

Hydroponics

Benchmark websites (can use as an example to base drawings off):

- <http://www.towergarden.ca/shop/growing-system>
- <https://zipgrow.ca/products/zipgrow-farm-wall>
- <https://nutritower.com/wp-content/uploads/2017/05/Web-brochure.pdf>

Different system:

- <http://www.simplyhydro.com/system.htm>
- I think the flood and flow or the nutrient film technique would work best with our design

Check makerspace.ca for materials

Deliverable C ideas

- Need to do benchmarking
 - What materials are we going to use (plastic, rubber...)
 - lightweight metal (Allaura)
- Design specification
 - Specifications were laid out in deliverable B, I've started on C at the bottom of the page based on what I think the excel rubric is describing (Allaura)

Deliverable B: Needs Identification and Problem Identification Statement

Team 5: Allaura, Mary-Kate, Haya, Jacqueline

The students in charge of the grow walls in partnership with Growing Futures are finding issues with their hydroponic walls. They came to us to develop an improved system that could replace their current growing walls. This document outlines the interpreted needs from the first interview and defines the problem statement.

Needs:

- Small enough to be harvested by children and those in wheelchairs.
- Portable and able to fit in an elevator.
- Large enough reservoir so as not to dry out during long weekends and holidays.
 - Sensor for when the reservoir is empty and to measure pH levels potentially connected to an app.
- An unobstructed place for branding explaining the story of “Growing Futures”.
- Lights that need to move and sturdy, while not singes the plants
- Some system to protect the plants from bugs
- Modules need to be light and easily removable without damaging the plants

Prioritization:

1.	Lightweight/Maneuverable	5
2.	Water management	5
3.	Modularity	4
4.	Height	5
5.	Number of Plants	4
6.	Branding	3
7.	Bugs	2
8.	Lighting	3

Problem Identification Statement:

There exists a need for elementary school children to grow plants in a hydroponic grow wall which is portable, allows all the children to participate, alerts them when the water supply is running low, minimizing the contact bugs can have with the plants, and preventing the lights from burning the plants all while maximizing the amount of plants that can grow and tell the story of the “Growing Futures” brand.

Benchmarking:

	Plants	Size	Maneuverable	Weight	Water Management	Lighting	Modularity
Ice Plus	20	30"	-	Light	-	Yes	-
ZipGrow	64	5"	-	Heavy	-	Yes	Yes
VertiTower	24	89'	-	3 lbs	-	Yes	Yes

Metrics:

	<u>Design Specifications</u>	<u>Relation</u> (=, < or >)	<u>Value</u>	<u>Units</u>	<u>Verification Method</u>
	Functional Requirements				
1	Number of Plants	>	20	Plants	Analysis
2	Water Management	>=	76	Liters	Analysis
3	Modularity	=	Yes	-	Analysis
4	Lighting	=	Yes	-	Analysis
	Constraints				
1	Height	=	41	Inches	Analysis
2	Lightweight/ Maneuverable	=<	68	Pounds	Analysis
	Non-Functional Requirements				
1	Branding	=	Yes	-	Analysis

In the process of creating a new growing wall system the above must be considered in all stages of the design process. Finding individual solutions to each problem will not be sufficient if the wall does not function as a unit, therefore a general design showing the interconnections will be beneficial to creating prototypes.

Deliverable C: Design Criteria

Team 5C: Allaura, Mary-Kate, Haya, Jacqueline

Based on the first customer meeting with the students using the growing wall in partnership with Growing Futures a list of requirements was compiled and prioritized. Further research was done on products already available to use as benchmarks for our design. From these criteria, this document will provide ideas and potential prototype models.

Benchmarking:

	Plants	Size	Maneuverable	Weight	Water Management	Lighting	Modularity
Juice Plus	20	30"	-	Light	-	Yes	-
ZipGrow	64	5"	-	Heavy	-	Yes	Yes
UrtiTower	24	89"	-	68 lbs	-	Yes	Yes

Metrics:

	<u>Design Specifications</u>	<u>Relation</u> (=, < or >)	<u>Value</u>	<u>Units</u>	<u>Verification Method</u>
	Functional Requirements				
1	Number of Plants	>	20	Plants	Analysis
2	Water Management	>=	76	Liters	Analysis
3	Modularity	=	Yes	-	Analysis
4	Lighting	=	Yes	-	Analysis
	Constraints				
1	Height	=	41	Inches	Analysis
2	Lightweight/ Maneuverable	=<	68	Pounds	Analysis
	Non-Functional Requirements				
1	Branding	=	Yes	-	Analysis

Criteria 1: Plants

From the interview with the client we know that their current wall (ZipGrow) holds 64 individual plants and that our design is required to hold from 20 to 64 plants in order to continue with their business. The ZipGrow uses a metal compartment shaped similarly to an eavesdrop that contains steel wool. Issues with the current container is that it prevents water from distributing evenly to all the plants in the container.

Solutions:

1. Rotate the containers holding the plants. Have the grow wall be horizontal rather than vertical.
2. Have the containers on a slope with the water dripping higher above the first plant. The water running through the steel wool or other material will ensure that all plants receive similar amounts of water.
3. Instead of an eavesdrop like container, have pods that contain plants and a similar tube that they are attached to.

Criteria 2: Water Management

The interview revealed that the client is frequently not at the location of the growing wall for some time (varying from a weekend to Christmas break), as a result the reservoir will run dry without any notice or warning. It is also difficult to judge how much water is currently in in reservoir. Their reservoir holds 76 liters of water at a time and they refill it with about 10-15 liters every week.

Solutions:

1. Clear plastic on a visible part of the reservoir to enable easy checking of the reservoir and a second reservoir for weeks away that pumps into the first.
- 2.

Criteria 3: Modularity

Some of the plants in the container are damaged when the container is removed. It is necessary for our model to have modularity for simply cleaning and harvesting.

Solutions:

1. Lightweight materials to facilitate modularity, without damaging the plants.
2. Having the modules horizontally, will help improve the modularity by making it easier for the children to take it apart.

Criteria 4: Lighting

Plants are occasionally singed by the lights that are near them resulting in loss of product. LED bulbs are what the market is moving to use more frequently.

Solutions:

1. Making sure the lights are at the right distance to still be effective without causing damage to the plants.

Criteria 5: Height

Not all the elementary children working with the ZipGrow wall can currently reach the plants so their involvement is limited. Our wall need to allow children in wheelchairs to access part. The minimum height of a plant container is 35 inches from the ground, this is considering the average height of a kindergartener.

Solutions:

1. Make the grow wall short

Criteria 6: Lightweight/Maneuverable

The grow wall is moved occasionally and is taken in elevators. Our design needs to fit in an elevator with ease and maneuverable by our clients (children). The maximum weight is 68 pounds, which is the weight of the NutriTower. Research is need to see the amount the average elementary school child can push on wheels.

Solutions:

1. PVC pipe
2. Lightweight metals

Criteria 7: Branding

The client is looking to expand the locations of the grow walls and would like to be able to brand the wall with their logo and story. The location of the branding needs to be visible even with plants in the wall.

Solutions:

1. On the side (non moveable area)
2. Flag like (retractable)

While creating the design for a new growing wall system the topics of harvest size, water management, modularity, lighting, height, maneuverability, and branding must be considered. Further research will have to be done on the materials to be used for the modules, the wall mount, hinges for portability, and the frame for the growing wall as there is a lapse in knowledge on that subject in our group. Examples we can learn from are the current grow walls that schools have.

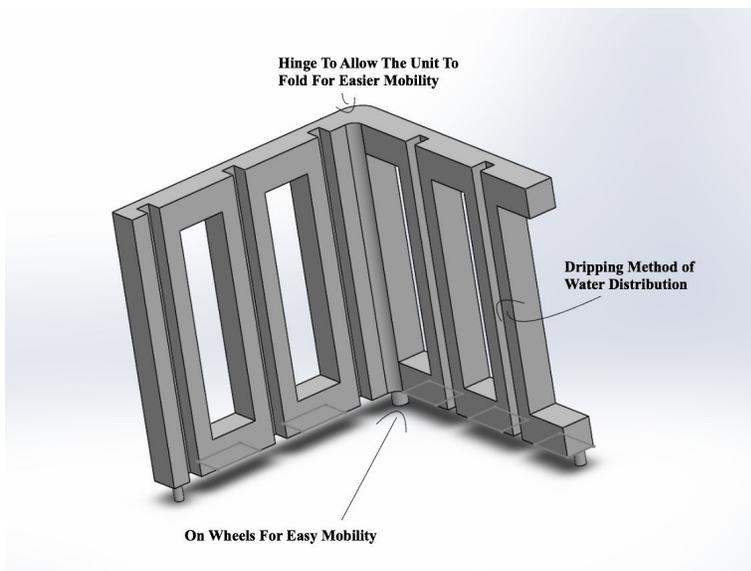
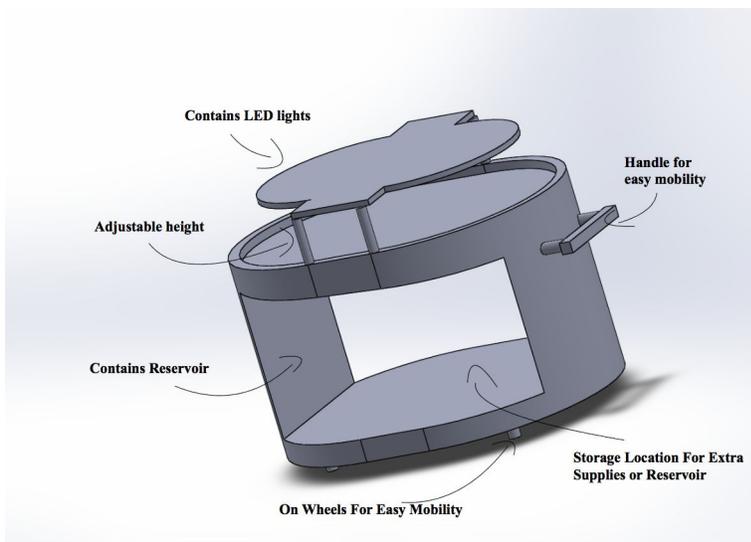
Deliverable D: Conceptual Design

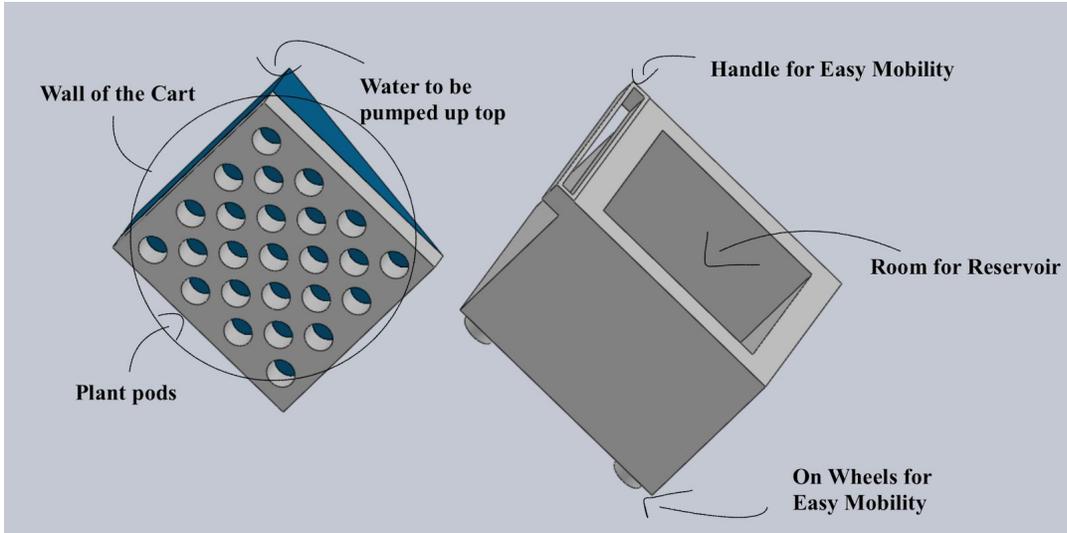
Team 5C: Allaura, Mary-Kate, Haya, Jacqueline

In preparation for our second meeting with the clients we are focusing our attention to the subsystem of the growing wall that we have decided to improve: the maneuverability. Each of our members have created three designs for possible solutions, this document will showcase and explain those designs. After explaining each design, we will come together to decide our best approach considering all the designs.

Individual member's design:

Mary-Kate:

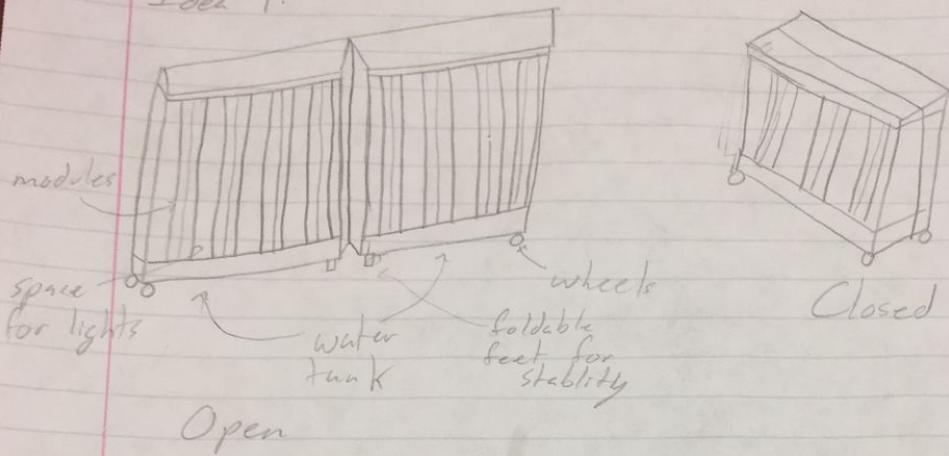




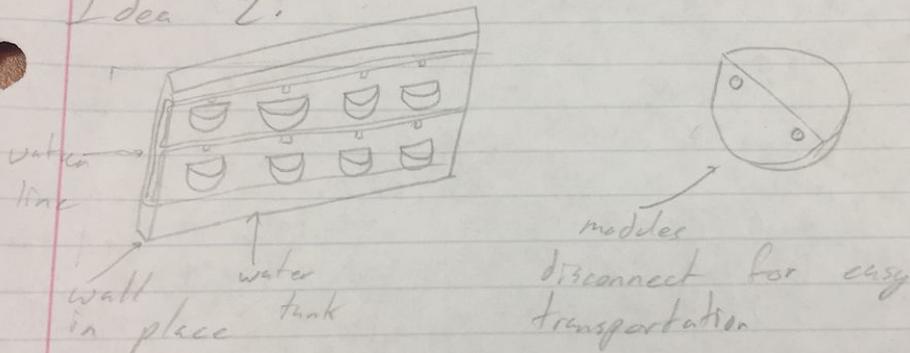
Allaura:

Allaura

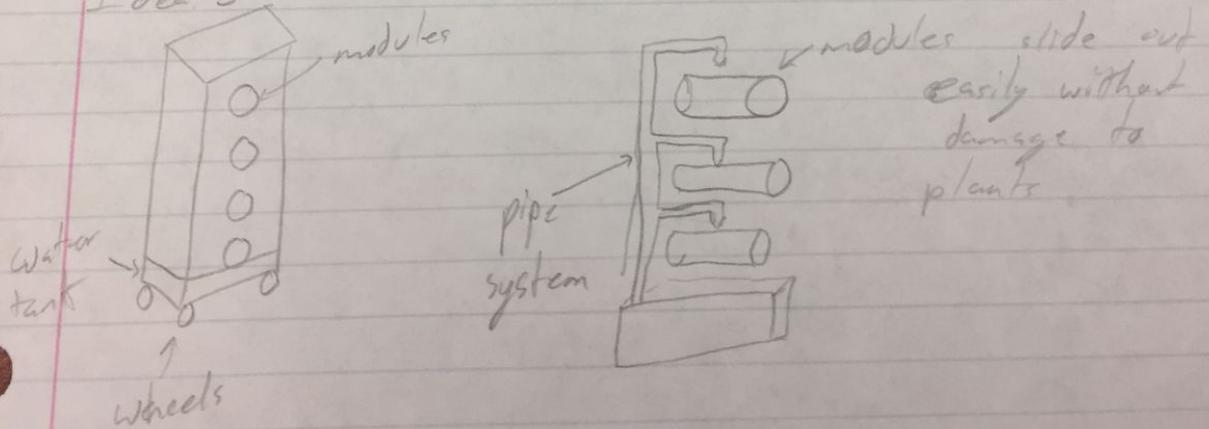
Idea 1:



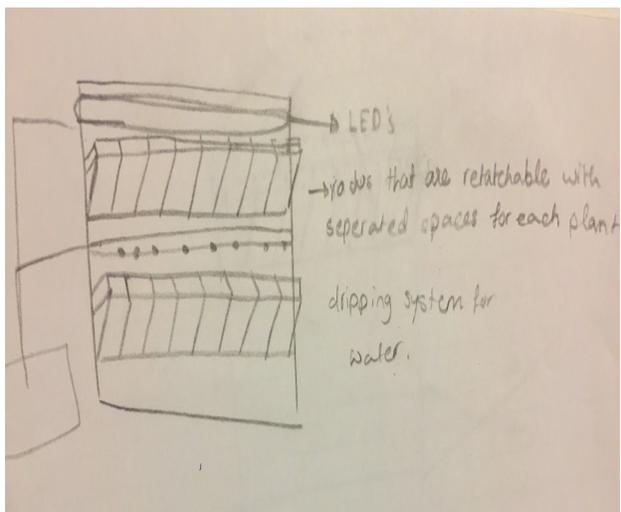
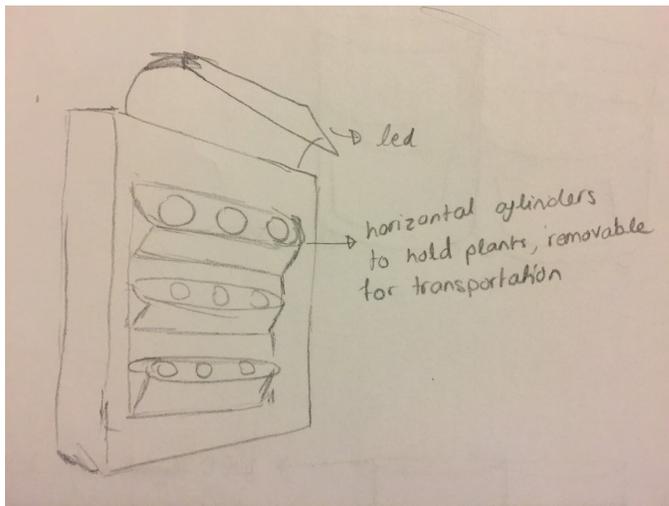
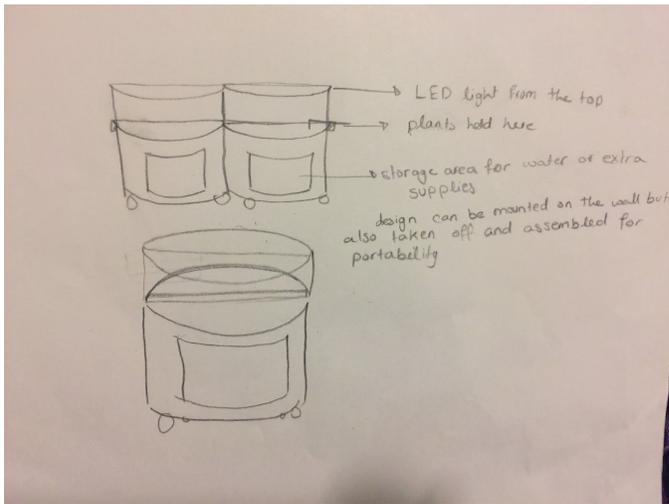
Idea 2:



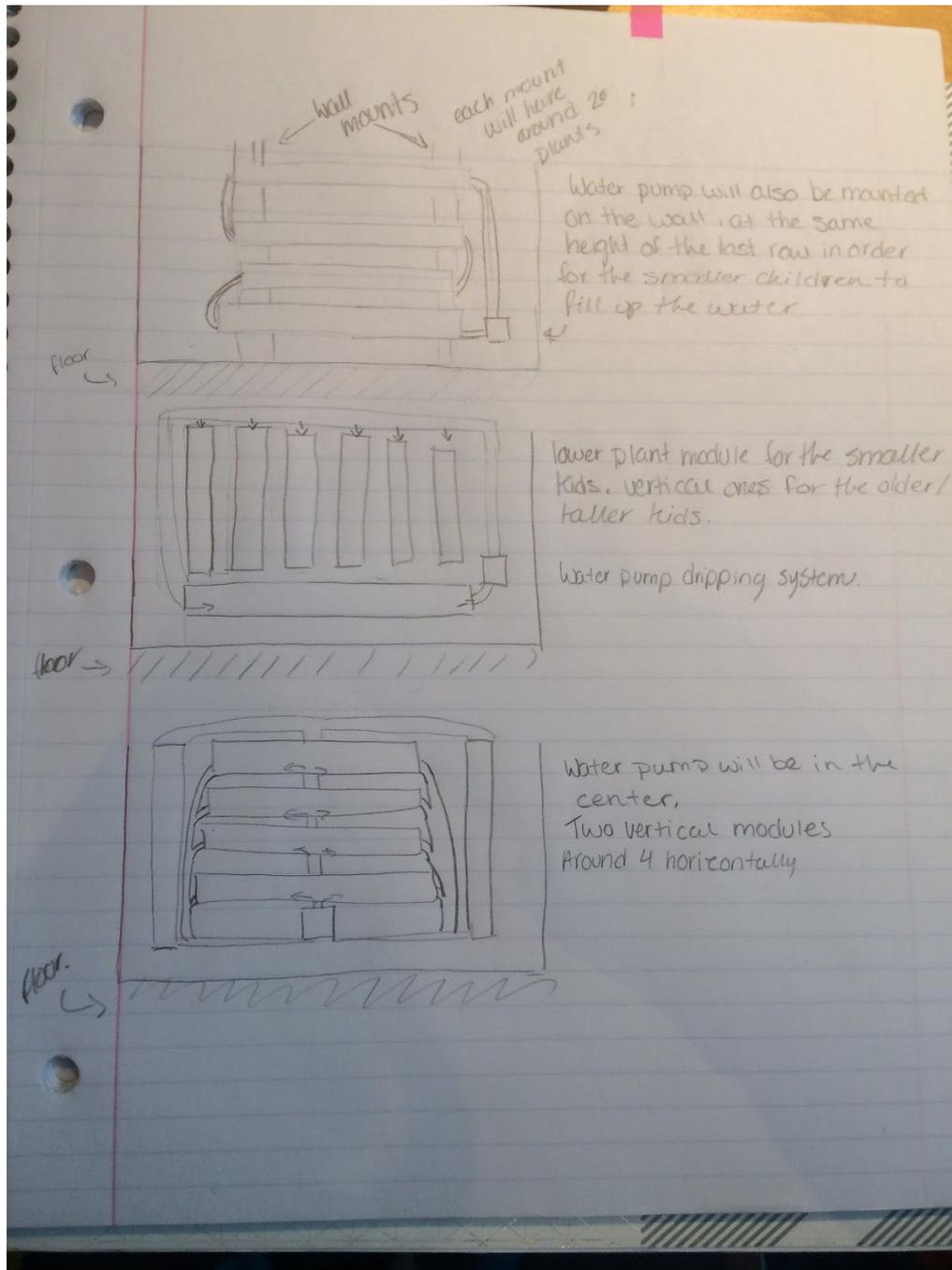
Idea 3:



Haya:



Jacqueline:



Finalized team agreed design:

A combination of Haya and Mary-Kate's first designs. A round cart that opens into semi-circles against a wall.

Our chosen design is best suited to the subsystem of maneuverability and is centered around that criteria. There are some consideration shown for the modularity and height without specifically targeting those subsystems. The design will be further improved upon with prototyping and testing.

Deliverable E: Project Plan and Cost Estimate

Team 5: Allaura, Mary-Kate, Haya, Jacqueline

In order to achieve successful prototyping, this document outlines a schedule in accordance with deadlines set by the time we have to create the design and outlines possible problems that may arise from the development phase. Our material cost is also included, allowing us to track our spending and find the best value materials in time for our final prototype.

List of all the tasks which need to be completed

- Prototype 1 and customer feedback
 - Due March 4th at 11:59 pm
 - Steps:
 1. Select a final idea of the design (all) (1 day)
 2. Buy the necessary material to create a drawing or prototype of the final idea (Jacqueline, Haya) (2 days) (Dependency: 1)
 3. Make draft copies of the 3 points of view, of the final idea and determine the dimensions/scale (Allaura) (2 days) (Dependency: 2)
 4. Select the appropriate draft copies or sketches for the final (all) (1 day) (Dependency: 3)
 5. Make the diagram with the three views for prototype 1 (Haya) (1 day) (Dependency: 3)
 6. Group feedback and return to the draft copies from step 3 if needed (all) (1 day) (Dependency: 5)
- Prototype 2 (Use 3D printing)
 - For this part, there will be no cost since the University of Ottawa allows students to use the 3D printers in the Makerspace lab.
 - Steps:
 1. Create a design (STL) on solidworks (Mary-Kate, Allaura) (4-5 hours)
 2. Print the design (all) (2 days of 8 hours each)
 - Most critical prototype/subsystem (will ensure that the design will work or not)
 - An analytical, numerical or experimental model should be included.
- Prototype 3
 - Steps:
 1. List the strengths and weaknesses of the first two prototype (all)
 2. Combine all of the assets of the previous prototypes
 3. Create a detailed drawing of the improved design (including the correct scales and dimensions) with multiple views with a list of all the materials needed
 4. Purchase all necessary material for the final prototype with the costs not exceeding \$100
 5. Once all materials purchased, build the final prototype

Fully functional version of our solution

Project Risks:

- Prototype completely fails and does not hold up during testing.
 - To mitigate this risk, our team will invest a lot of time in research to ensure that the materials we use are the best option. Additionally, we will leave sufficient time in our schedule to allow for damage control on the prototype to occur.
- Materials that are ordered online are not delivered in time for the final prototype to be constructed.
 - To mitigate this risk, our team will only order materials from other parts of Canada or the United States so as to cut down on shipping time and costs
- Materials that are ordered online are flawed, or broken during shipping.
 - To mitigate this risk, our team will ensure that we only purchase materials from reputable sources
- Communication between team members completely breaks down and the different components of the project are not cohesive.
 - To mitigate this risk, our team will continue to use various platforms to communicate including but not limited to: Google docs, Facebook messenger, and iMessage. Additionally, our group will have project updates at our weekly meetings to ensure that all parts of the project are progressing as expected.
- Construction of the prototype is too lengthy a process and a final product is not created.
 - To mitigate this risk, our team will use Microsoft project to it's full advantage to ensure that enough time is allotted to each task so that each project deliverable can be completed in a timely manner.

For Pump:

https://www.amazon.ca/Hydrofarm-AAPW160-Active-Aqua-Submersible/dp/B002JPGE6S?source=googleshopping&locale=en-CA&tag=googcana-20&ref=pd_sl_8rzk88ebbc_e

For wheels:

https://www.amazon.com/bayite-Profile-Casters-Capacity-without/dp/B071GTK6NZ/ref=sr_1_6?ie=UTF8&qid=1519581608&sr=8-6&keywords=castors

Reservoir:

<https://www.walmart.ca/en/ip/gracious-living-garbage-container-with-domed-lid/6000193605323>

Hinges:

http://www.canadadecor.ca/Prd/2134081/B-Hickory-Hardware-1526/?utm_source=Google&utm_medium=CPC&utm_campaign=PLA_1526_HH&mt=&k1=&ap=1o6&utm_adgroup=1526_HH&gclid=EALalQobChMIslyM0NfB2QIVD7nACh1OgQ9dEAYYBiABEgLaVvD_BwE&isf=1

LEDs:

https://www.lightinthebox.com/led-strip-lights-kit-5050-waterproof-5m-300leds-rgb-60leds-m-with-44key-ir-controller-and-5pcs-mounting-bracket-dc12v_p5895488.html?currency=CAD&litb_from=paid_adwords_shopping&country_code=ca&utm_source=google_shopping&utm_medium=cpc&adword_mt=&adword_ct=203563514094&adword_kw=&adword_pos=1o6&adword_pl=&adword_net=g&adword_tar=&adw_src_id=4674349488_857972391_50662388824_pla-33042255

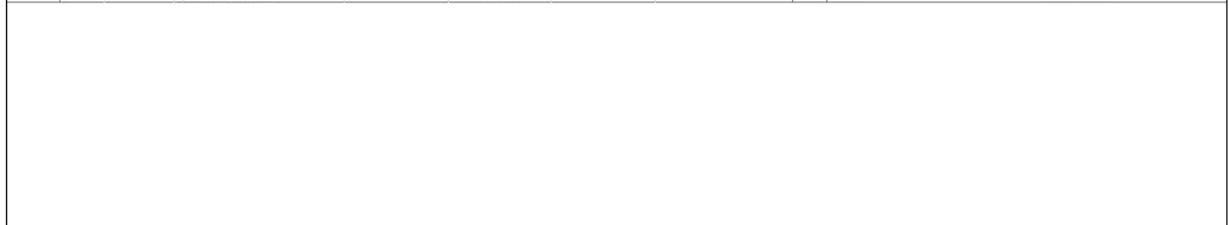
[3963&gclid=Cj0KCQiA2snUBRDfARIsAIGfpqHzabx0JuqBME3KePdR5IRsMtdBMv4Gfh-ETfQO0Xq7I4DI7I6jxFUaAgvCEALw_wcB](https://www.google.com/search?q=3963&gclid=Cj0KCQiA2snUBRDfARIsAIGfpqHzabx0JuqBME3KePdR5IRsMtdBMv4Gfh-ETfQO0Xq7I4DI7I6jxFUaAgvCEALw_wcB)

List of materials required for prototype 3 with costs		
Item	Cost per unit	Total cost
Wheels (x4)	N/A	10\$
Pump	N/A	20\$
Tubing	N/A	10\$
Reservoir	N/A	10\$
Cart	N/A	25\$
Hinges (x4)	N/A	11\$
LED lights	N/A	14\$
Total cost:		100\$

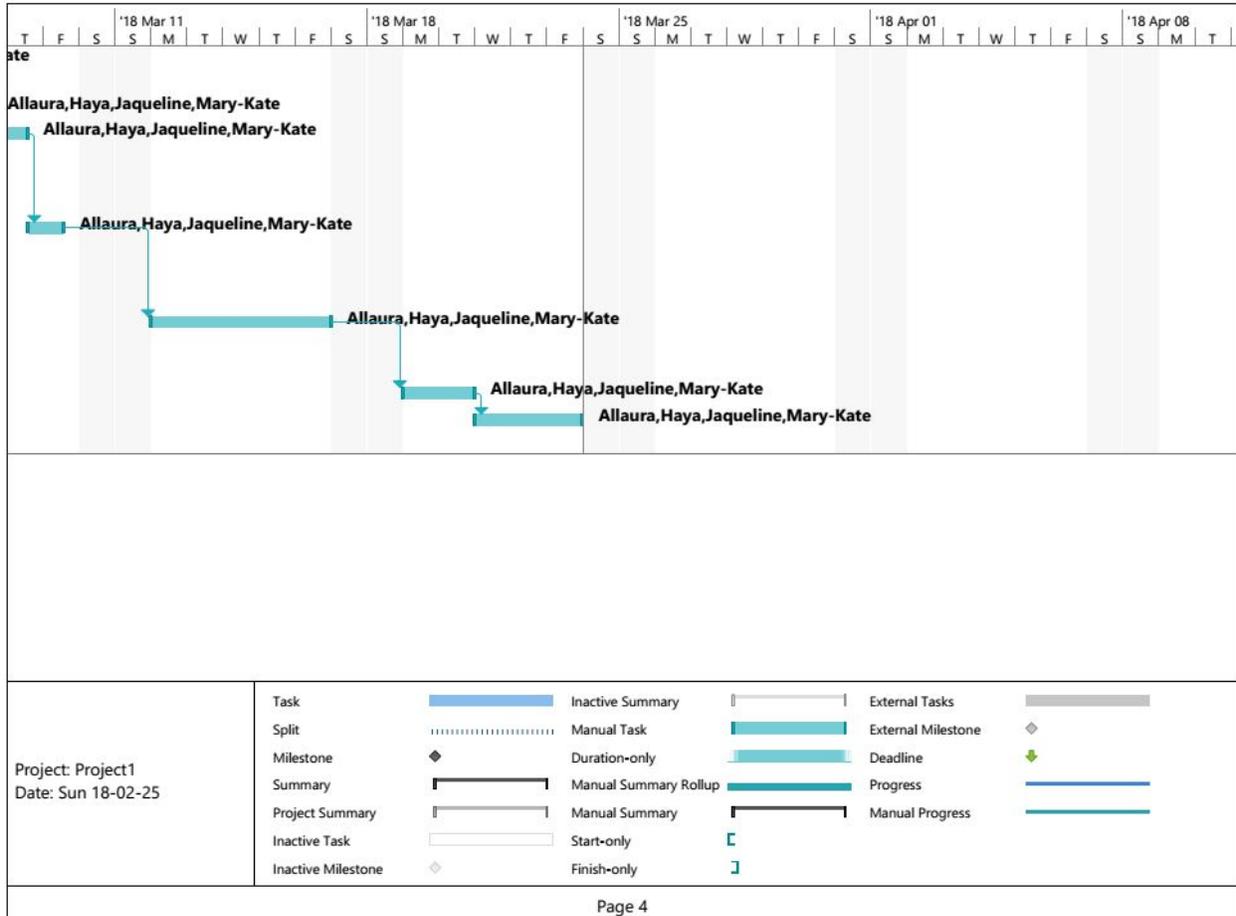
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Gantt Chart (18 Feb 25 to 18 Mar 04)													
1		Select a final idea of the design	1 day	Sun 18-02-25	Sun 18-02-25		Allaura, Haya, Jaqueline, Mary-Kate													
2		Buy all necessary material to create a drawing or prototype of the final idea	2 days	Mon 18-02-26	Tue 18-02-27	1	Haya, Jaqueline													
3		Make Draft copies of the 3 points of view of the final idea and determine the dimensions and scale	2 days	Tue 18-02-27	Wed 18-02-28	2	Allaura													
4		Select the appropriate draft copies or sketches for the final	1 day	Thu 18-03-01	Thu 18-03-01	3	Mary-Kate, Haya, Jaqueline													
5		Make the diagram with the three views for prototype 1	1 day	Fri 18-03-02	Fri 18-03-02	4	Haya													
6		Group feedback and return to the draft copies from step 3 if needed	1 day	Fri 18-03-02	Fri 18-03-02		Allaura, Haya, Jaqueline													

Project: Project1 Date: Sun 18-02-25	Task		Inactive Summary		External Tasks	
	Split		Manual Task		External Milestone	
	Milestone		Duration-only		Deadline	
	Summary		Manual Summary Rollup		Progress	
	Project Summary		Manual Summary		Manual Progress	
	Inactive Task		Start-only			
	Inactive Milestone		Finish-only			

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	'18 Feb 25							'18 Mar 04				
							S	S	M	T	W	T	F	S	S	M	T	W
7	★	Create design on solidworks	5 hrs	Mon 18-03-05	Mon 18-03-05	6												
8	★	3D print the design	2 days	Mon 18-03-05	Wed 18-03-07	7												
9	★	List the strengths and weaknesses of the first two prototypes	1 day	Wed 18-03-07	Thu 18-03-08	8												
10	★	Combine all assests of the previous prototypes	1 day	Thu 18-03-08	Fri 18-03-09	9												
11	★	Create a functional version of our design	5 days	Mon 18-03-12	Fri 18-03-16	10												
12	★	Test	2 days	Mon 18-03-11	Tue 18-03-20	11												
13	★	Prepare for presentation	3 days	Wed 18-03-21	Fri 18-03-23	12												



Project: Project1 Date: Sun 18-02-25	Task		Inactive Summary		External Tasks	
	Split		Manual Task		External Milestone	
	Milestone		Duration-only		Deadline	
	Summary		Manual Summary Rollup		Progress	
	Project Summary		Manual Summary		Manual Progress	
	Inactive Task		Start-only			
	Inactive Milestone		Finish-only			



By following the schedule we have outlined and tracking our costs, our design will be successful. Changes will have to be made to the schedule when the problems discussed above are encountered, however, we have left enough room in the schedule that there should not be any problems with rescheduling.

Deliverable F: Prototype I and Customer Feedback

Team 5: Allaura, Mary-Kate, Haya, Jacqueline

Test planning steps

1. Define the purpose of the test
 - a. Q: What are you trying to figure out or learn your prototype?
2. Choose a specific design concept (or part of a concept)
 - a. Target measurable attributes
3. Choose a testing method
 - a. Examples: analytical simulation, physical prototype test, etc.
4. Perform the test
5. Measure the important attributes, observe and record the results carefully
6. Interpret the results (i.e. are they applicable?) and document your conclusions, reviewing them with others

Why are we doing this test?

Introduction; Capture the reasons for the test, giving enough background information to justify doing any prototyping at all. Is the general objective one of: learning, communication, de-risking, ect.

The objective behind prototyping is to de risk and visualize the size of the cart, making sure that it would fit through a door and if the concept of a cart that would unfold from its original cart state into a wall unit is implementable.

Test Objectives Description

What are the specific test objective?

See if the design can hold all the components, fit in an elevator, and open and close.

What exactly is being learned or communicated with the prototype?

We are learning on how all the dimensions will work, and we can learn if anything is missing in our design.

What are the possible types of result?

The dimensions are correct in order to fit through doorways including the elevator door.

How will these results be used to make decisions or select concepts?

The results will be used to improve the functionality of the design.

What are the criteria for test success or failure?

It contains all the components, fits in the elevator, and opens and closes.

What is going on and how is it being done?

Describe the prototype type (focused or comprehensive) and the reason for the selection of this type of prototype.

The prototype type is a comprehensive, and the reason for it is that finalizing our final design concept in a manner that enables us to visualize what our final product will look like.

Describe the testing process in enough detail to allow someone else to build and test the prototype instead of you.

The testing process for the first prototype is a recreation of the design to finalize the dimension, however, the prototype will be a fourth of the size of the final product. To choose our dimension we took our design and found the ideal spacing for the plants and their pots and found the required reservoir size (from the customer interview).

What information is being measured?

Modularity, height and portability..

What is being observed and how is it being recorded?

The portability, modularity and size of the unit is being

What materials are required and what is the approximate estimated cost?

For the prototype the university is providing cardboard. However, the final prototype will have a material cost of \$100.

What work (test software or construction or modeling work or research) needs to be done?

Research on the nettings for the pots.

When is it happening?

How long will the test take and what are the dependencies (what needs to happen before the testing can occur)?

Before testing can occur we must create a full size model of the design and calculate the weight of the water in the reservoir. Taking the weight of the water into account the ideal metal can be determine to increase the strength of the cart and minimize its weight. Testing should take about a day.

A separate test planning chart can be created to help making sure that the testing fits with the overall project schedule or it can be defined as part of that schedule (as a sub-task).

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	
1		Select a final idea of the design	1 day	Sun 18-02-25	Sun 18-02-25		
2		Buy all necessary material to create a drawing or prototype of the final idea	2 days	Mon 18-02-26	Tue 18-02-27	1	
3		Make Draft copies of the 3 points of view of the final idea and determine the dimensions and scale	2 days	Tue 18-02-27	Wed 18-02-28	2	
4		Select the appropriate draft copies or sketches for the final	1 day	Thu 18-03-01	Thu 18-03-01	3	
5		Make the diagram with the three views for prototype 1	1 day	Fri 18-03-02	Fri 18-03-02	4	
6		Group feedback and return to the draft copies from step 3 if needed	1 day	Fri 18-03-02	Fri 18-03-02		

Project: Project1
Date: Sun 18-03-04

Task		Inactive Summary		External Tasks
Split		Manual Task		External Milestone
Milestone		Duration-only		Deadline
Summary		Manual Summary Rollup		Progress
Project Summary		Manual Summary		Manual Progress
Inactive Task		Start-only		
Inactive Milestone		Finish-only		

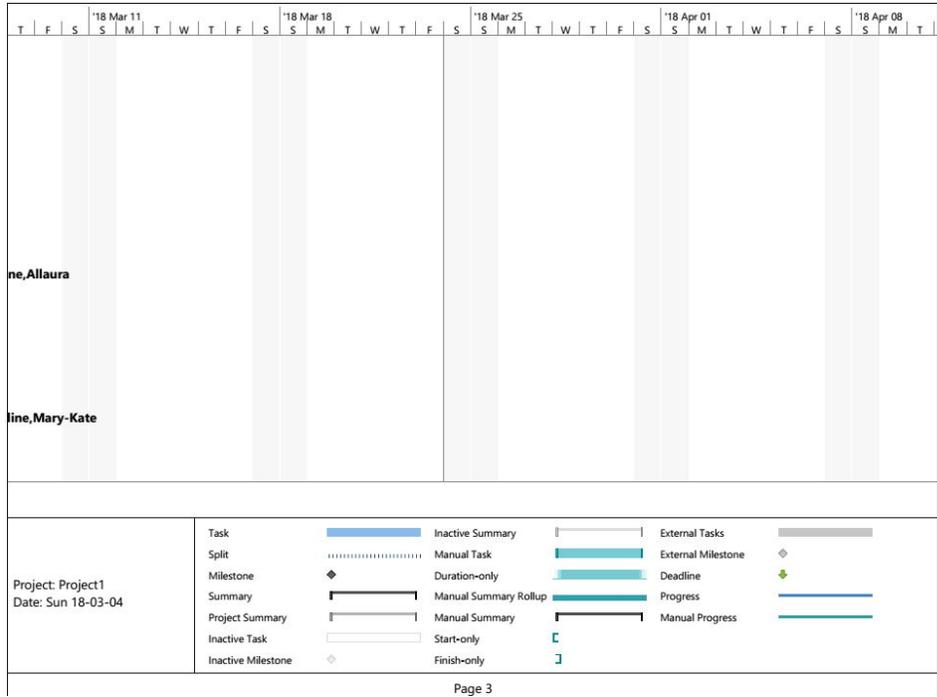
Page 1

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors	
7		Create design on solidworks	5 hrs	Mon 18-03-05	Mon 18-03-05	6	
8		3D print the design	2 days	Mon 18-03-05	Wed 18-03-07		
9		Test (Designed in Deliverable F)	1 day	Mon 18-03-05	Tue 18-03-06	7	
10		List the strengths and weaknesses of the first two prototypes	1 day	Wed 18-03-07	Thu 18-03-08	8	
11		Combine all assesst of the previous prototypes	1 day	Thu 18-03-08	Fri 18-03-09	10	
12		Create a functional version of our design	5 days	Mon 18-03-12	Fri 18-03-16	11	
13		Test	2 days	Mon 18-03-11	Tue 18-03-12		
14		Prepare for presentation	3 days	Wed 18-03-21	Fri 18-03-23	13	

Project: Project1
Date: Sun 18-03-04

Task		Inactive Summary		External Tasks
Split		Manual Task		External Milestone
Milestone		Duration-only		Deadline
Summary		Manual Summary Rollup		Progress
Project Summary		Manual Summary		Manual Progress
Inactive Task		Start-only		
Inactive Milestone		Finish-only		

Page 2



When are the results required (what depends on the results of this test in the project plan)?
 The results required are the general dimensions of the design and the area's of the tubing. The results are required by March 6th, so that we are able to begin the second prototype.

End of Test Plan Template

Stopping Criteria:

- When the risk is very minimal
- When the cart's design contains all components
- When an average amount of plants can be planted (preferably more than the minimum 20)

GROUP 5C-GROW CART

Focus

- Mobility
- Ease of Access

Limit

- Plant Numbers

Considerations

- Modularity
- Water supply

Hello. Our design is focused on what we found to be the most pressing issues and combined that with the limits given to us in terms of the number of plants you need to

Here what I'll say:

*Hello. My name is Allaura, this is *Introduce everyone*. Our design is focused on what we found to be the most pressing issues and combined that with the limits given to us in terms of the number of plants you need to continue your business at a decent pace. We focused on mobility and ease of access, though we didn't want to forget about the other areas of concern, mainly, modularity and water supply. Our design will be using a flood flow watering system, and pods to hold the plants. Our grow method will be expandable clay pellets. The pellets are reusable and although there is a danger of them drying out, the flood-flow watering system on a timer should counteract that danger. Now my colleague Mary-Kate will explain more about our first prototype.*

Deliverable G: Prototype II and Customer Feedback

Team 5: Allaura, Mary-Kate, Haya, Jacqueline

Test planning steps

1. Define the purpose of the test
 - a. Q: What are you trying to figure out or learn your prototype?
2. Choose a specific design concept (or part of a concept)
 - b. Target measurable attributes
3. Choose a testing method
 - c. Examples: analytical simulation, physical prototype test, etc.
4. Perform the test
5. Measure the important attributes, observe and record the results carefully
6. Interpret the results (i.e. are they applicable?) and document your conclusions, reviewing them with others

Why are we doing this test?

Introduction; Capture the reasons for the test, giving enough background information to justify doing any prototyping at all. Is the general objective one of: learning, communication, de-risking, ect.

The objective behind the second prototype is to learn if the cart at full scale will fit in an elevator and through doorways. As our design's focus is size and mobility this test is essential to the idea of the project.

Test Objectives Descriptions

What are the specific test objective?

The specific test objective is to create the body of the cart for it to fully function as a wall unit and for it fold into a cart to fit through doorways and into an elevator.

What exactly is being learned or communicated with the prototype?

The prototype is showing the exact dimensions of the final cart.

What are the possible types of results?

To see if the cart fits through a door and in an elevator or to see if it doesn't.

How will these results be used to make decisions or select concepts?

This results will lead to improving the dimensions of the cart.

What are the criteria for the test success or failure?

Either it fits comfortably or it doesn't.

What is going on and how it is being done?

Describe the prototype type (focused or comprehensive) and the reason for the selection of this type of prototype.

This is a focused prototype, the focus being size. The reason is if we consider all the other systems involved then the second prototype wouldn't be done in time.

Describe the testing process in enough detail to allow someone else to build and test the prototype instead of you.

The test is to build the cart as mentioned in calculations below and to roll it through a door and into an elevator.

What information is being measured?

The size is the only information being measured.

What is being observed and how is it being recorded?

The cart movement is the observed property and the clearance is being recorded.

What materials are required and what is the approximate estimated cost?

Materials are wood boards, planks, glue, and screws. The cost is approximately 45 dollars.

What work (test software or construction or modeling work or research) needs to be done?

The work being done is constructive in nature.

When is it happening?

How long will the test take and what are the dependencies (what needs to happen before the testing can occur)?

The test will take about 10 minutes, and before it can occur the cart must be made and dimensions confirmed.

End of Test Plan Template

Explain results from prototype 1

Numerical model:

$$76L = 4637.8 \text{ inches}^3$$

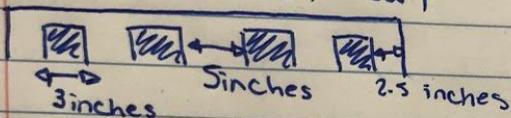
Space allotted for the reservoirs:
12 inches \times 36 inches \times 32 inches

Volume of space allotted for reservoirs:
 $V = 12 \times 36 \times 32 = 13824 \text{ inches}^3$

$$13824 > 4637.8 \text{ inches}^3$$

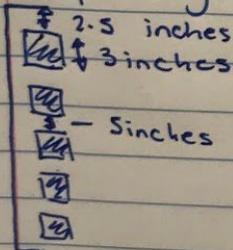
\therefore The reservoir can hold the minimum 76 litres required for the plants.

Top Width of Cart



Total width required = 32 inches

Top Length of Cart



Total length required = 40 inches

This is
a minimum

4 plants \times 5 plants = 20 Plants total can fit in the cart.

Photos of prototype II:



Deliverable H: Prototype III and Customer Feedback

Team 5: Allaura, Mary-Kate, Haya, Jacqueline

The testing of prototype two was successful in that the cart that was built to house the hydroponics system was able to fit through doors and into elevators. The following document contains the test plan required to develop our groups third prototype, featuring a functioning watering system. It also addresses customer feedback provided on previous prototypes to optimize the final functioning prototype.

Test planning steps

2. Define the purpose of the test
 - d. Q: What are you trying to figure out or learn your prototype?
2. Choose a specific design concept (or part of a concept)
 - e. Target measurable attributes
3. Choose a testing method
 - f. Examples: analytical simulation, physical prototype test, etc.
4. Perform the test
5. Measure the important attributes, observe and record the results carefully
6. Interpret the results (i.e. are they applicable?) and document your conclusions, reviewing them with others

Why are we doing this test?

Introduction; Capture the reasons for the test, giving enough background information to justify doing any prototyping at all. Is the general objective one of: learning, communication, de-risking, ect.

The test is creating the piping system for the water. The reason for this test is to verify this subsystem of the hydroponic system. The general objective is de-risking the watering system.

Test Objectives Descriptions

What are the specific test objective?

The specific test objective is that the watering system displaces the water equally to the two sides of the hydroponic system.

What exactly is being learned or communicated with the prototype?

We are learning the proper pipe size that functions with the pump and the power of the pump.

What are the possible types of results?

Some possible results would be to see if the watering system will work and if the lights are connected correctly.

How will these results be used to make decisions or select concepts?

The results will be used to improve the pump size and the lighting spacing.

What are the criteria for the test success or failure?

The criteria of the test success for the pump is that the water goes through the pipes and down the ramp on the interior at a solid flow.

What is going on and how it is being done?

Describe the prototype type (focused or comprehensive) and the reason for the selection of this type of prototype.

This is a focused prototype, the focus being the internal watering system of the mobile hydroponics cart. This is because the other subsystems of a complete hydroponics system were created in prototype number two.

Describe the testing process in enough detail to allow someone else to build and test the prototype instead of you.

The test is to build the watering system including, the reservoir, tubing that will allow water to flow to both sides of the cart, and the water pump. The pump will be turned on and if water can flow throughout the entire system using the force of the pump and gravity, without spillage, the test will be deemed a success.

What information is being measured?

The amount of water that can fit in the reservoir and effectively circulate throughout the hydroponics watering system.

What is being observed and how is it being recorded?

The water movement is the observed property and the volume of water and flow rate is being recorded.

What materials are required and what is the approximate estimated cost?

Materials are eaves troughs, plastic tubing, plastic bins, and aquatic pump. The cost is approximately 30 dollars.

What work (test software or construction or modeling work or research) needs to be done?

The construction of the watering system has to be done. Connecting all the materials and tubing for the optimum water flow.

When is it happening?

How long will the test take and what are the dependencies (what needs to happen before the testing can occur)?

Testing will take approximately a day or two, it depends on whether we have the right size tubing.

End of Test Plan Template

Stopping Criteria:

- When the risk is very minimal
- When the cart's design contains all components
- When an average amount of plants can be planted (preferably more than the minimum 20)

Pictures:



Client Feedback

- Clay pellets work well if seedlings are strong and it's nice that they're reusable - could another medium work
- Low yield - how can you maximize?
- Adjustable lights are a great idea so the plants don't ever hit the light (they will burn)
- Amazing to have the storage room

A common critique of our design is the low yield as the grow cart can only accommodate 20 plants. The reason for the low yield is the size of the pots used to hold plants in place in the hydroponics system. The pots in our groups design are 3" by 3" however, a pot of that size is

only needed for larger plants. As the kids are focusing their harvest on plants the size of lettuce or smaller a 2" by 2" pot would suffice. Decreasing the pot size would leave enough room on the surface of the grow cart for four additional plants, increasing the yield to 24 plants. Decreasing the pot size while increasing the pots would not cost any more money than is currently budgeted for this subsystem.

This concludes the final test for this stage of the prototype. The final components being added have already been tested in previous prototypes and will be ready for the presentation to the client on Thursday, March 29, 2018. Unfortunately with the time remaining we cannot make the changes that reflect consideration of the client's feedback, however in our presentation we will make it clear that we heard their concerns and have future plans on addressing them.