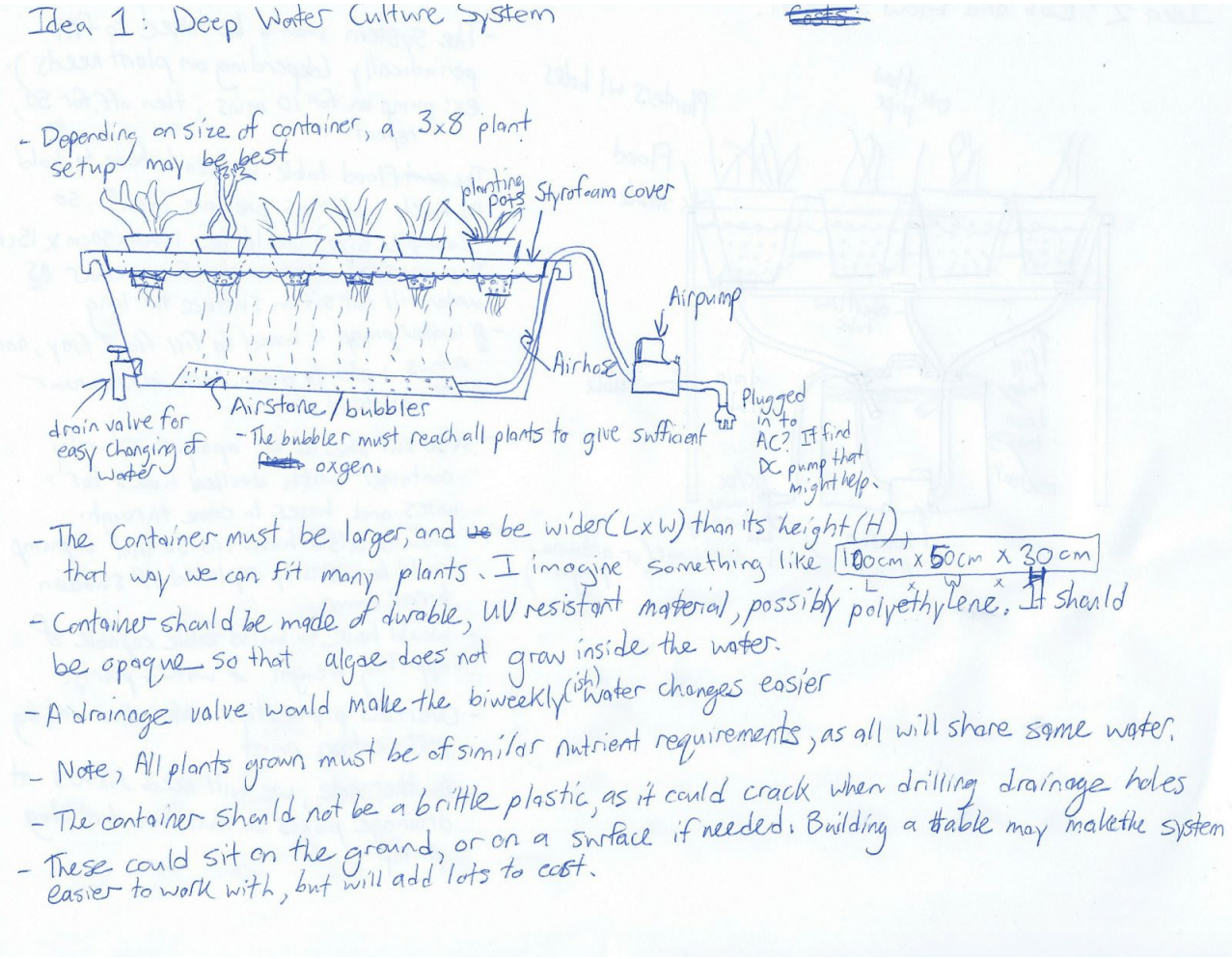
GNG1103 - Deliverable D
Hydroponics
Group B4

INTRODUCTION

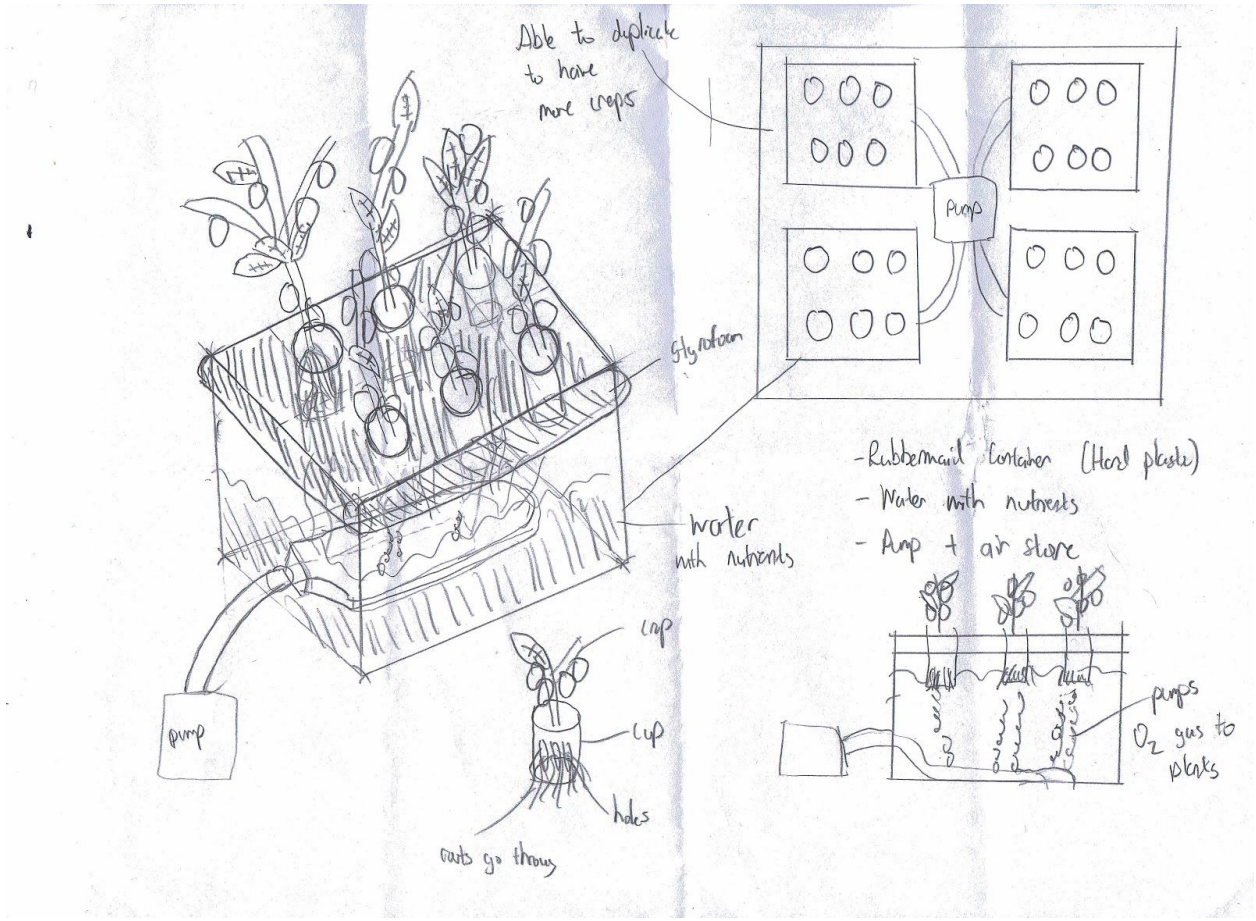
By using deliverable C problem statement, benchmarking and list of prioritized design criteria, we have developed conceptual designs for our hydroponics system. After analyzing and discussing our different ideas, we will produce a final design that will incorporate the best features on our different designs which will be used in our final design.

TEAM CONCEPTS

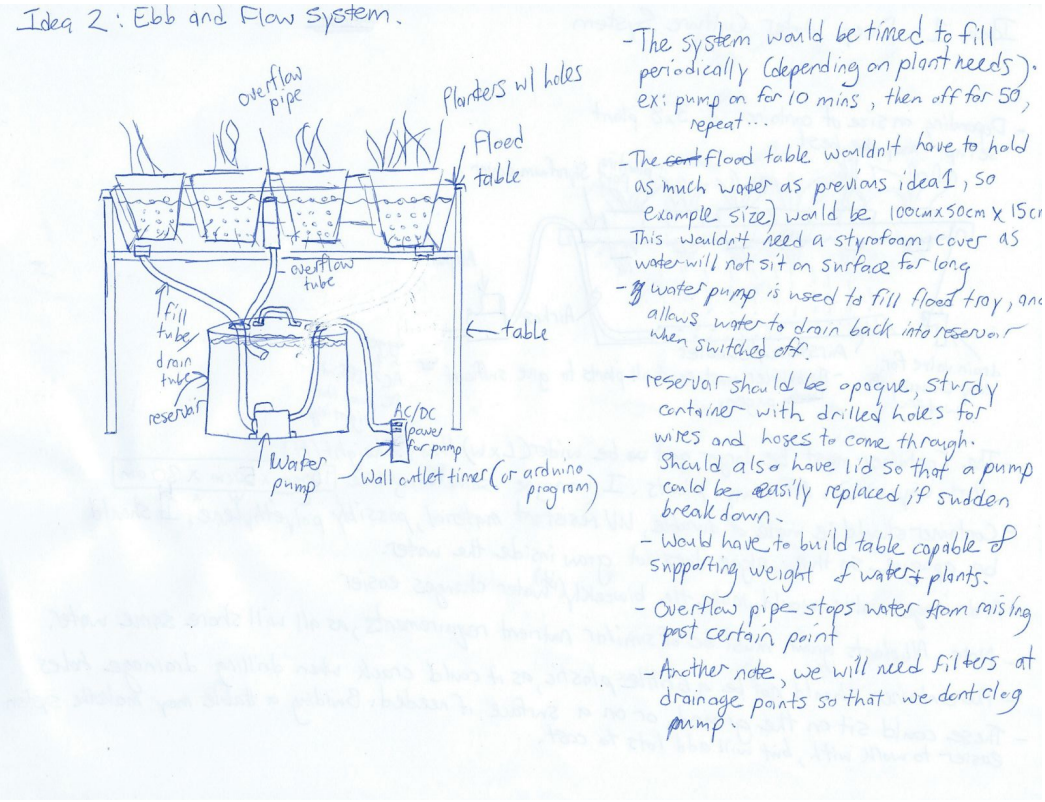
Daniel Concept 1:



Andre's Concept 1:

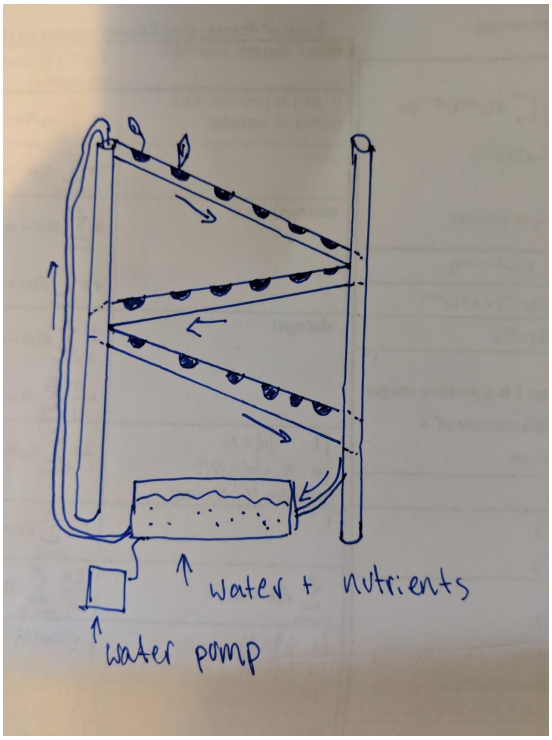


Daniel Concept 2:

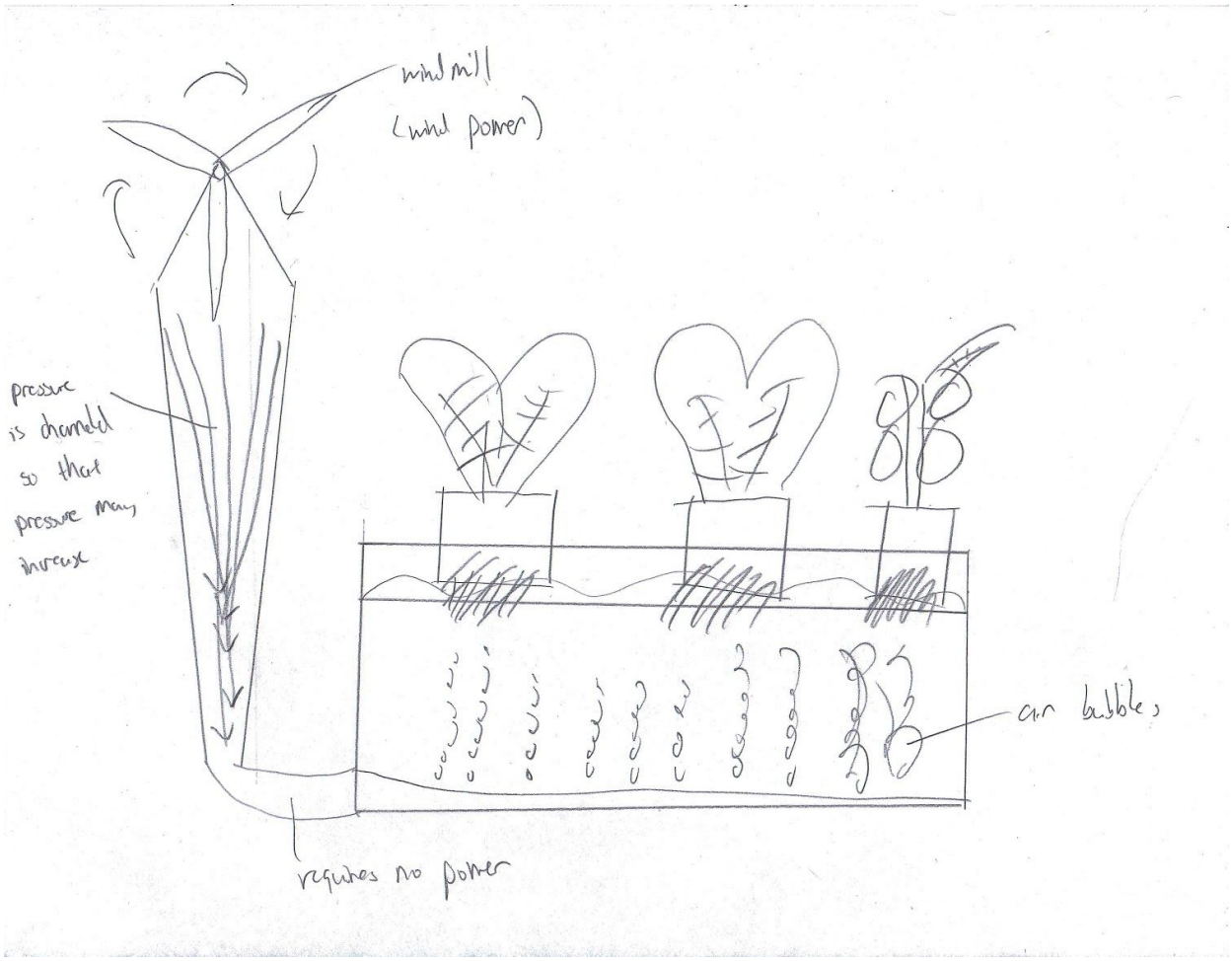


Haozhou's Concept:

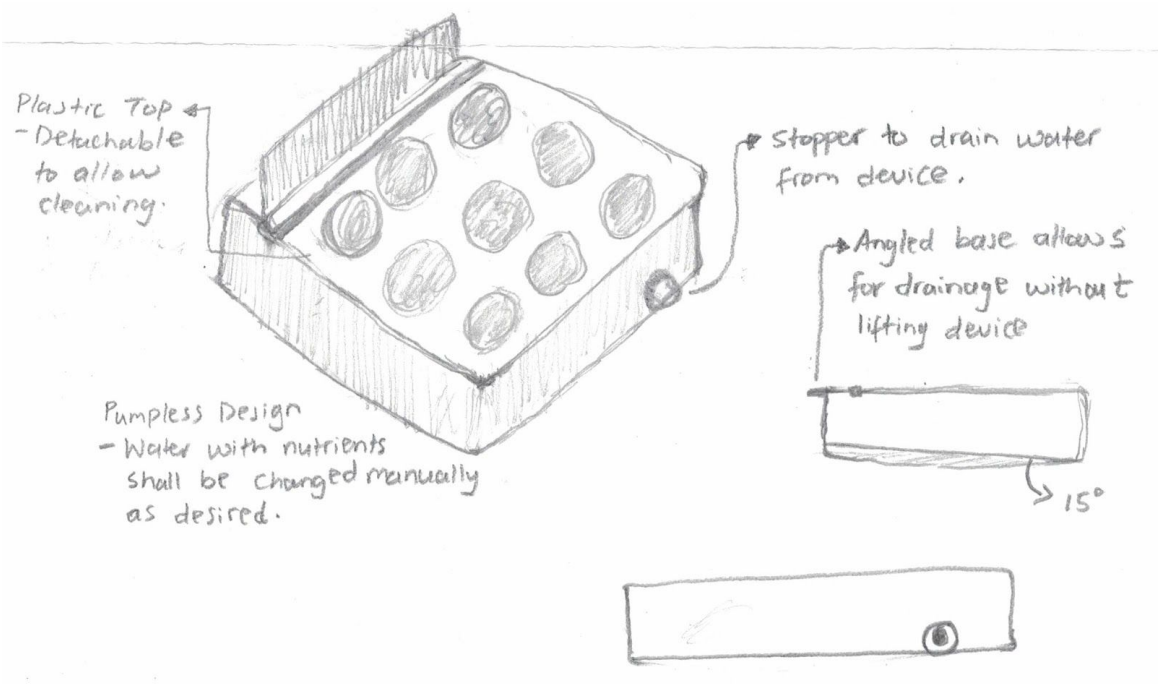
- This system uses gravity to run water/nutrients to the plants
- The water tank should be opaque to prevent the development of algae
- Water pump will be powered through solar panels
- This system will periodically pump water powered by a microcontroller
- Water reservoir will contain draining pumps for easy control over water levels



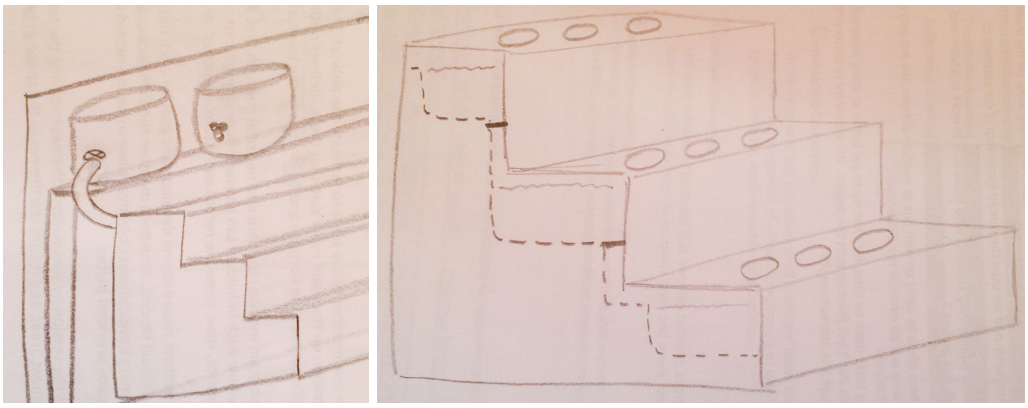
Andre's Concept 2:



Prince's Concept 1:

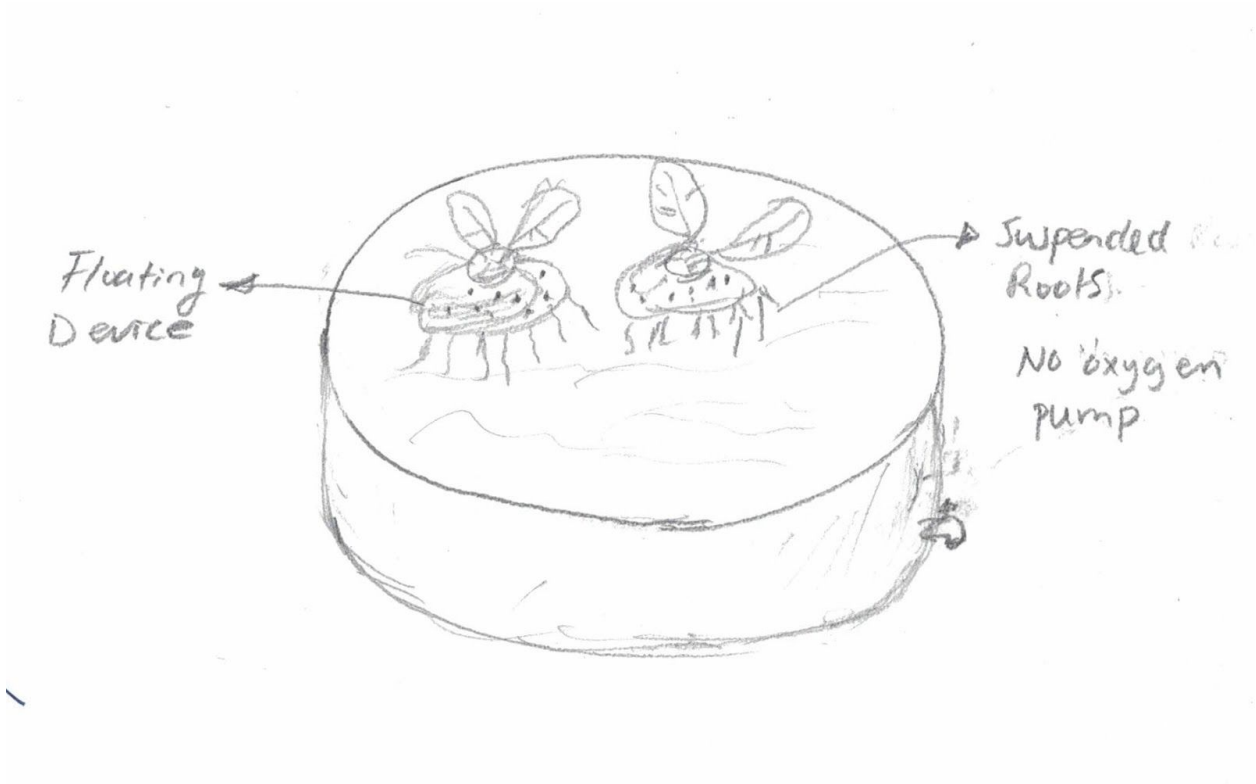


Carolina's Concept 1:



- Water reservoirs in high and "stairs shape" for the containers in order to use gravity for water flow.
- Fans will be powered through the energy system of the green house.
- Different water tanks with different solutions only to connect to the respective stair level through hoses.
- There will be different lids for the containers, with different capacity for plants. You can use the same base and just pick the lid that you prefer depending of the amount of vegetables you want to plant.
- Cons: Size and space not used.

Prince Concept 2:



DISCUSSION

Our design criteria, determined several needs for our system. The $100 budget is the primary limiting factor. After considering the information obtained from the client meeting, and the goal of the overall project, it was concluded the the dimensions of our system needs to be less than 60 in long by 36 in wide.. Ease of to use, low maintenance, and the capability to grow large volumes and variety of plants is of paramount importance.

It was decided that the Daniel's Concept 1 meets these criteria, however a smaller scale version of the system would be easier to find cheap parts for, and more easily upscaled for a future full-size version of the greenhouse.

Andre's design is another version of a deep water culture system very similar to Daniel's concept 1 where the roots of the plants are submerged under water and an airstone pump oxygenates the plants by pumping air bubbles to the surface of the water. Unlike Daniel's design, this system is designed to hold fewer, but larger plants. By having less plant cups, there is more room for the plants to grow, thus this system is capable of growing medium sized plants such as lettuce, tomatoes and swiss chard.

Additionally, Andre's and Daniel's first concept are both very cost-effective and can be easily scaled up. As shown in the sketch, each container can be duplicated to form multiple hydroponics systems. Four containers are drawn that are all linked to a central pump that is able to power four air stones at once. By doing this, it can minimize the amount of air pumps that are required and power would only have to run to that single air pump.

Daniel's Concept 2 was evaluated by the group, and did not seem to be as effective a solution because it includes a pump, a table, an additional reservoir, and other small additions that would add significantly to the project costs. However, this system would be able to grow many plants, and would be easy to use and maintain.

Andre's concept 2 was evaluated by the group, and did not seem to be an effective solution because the addition of a windmill provided more cons than pros. For example, using it is a big risk because it relies solely on wind power, therefore, if there is no wind, there will be no power for the system. In addition, it adds extra costs to the budget and can be very hard to maintain and build.

Benchmarking: (Green = 3, Yellow = 2, Red = 1)

Specifications	Concept design		
	DANIEL X1	**ANDRE X1**	**PRINCE X1**
System Cost ($) (4)	~ $90 - $100	~ $80 - $90	~ $70 - $80
Weight (kg) (1)	~ 6.5 kg	~ 5 kg	~ 5 kg
Dimensions (2)	(100 x 50 x 30) cm	(70 x 50 x 50) cm	(80 x 80 x 25) cm
Ease of Use (7)	Easy to use and user friendly. Can be dismantled for easy cleaning.	User friendly. Operation of device is self explanatory.	Simple to use but requires small amounts manual labour to fill device with water weekly.
Types of Crops (3)	Leafy crops (Lettuce, Celery, Kale etc.)	Thin-leaved crops (Spinach, Mizuno, Radicchio, etc.)	Bulky crops (Cabbage, Radish, Carrots, Cassava, etc.)
Build Quality & Maintenance (5)	Robust and Built to last. Requires occasional cleaning if algae begins to bloom.	Tough and sturdy. Requires occasional cleaning if algae appears.	Light but Rugged. Requires frequent change of water due to lack of oxygen pump.
Planting Capacity (6)	18 Bountiful leafy crops.	6 Nutritious crops and spices.	12 Healthy crops.
Total	**83**	**58**	**52**

* 1 = Less important and 7 = Most important

PROPOSED SOLUTIONS

After consulting all the concepts, the team decided that a deep water culture system was the ideal solution for the hydroponics system. DWC is one of the easiest ways to produce crops hydroponically as it requires minimal maintenance and prior knowledge. The roots of the plants are submerged in the water and an airstone pump would oxygenate the plants by pumping air bubbles to the surface. This airstone is powered by a central pump. The only required maintenance would be to change the water every week, to add more nutrients into the water and to scrub the containers clean to prevent a build up of algae.

CONCLUSION

For these reasons, Daniel's concept 1 was chosen as the main design of the hydroponics system because it met the most number of design criteria and is the ideal solution for the problem due to its easy to use deep water culture system, its minimal maintenance, and low cost.