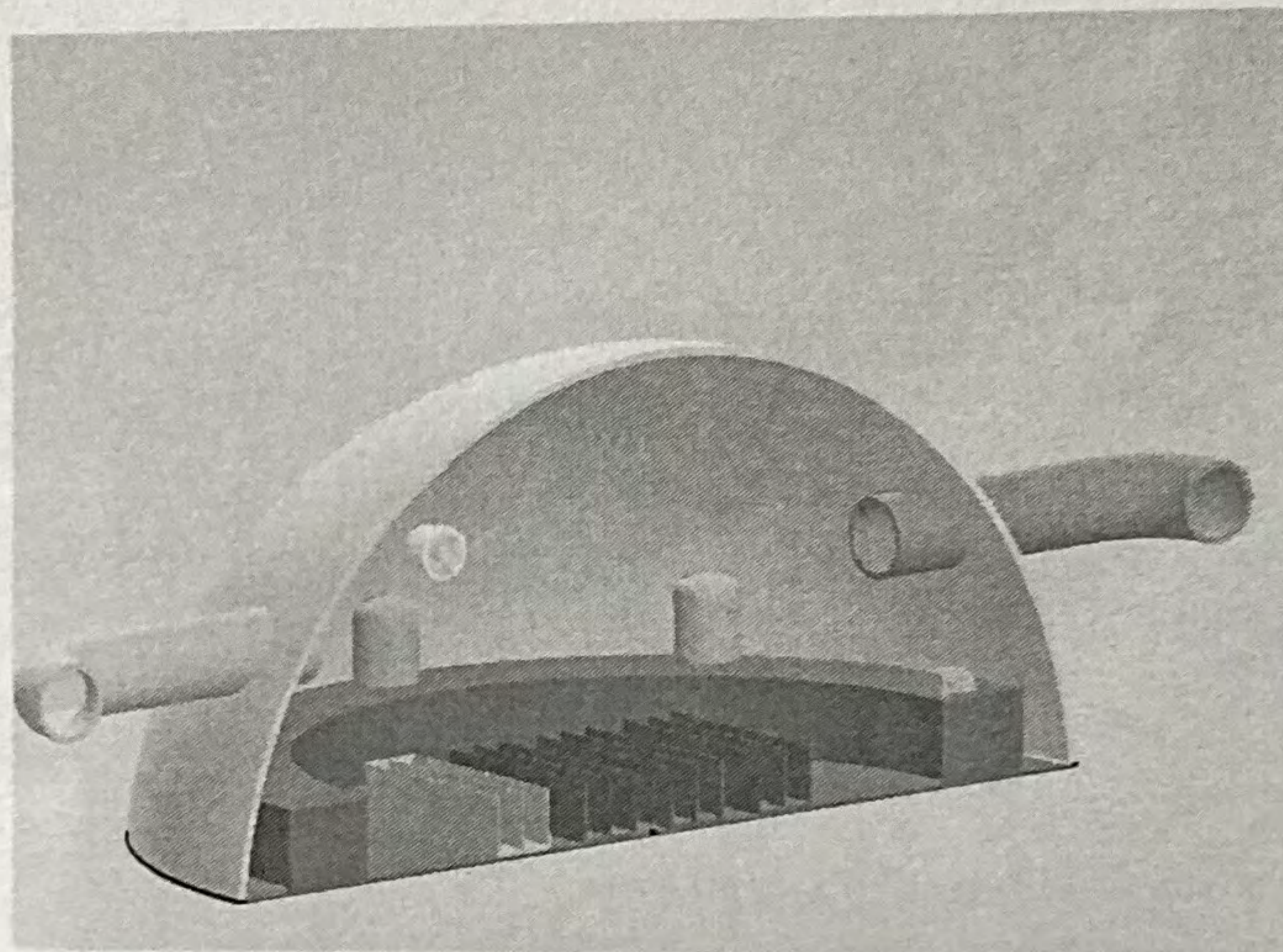


## Materials Used:

Materials that we used was metal wiring, paint, foam base, tarp, LED lights, tubing, cotton, fabric, glue. We also bought some things like a temperture regulator and tubes for water transportation to show all the different parts of our greenhouse. We had to buy batteries for some of these materials, so they could work.

## Our Prototype/ Design:

Making our prototype, we made sure that everything is placed correctly so that it all works and is at the best condition.



## QR Code to Data:

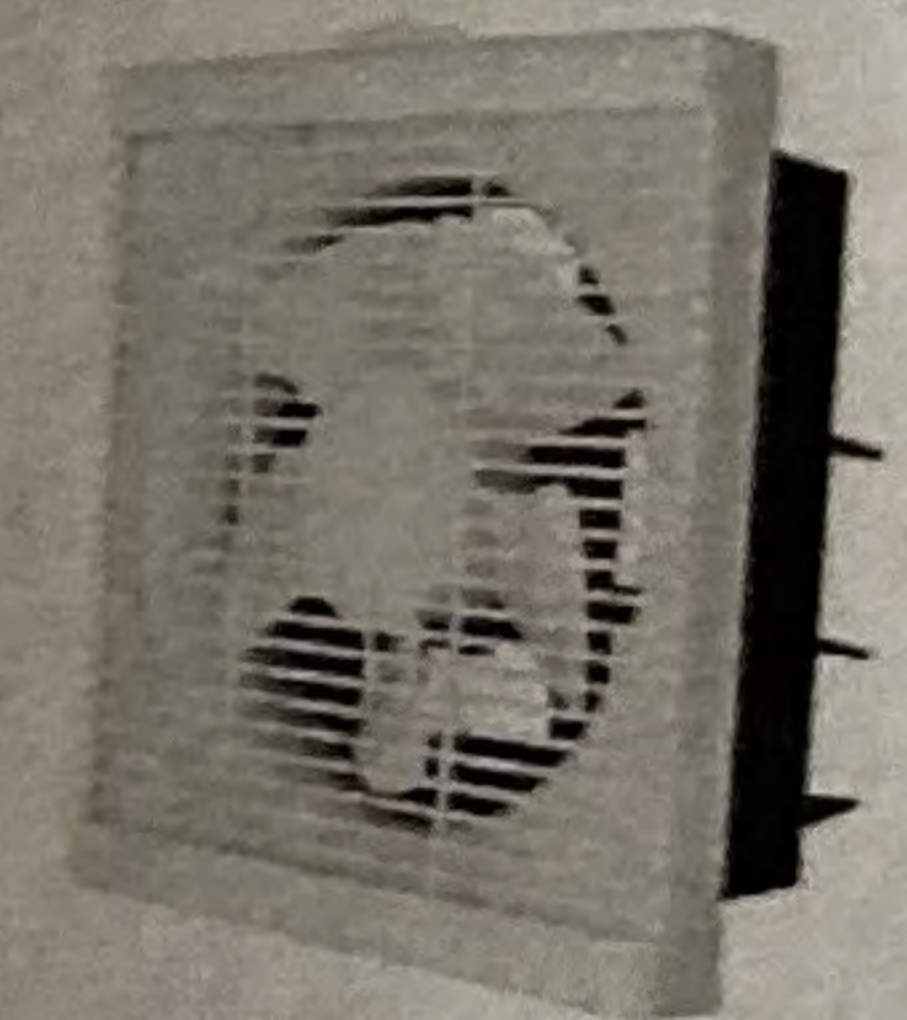


## Inspiration/ Ideas:

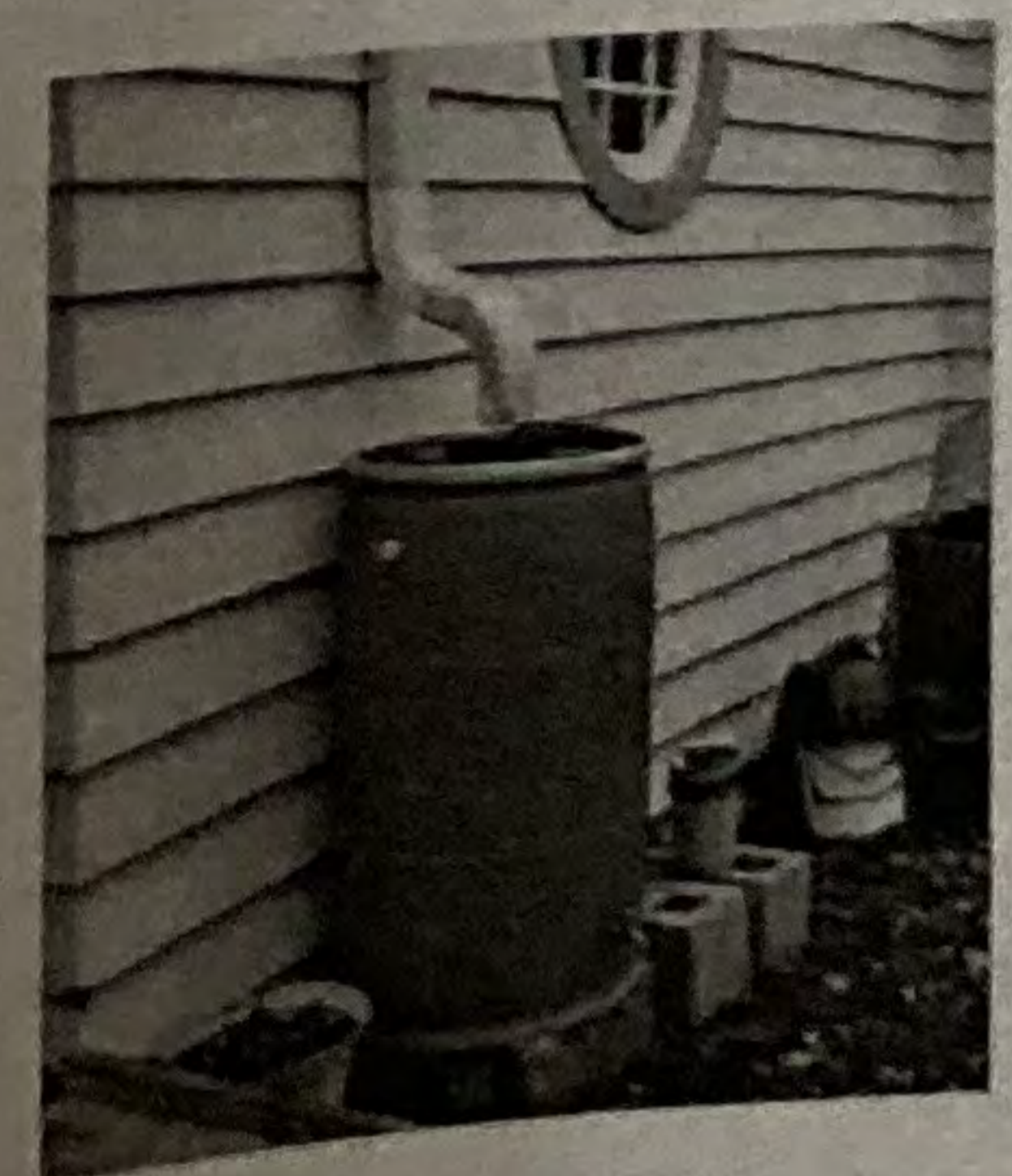
Some inspiration was normal greenhouses on Earth and current greenhouses on the Moon.

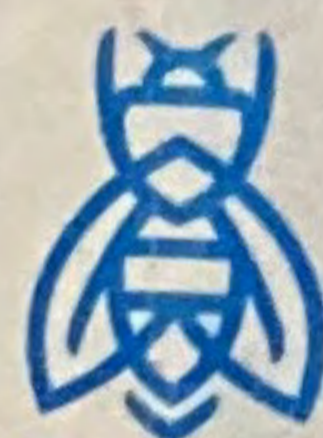
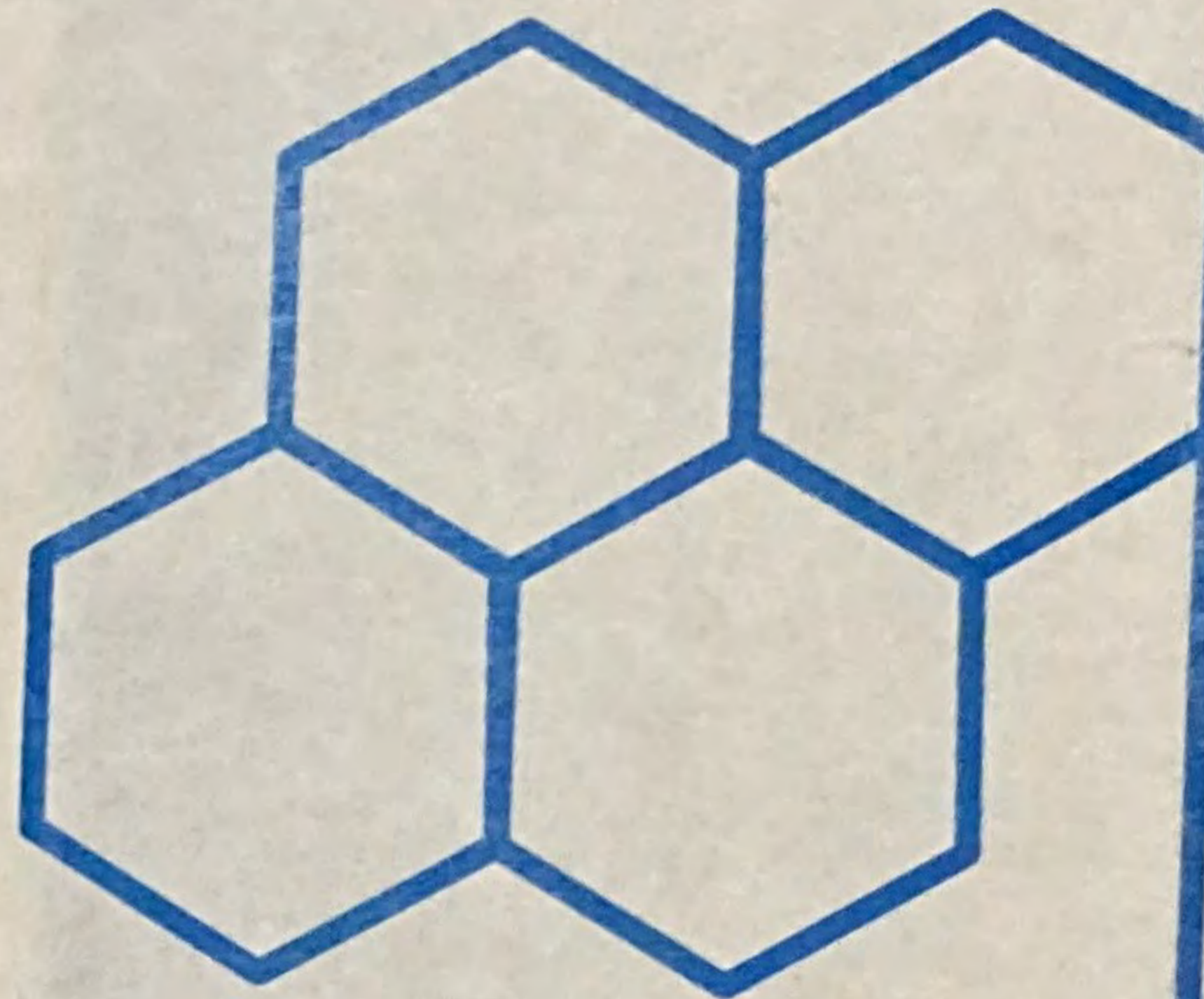


We also got inspiration from places with lots of humidity and moisture and are thinking of using a fan and vent system combined with a temperature regulator.

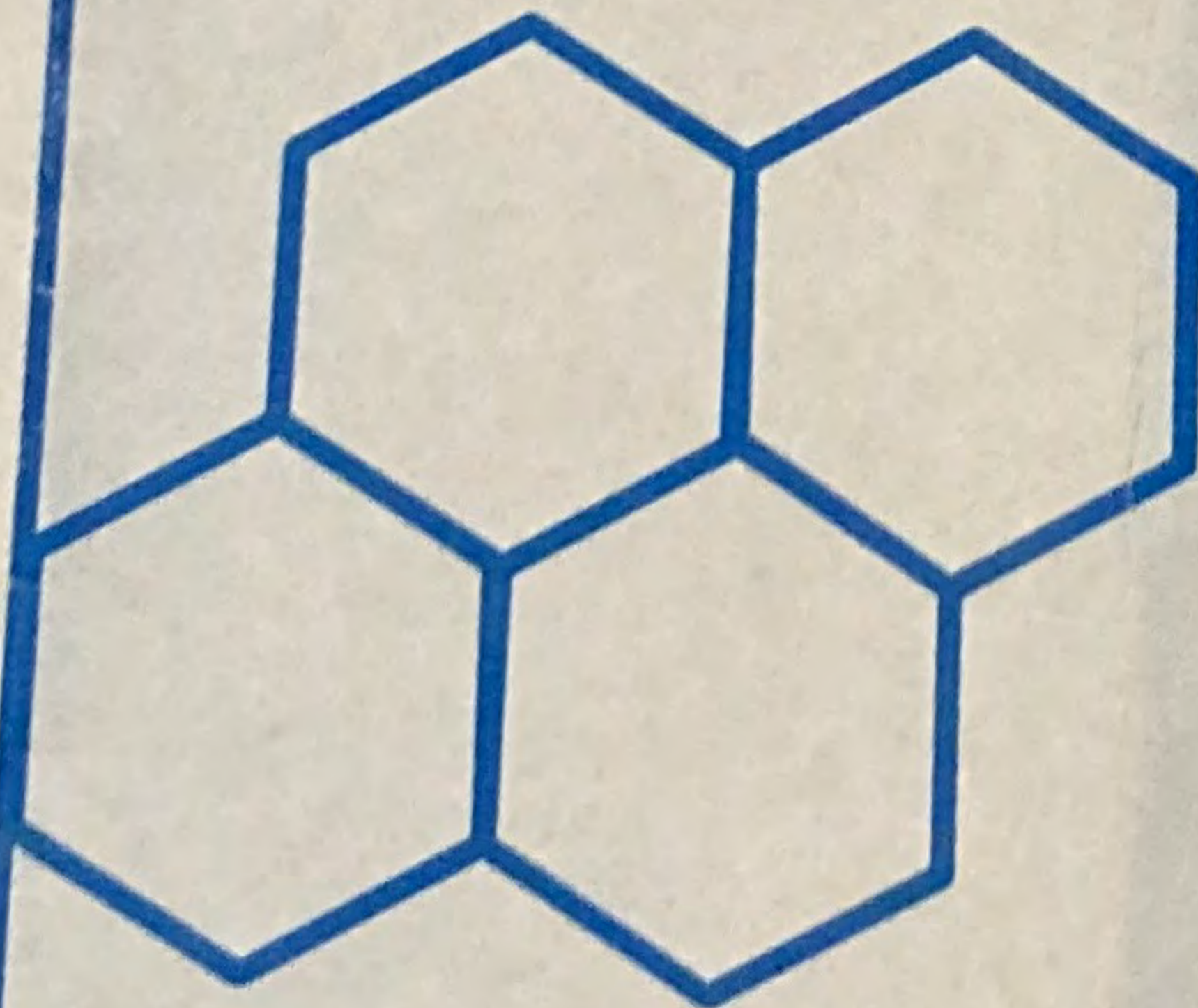


We took ideas from previous places using water tanks to store a large amount of water, so we're going to put water tanks to supply water to the growing beds.





MINNETONKA ENGINEERING PROGRAM



## Our Team



Tyler Vos



Liam Cassidy



Lukas Wolf

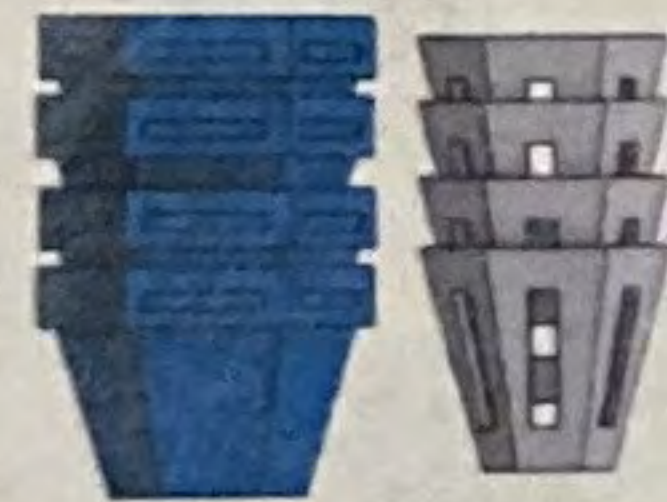
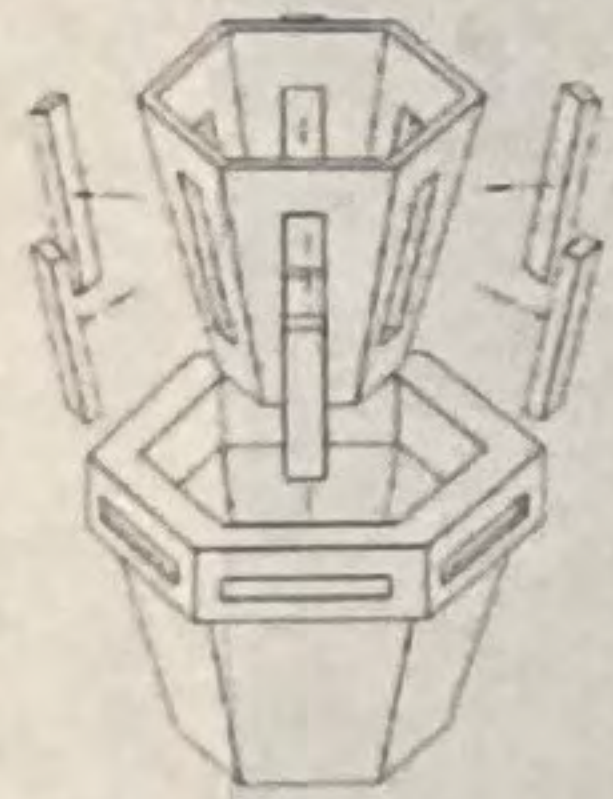


Wyatt Wobbema

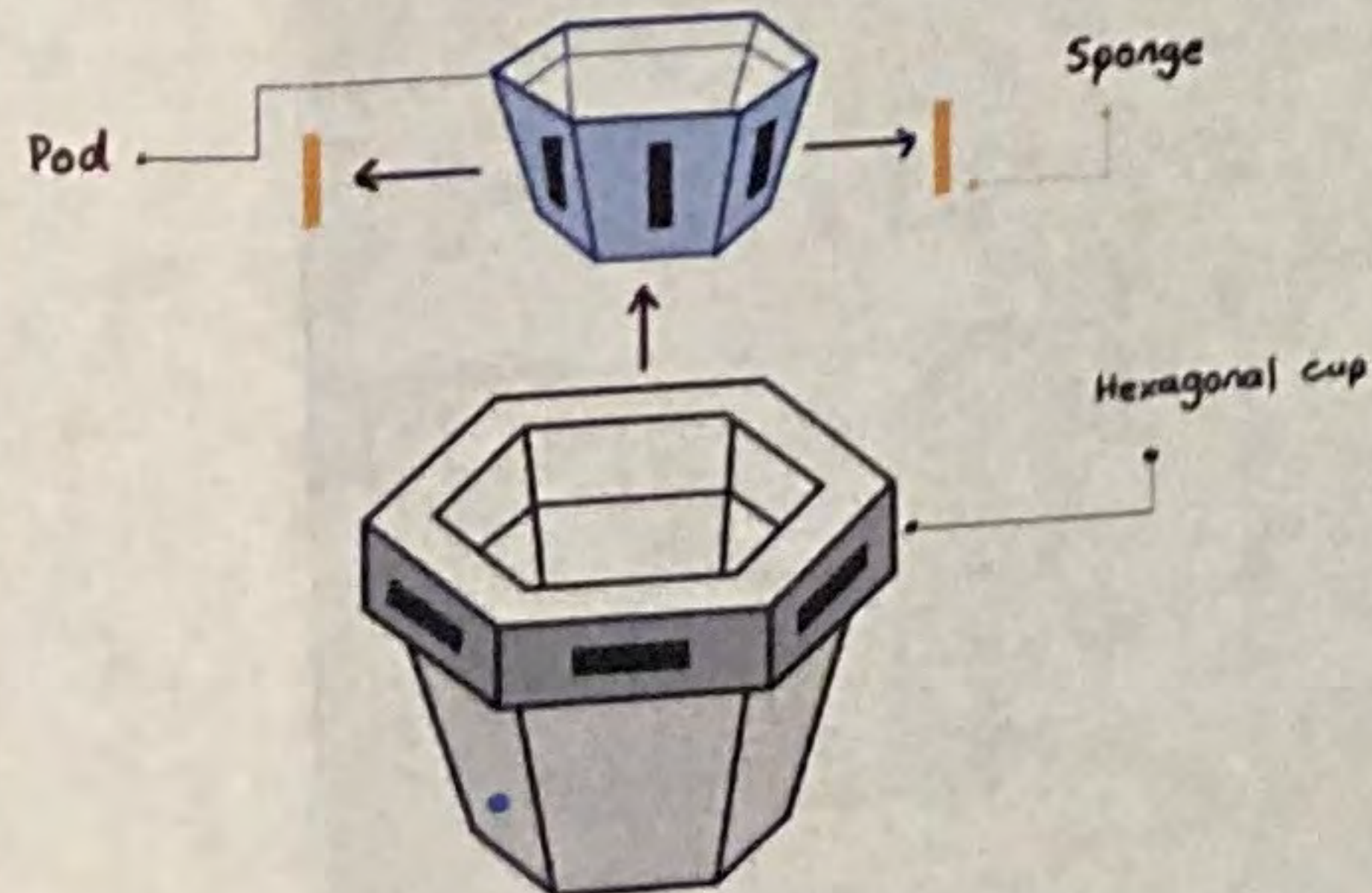
## Ease of Transport



- Entire design is collapsible
- Foldable pillars
- A realistic design for transporting the growth system to the moon



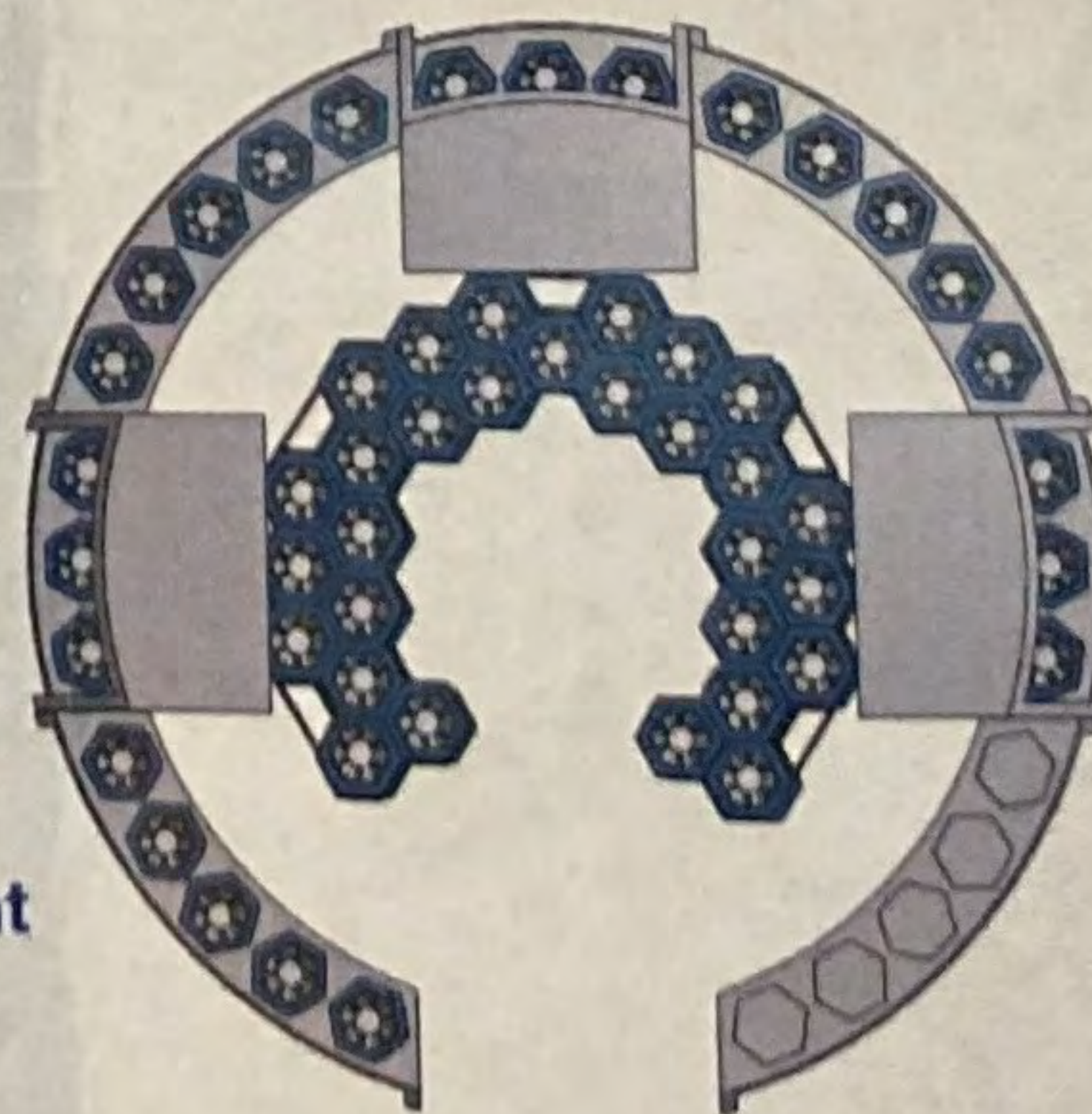
A single HIVE system is composed of a pod which is placed into a holder, a water hose is run into the holder from the side facilitating the passive nutrient diffusion



## MINNETONKA ENGINEERING PROGRAM Design overview



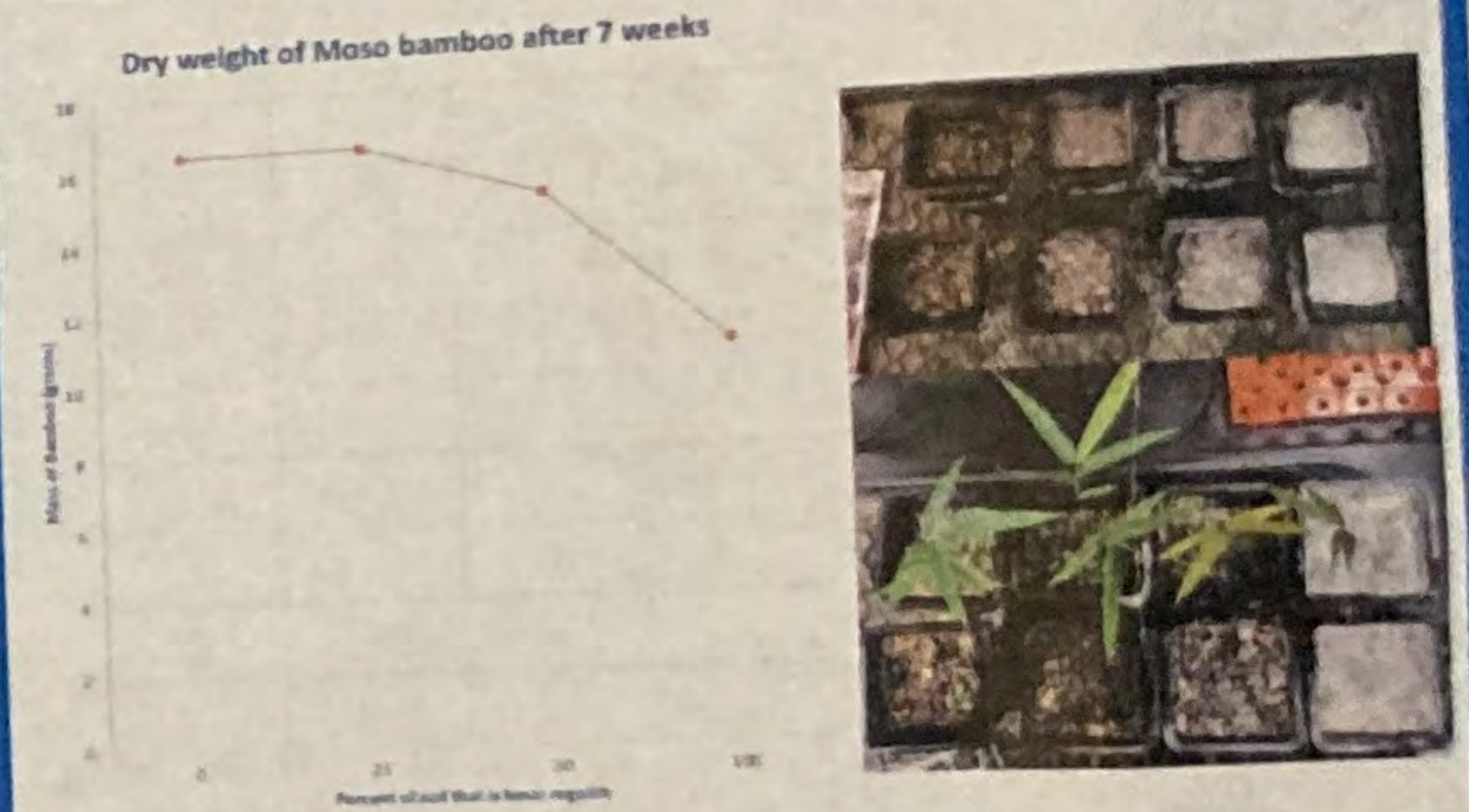
- Outer tables can function as desk or growth unit
- Ample storage
- Grow room will be Negatively pressurized for stable conditions
- Cooler more oxygenated air will fall and then be circulated out
- Revolving door at entrance to minimize heat loss



- Modular design
- Easily removable pods for maximum versatility
- Completely customizable
- Self-watering and regulating
- Compatible with multiple plant species

## The experiment

A experiment was conducted to test if the lunar regolith had measurable effects on the growth rate of the bamboo, the data proved that there was a 37% decrease over the 7 week grow period



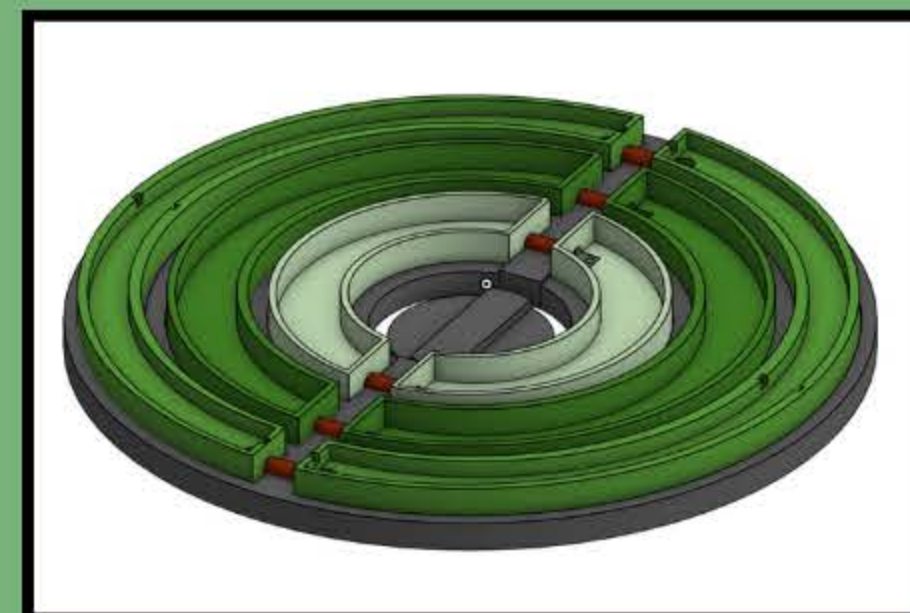
- HIVE system 3D printed
- Tested by growing Moso bamboo from seed with 50% simulated lunar soil





## Mission

To create a lightweight planter that is easy to assemble, design an optimal greenhouse for bamboo to be grown in, and research the perfect bamboo and how it needs to grow.



# TEAM BIG BAMBOO COMPLEX



## Build

- Light compact easy to assemble planters (will make transporting to the moon cheaper/easier)
- Heated grow lights that will help control the environment and keep plants happy and healthy
- Dehumidifiers will help control the environment and gather wasted water in the air
- The water filter will filter the dirty plant water into clean usable water. It will also filter other liquids from the main habitat and be made into drinkable water. (dirty water, urine, etc)

## Features

- Workspace can be used for extra storage or a place for the astronauts to work and research the moon and their surroundings (will also be a nice place to relax for the astronaut because the environment will remind them of Earth's own forests and natural beauty)
- Solar panels power the pump, lights, and dehumidifier without wasting energy.
- Automated pumps and sprinklers, the only manual part is planting and harvesting!



## Habitat

- Preferred bamboo type - Bambusa Polymorpha
- preferred humidity - USDA Hardness of 9-12
- Preferred temp - 22-28 degrees Celsius
- Preferred nutrients in a hydroponic system - 20-5-10 (NPK) with added iron
- Shoots can be eaten and when grown in can be built with



## Temp and Humidity

- Grow lights will double as heat lamps which will control the temperature of the environment of the habitat
- Depending on the temperature, it will cause more humidity, which will be controlled by the dehumidifier, which will draw the excess water out of the air and put it through the water filter to the water tank.



**Jackson Hole High School**

**Alex, Blake, Axel**





## Team Members

### Top Row

- Jacob Johnson
- Tristan Zepeda
- Oryn Glick
- Zachary Monger

### Bottom Row

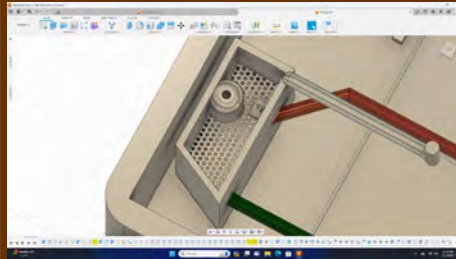
- Hayden Berge
- Dallas Jackson

### Teacher

- Mr. Hill

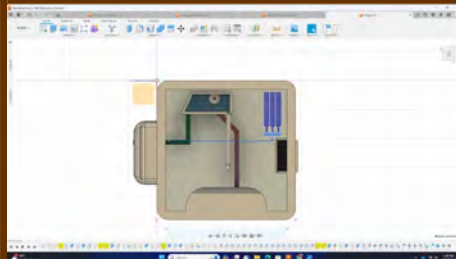
Laurel High School, Laurel MT

## water



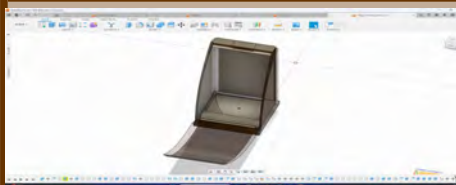
- Filters for purification
- Circulation for recycling water

## Electricity



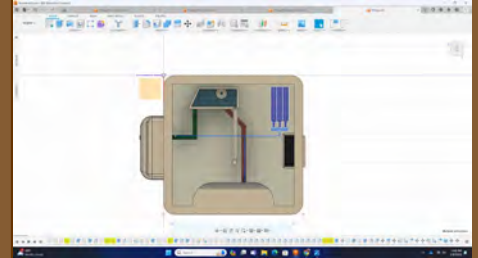
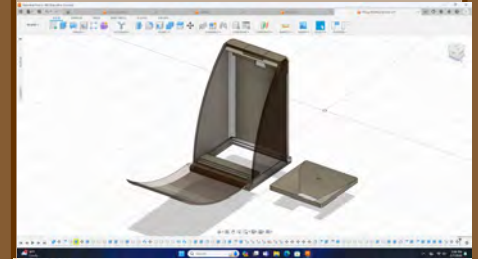
- Battery and solar powered electronics system

## Growth Chamber



- Water distribution
- Bamboo soil and chamber that curves bam-

## P.Egg



- Egg growth chamber
- Puzzle piece base
- Water Ramp
- Door for growth chamber



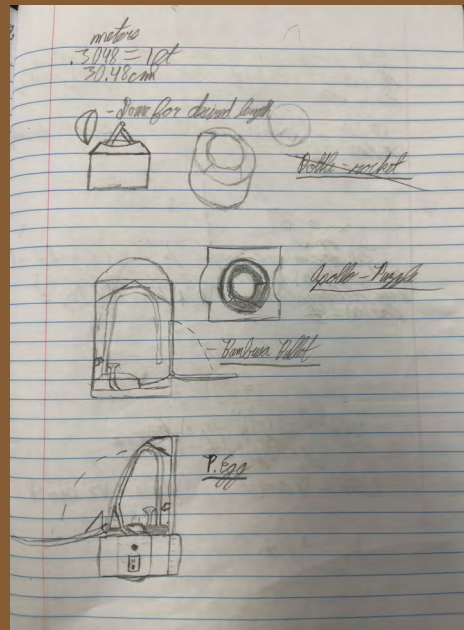
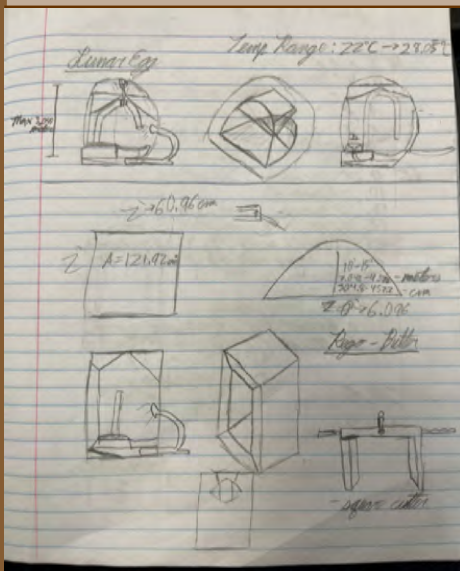
## Bamboo Type



- Bamboo we used is Giant bamboo
- Recommended bamboo Bambusa Tulda



## Rough drafts



- Original plans for the growing chamber and puzzle piece
- Designed for best growth.

## Dimensions

- Growth chamber is 6.15 feet tall
- 3.609 feet in width
- 3.937 feet in length
- Room for bamboo is 14.2 square feet.
- Water chamber can hold up to 5 gallons
- Puzzle piece height is 2.05 feet

- Puzzle piece length is 3.937
- Puzzle piece width is 3.609
- Water ramp is 0.246 feet tall
- Water ramp is 3.445 feet width and length
- Tubing inside is 1.25 in for diameter.
- Tubing outside diameter is 1.636 inch
- The outlet is 1 sixteenth of an inch smaller than the inlet to fit properly

## Materials

- Main module is made out of titanium
- Glass shield is poly carbon
- Puzzle piece base made out of titanium
- Piping made out of vinyl braided nylon
- Water ramp is made out of titanium

## features

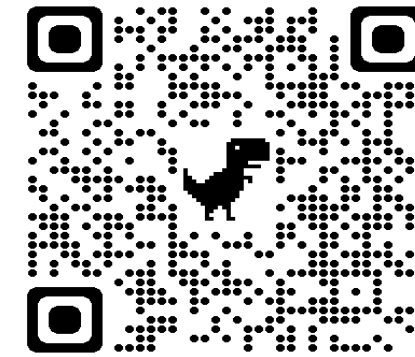
- Water flow throughout modules
- Water sprayed aimed at base of bamboo
- Heating light and air circulation for maximum growth
- Egg shaped growth chamber for curvature of the bamboo
- Vents pump carbon dioxide into the chamber then circulates oxygen throughout the
- Share electricity throughout modules



# Bamboo Greenhouse

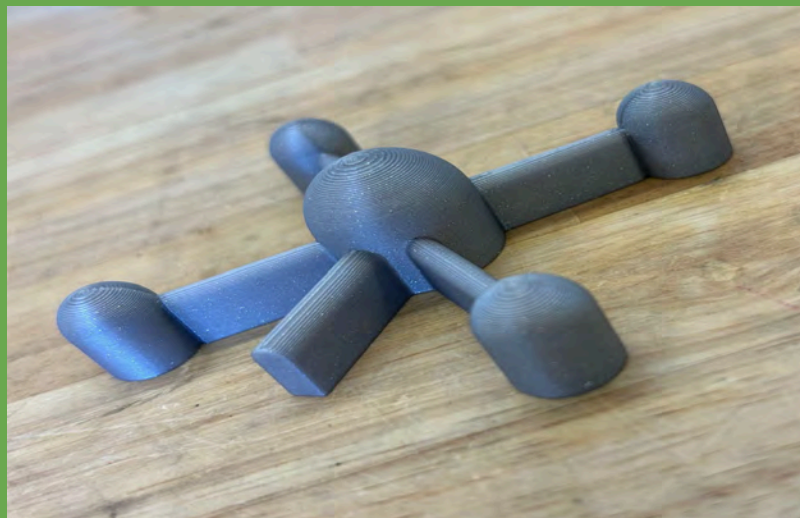
By: David Augustine and Jacob Skewis

Our Website



Jacob Skewis (Left)  
David Augustine (Right)

## Design



This is our finalized design. We wanted to make the final structure To be practical and ideal. Our final design for this can use Multiple domed sections as practical rooms for storage, living quarters, the garden/ greenhouse, a hub, and a bathroom area. Those are a few ideas That comes to mind for this structure.

## Phyllostachys Bissetii



- Type: running bamboo
- Water: 10 oz per plant every day
- Soil: Phyllostachys bissetii is going to need to be moist or damp
- Sun Requirement: If receiving lots of direct sunlight, the green culms often turn a light golden light color. In more shaded areas, the bamboo is a dark lush green. Its culm sheaths are brown.

## Watering system



After lots of thought we have come up with this design for our watering system. The system will have boxes next to each other and a long pipe going through each box. The pipe will have holes on it so water is able to leak through.