GNG1103

**Design Project User Manual**

**[Hydroponics 2 Design Project Manual]**

Submitted by:

[Hydroponics 2]

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**Abstract**

After meeting with the client it became apparent what limitations and restrictions will be set on our team when designing. The most glaring need of the greenhouse is for it to be completely self sufficient. This means that acquiring things such as plant fertilizer is not an option because of the seclusion of the town. A large obstacle in self sufficiency is having no electricity. To operate the hydroponics system, electricity is required to run pumps that continuously circulate water for oxygenation. We must use a self sufficient energy source such as solar panels. To run the pumps we must find a way to harvest enough water using the greenhouse itself while also storing the water within the building.

The town's location offers many obstacles on its own. Because of the harsh winters it is ideal that the system is used during the other three seasons, none the less it must be designed to be functional after the winter season. This calls for durable materials that can withstand extreme low temperatures, high winds, and large amounts of snow. Because of the rural environment we must consider animals that may attempt to damage or find sanction inside the greenhouse and build accordingly.

Building the greenhouse is challenging enough but we must also take into account transportation, ease of use, and maintenance of the building. We do not have the resources to transport a fully built greenhouse so we must move it in smaller sections. The sections must be quick and easy to assemble because of the lack of resources and mechanical experience of the designated users. Because of limited mechanical experience we must plan for minimal maintenance that can be done with very common tools. Considering all needs we must design and create a compact, durable, self sufficient greenhouse that is easy to use with minimal maintenance.

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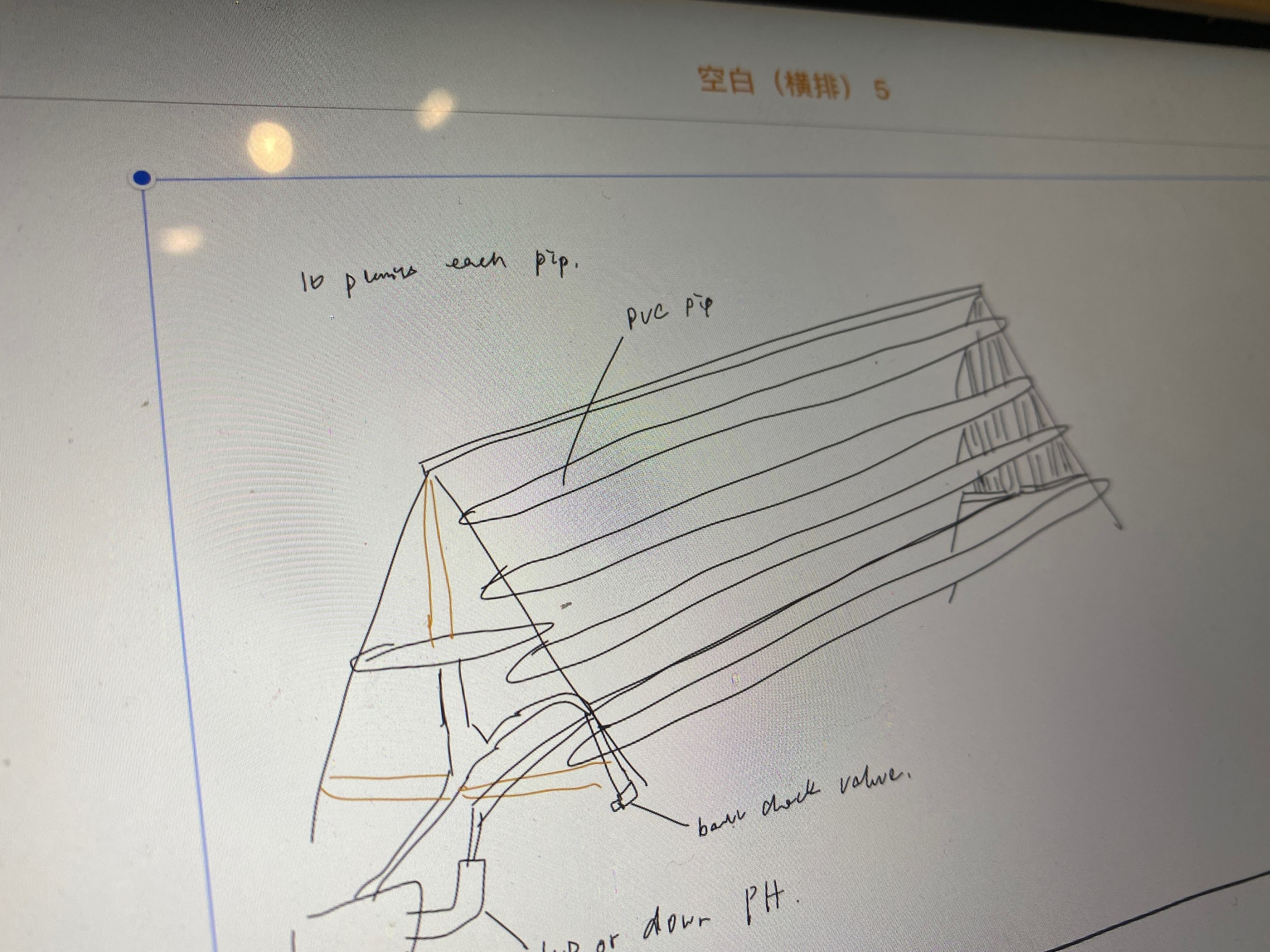
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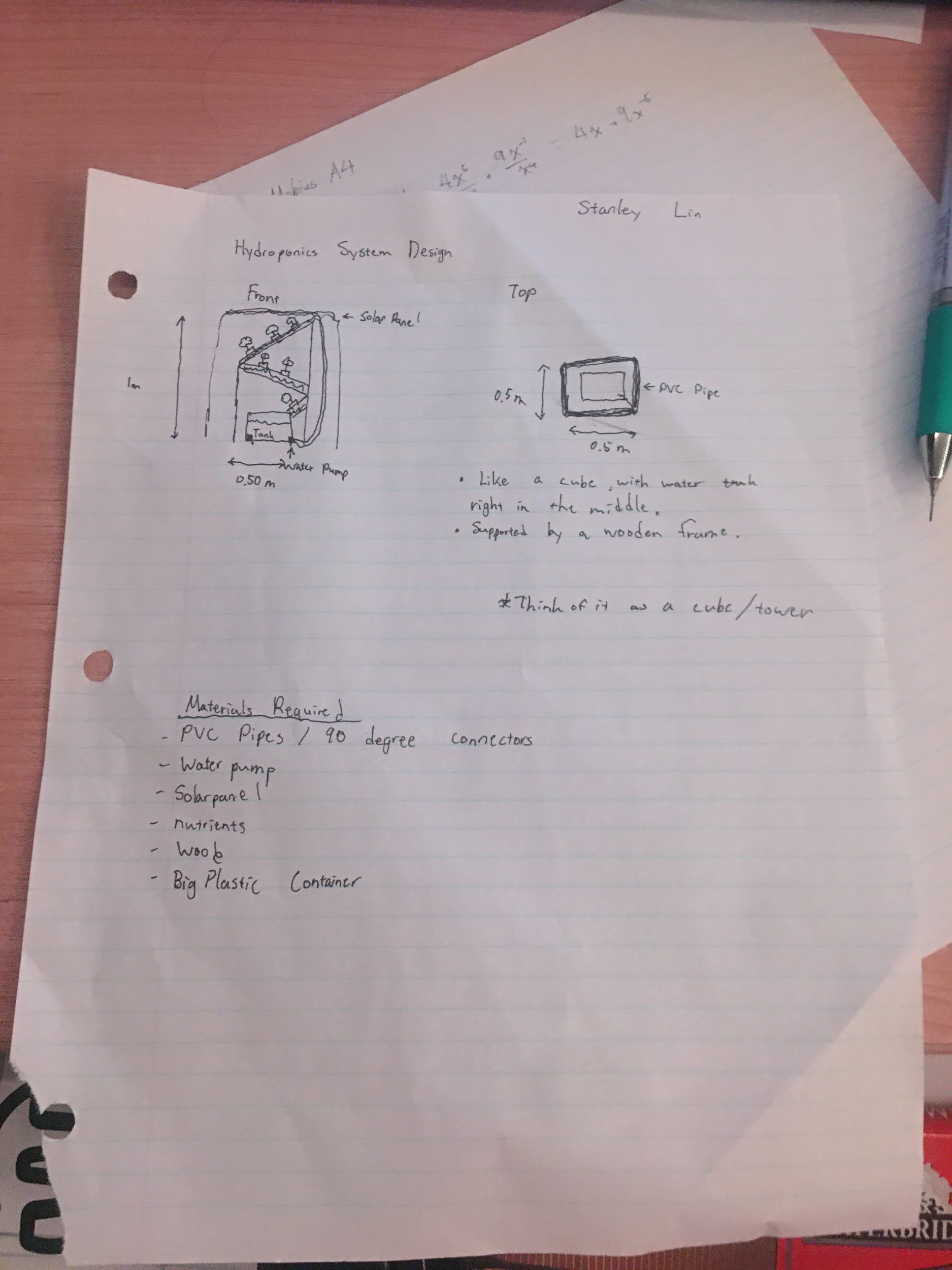
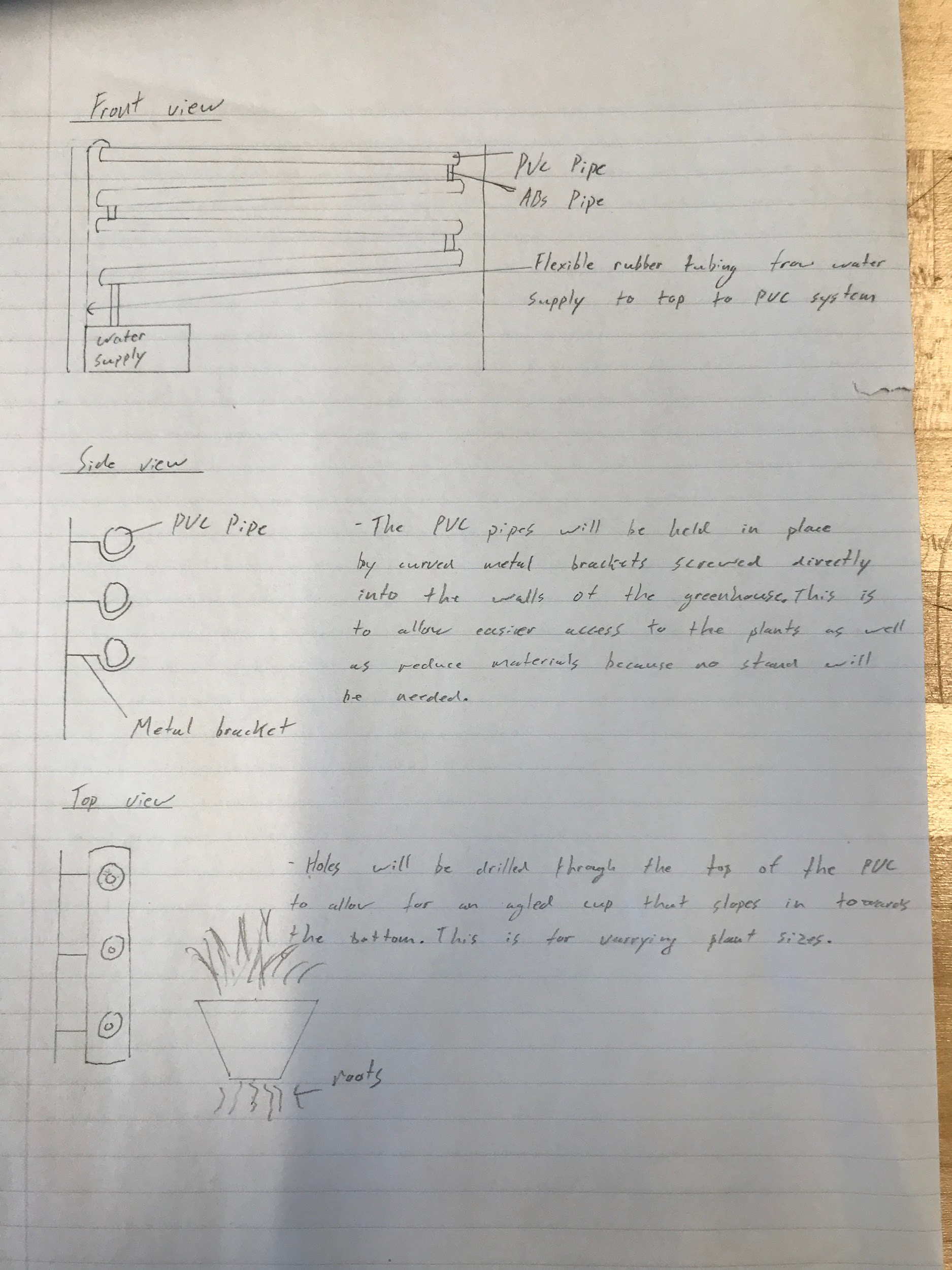
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# Introduction

Due to residences being in a rural community, they must provide for themselves such as growing their own vegetables and having safe drinking water. We have limited resources and time therefore we will be helping them grow vegetables in self sufficient hydroponic systems. This system only uses water and plant nutrients, free from any impurities that may occur while using soil as planting base, providing users a safe and easy to use system to plant vegetables.

## The Problem

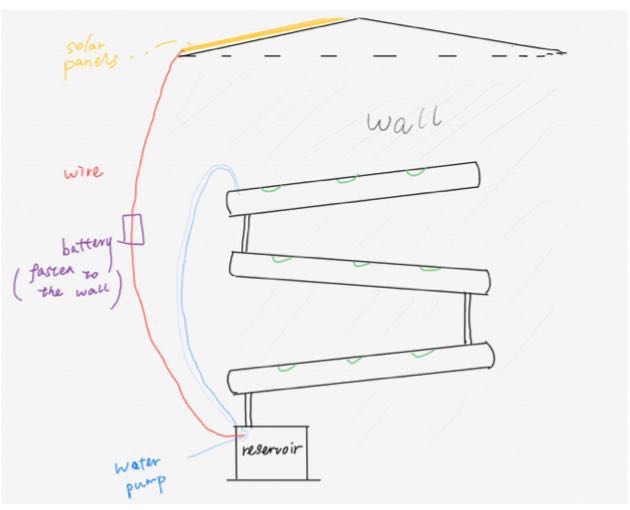
A self sufficient greenhouse is required in a rural community. We must use a self sufficient energy source such as solar panels to operate the hydroponic system and harvest rainwater for use in the system. Ultimately, we need to design and create a compact, durable, self-sufficient greenhouse that is easy to use with minimal maintenance. Not only will it provide them with an easy system to grow vegetables, they will also have a greenhouse to store tools and small machineries.

### Basic User Requirement

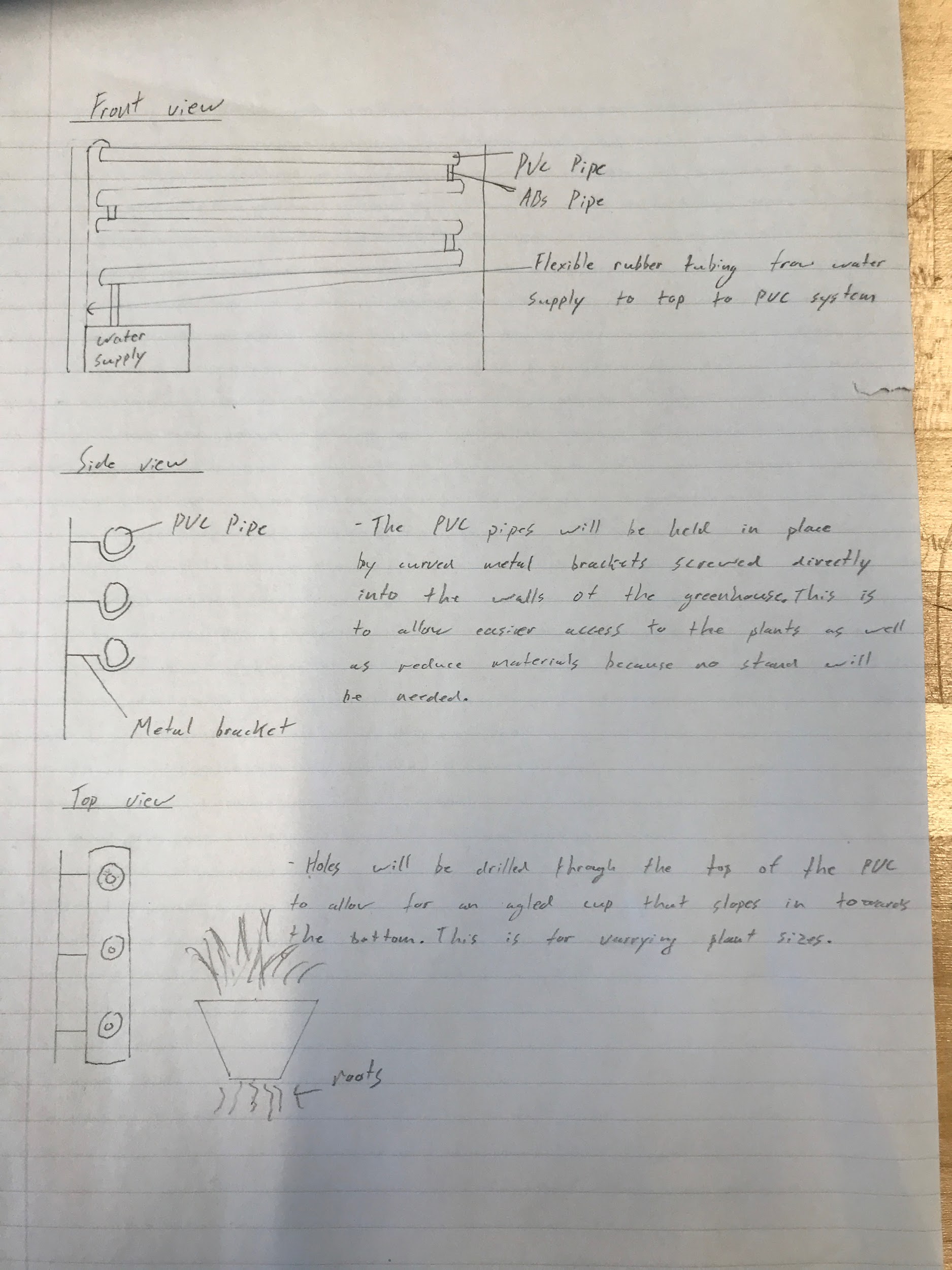
1. Users only need to provide their own initial amount of water to be used in the hydroponic system.
2. Little or no knowledge regarding building as it is a simple design yet completes the job.
3. Have plant nutrients or are able to make it, because this system can be used to plant various kinds of plants.

#### Differentiation In Our Design

As seen in our design, we are quite different from other groups. Our hydroponic system is mounted on to the sides of the greenhouse. free from any support structures. Which allows for more storage room within the greenhouse itself.



# How the Prototype is Made



The sketch to the left is a detailed image of our first proposed prototype heading into the client meeting. We decided upon this design that featured three pvc pipes fixed directly to the wall of the greenhouse to save on the cost and time of building a stand as well as maximizing the space in the greenhouse for the best access to the plants and leaves the client space for storage. On either side of the greenhouse we will install this system of three pipes to allow for 18 plants having 3 holes per pipe. The plants will be held in the holes by cheap plastic cups with perforated bottoms to allow the roots to reach the nutrient filled water. The cups will slant inwards towards the bottom to allow for various sizes of plants. The piping system will be secured to the walls using two metal clamps per pipe. The water supplied to the system will be held by a plastic storage bin and pump through flexible rubber tubing by a 12 volt pump. The same tubing will be used to connect each pvc pipe and used to send the water back to the storage bin. The water will be supplied by the runoff rainwater from the roof and collected by gutters and sent to the storage bin using flexible rubber tubing.

## Category

### BOM (Bill of Materials)

**Obtained : Can be found in Makerspace**

* 24 feet PVC pipe
* 15 feet flexible tubing
* 12V Water pump
* 12V Solar Panel
* Water Storage Bucket
* Metal Fasteners

**Required**

* Plastic cups x18 ($0.50 each) = $9
* Plant nutrients = $20
* 12V battery = $30
* Split valve $5.00

**Total Cost** : $65

### Equipment list

* Drill with circular bits for drilling holes on PVC pipe
* 1 Inch Deck Screws
* Metal Fasteners
* Scissors
* Plumbing Tape
* Electrical Tape
* Saw

### Instructions

1. Obtain material in bill of material.
2. Cut PVC pipes to desire length, must be smaller than the width of the green house
3. Proceed to drill the desired amount of holes for plants. Plant size will influence the size of whole being drilled
4. Mount PVC pipes in a slanted way by following our design, mount with fasters or deck screws
5. PVC pipes can have free falling water at the end or flex tubing to connect each pipe.
6. However if you choose to connect with flex tubing, you must put end caps for PVC pipes and connect it with flex tubing and secure with plumbers putty or plumbing tape.
7. Proceed to attach flex tubing to water pump and top of PVC pipe, place pump inside the obtained water storage bin.
8. With the wires for the pump out of the bin attach it to a solar panel or car battery with a switch in between the connection.
9. Users can opt for a timer to be used within the connection.
10. From the eavestrough of the greenhouse, water must exit safely and stored inside the water storage bin through uses of additional PVC pipes.
11. Add desired plants and nutrients into the hydroponic system.

# How to Use the Prototype

How it works

Water is collected from the roofs of the greenhouse and stored inside the bin. A pump is used to pump water upwards into the top of the PVC pipes, and uses gravity to bring the water back down to the bin. The pump is operated by battery and uses the solar panel to charge its battery during the day.

Safety

Users should not block the water flow from the pump with body parts as it can cause harm to the skin. Otherwise this system is absolutely safe to use even from young children.

# How to Maintain the Prototype

We do not have data collected to do COVD-19, however the pump is rated for 350 GPH ( Gallons per Hour) which provides adequate power to pump water throughout the system. Regular maintenance that should be performed on the prototype to avoid failure includes: weekly cleaning of the PVC pipes, checking for loose connection between flex tubings and PVC pipes, and adding nutrients to the hydroponic system. Some parts of our system may be prone to breaking such as electrical connection between the battery and the pump due to the harsh winter environment, which can cause connections to loosen. Regular maintenance on these parts could be done to prevent failure and improve life on the hydroponic system.

# Conclusions and Recommendations for Future Work

Due to COVD-19, our hydroponic system was not successfully built, but our designs are all complete and materials are all obtained. In the future, our hydroponic system can be easily built by following our 3rd design. Throughout this design and building process, we have come to a realization which prototyping is very important. Having functional prototypes provides feedback and room for improvement, it also allows you to look at potential changes which can make the final product an even better design.



# Bibliography

* Makerepo link:

<https://makerepo.com/ZhemaWen/hydroponic-2>

* Additional guide to hydroponic systems: <https://www.epicgardening.com/hydroponic-systems/>

**APPENDICES**

**APPENDIX I: Design Files**

In Makerepo we have attached all deliverables which can be used as samples for future hydroponic systems.

**APPENDIX II: Other Appendices**

Pictures for our hydroponic system can be found under List of Figures.