GROW SHARE

Urban Fresh Produce Accessibility

Industrial Design Thesis Report
Logan Smith

Urban Fresh Produce Accessibility

by

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Bachelor of Industrial Design

Faculty of Applied Sciences & Technology
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Abstract

Many people have a difficult time finding fresh affordable produce as researched by The Food Trust. An area with a large population facing this shortage is referred to as a food desert. Food deserts are a modern issue. Oftentimes there is an abundance of fast-food restaurants, which is an unhealthy option that many people resort to because they have no other alternative. According to The Food Trust, food deserts primarily impacted low-income or minority groups. This population is already at a disadvantage, but when adding the inability to source healthy food they are experiencing more shortcomings. This group of people are driven to live a generally unhealthy life which reduces lifespan as well as the quality of life. The purpose of this topic is to investigate the efficiency of systems that can be set up and use less space, water, and time to generate fresh produce for the target audience. Studies will examine growing techniques that can successfully cultivate produce with seasonal changes, optimizing growth and growing year-round. In order to evaluate the possible solutions, observation and interviews of those impacted by produce shortages will provide an in-depth understanding of the problems and how they can be addressed. A solution that could be beneficial on a day-to-day basis. Families would no longer have to worry about what they can find to feed themselves and can focus on healthy living.

Acknowledgements

First and foremost I would like to thank my mom, Elly, my sister Sierra and the rest of my family and friends for their constant support and tolerance during my entire academic career. Secondly, I would like to thank my supervisors, Catherine Chong and Sandro Zaccolo for their guidance through this process. Lastly, I would like to thank all the professors I have encountered throughout my many years at Humber College.

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CHAPTER 1 - Introduction

Photo by Isaiah Villar on Unsplash

1.1   Problem Definition

In many low-income urban communities fresh produce availability is extremely limited. When an area has such low accessibility to fresh affordable produce it is referred to as a 'Food Desert'. In food deserts, it is very easy for fast-food restaurants to step in and take over the area as one of the few options for food, this forces the people living in these communities to rely on these unhealthy options to feed their families. Due to so few stores carrying produce, the ones that do generally have inflated prices due to their demand and the people living in the area are unable to afford them. When people are forced to live off of fast food and other unhealthy options, their overall quality of life is lowered and their life span shortened. In these communities, there is a need for people to be self-reliant and provide fresh healthy produce for themselves and their families.

Photo by Nick Fewings on Unsplash

1.2   Rationale & Significance

1.2.1   Key Information to be Determined

Understanding why these low-income arrears are affected by produce scarcity will be

paramount in identifying a solution. Identifying why this demographic is being impacted will

also help in the development of solutions as well as being able to assist with integrating into

their lifestyles

Photo by Gor Davtyan on Unsplash

1.2.3   Key Questions to be Answered

Some questions that will benefit the research being conducted are:

- What are people in affected areas currently doing to find fresh produce?

- What types of produce would be most used?

- Where could a possible solution go?

- How would possible solutions impact users (primary, secondary, tertiary)

Photo by Timon Studler on Unsplash

1.2.4   Planned Investigation Approach

The plan for investigating the problem at hand, as well as possible solutions, will be to

- conduct one on one interviews

- Literature reviews

- User Activity mapping

- Ergonomic studies

- Existing product benchmarking

Photo by Van Tay Media on Unsplash

1.3   Background / History / Social Context

1.3.1   Demographic and Lifestyle Trends

Due to how easy it is for most people to access fresh produce, those who struggle to find some are often overlooked. In most communities, it is as easy as travelling a short distance to one of the many local grocery stores and you are met with a wide variety of fresh fruits and vegetables. People living in low-income urban areas do not have this luxury, many people have to travel upwards of an hour to go to the closest store that sells some produce. Once at the store these people are met with high prices, limited stock and very few varieties to pick from. Once the desired products have been purchased, the person then must commute back to their home with all their bags, usually on the bus/buses or rely on a friend or family member who is fortunate enough to have access to a vehicle to take time out of their day to pick them up.

1.3.2 Product Trends

Current products on the market for at-home gardening either take up valuable space, produce low quantities of produce or are expensive compared to their yield. Many of the in-home solutions are far too expensive for them to be a possible solution for people or families living in low-income areas. These products are more of a luxury and less of a reliable solution. Other solutions have a huge footprint and rely on existing knowledge of hydroponics and other growing techniques, which takes a long time to get good at, a time that many people can't find in their daily schedules.

Photo by Altifarm Enverde on Unsplash

CHAPTER 2 User Research
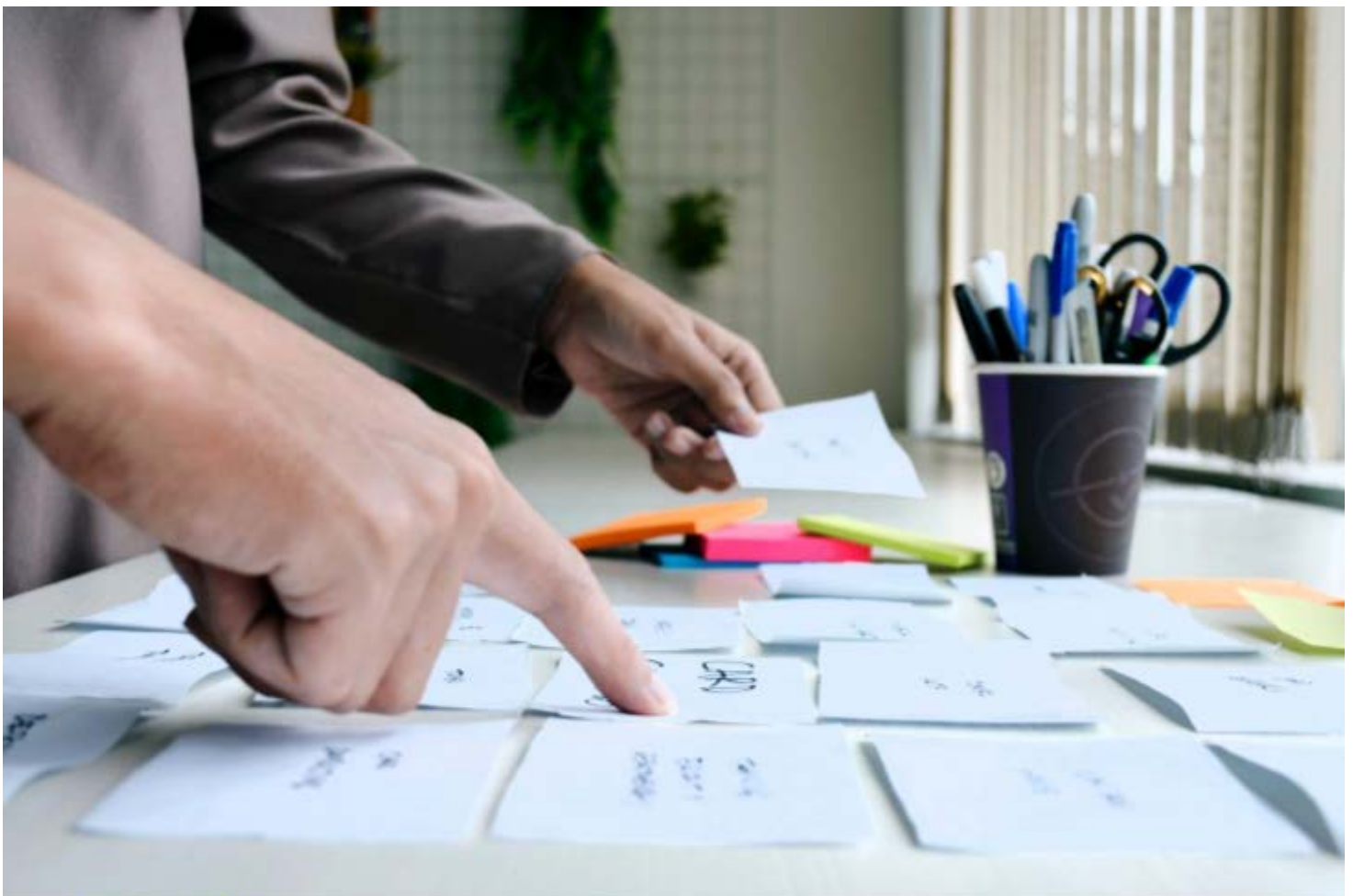
Photo by UX Indonesia on Unsplash

2.1   User Profile – Persona

2.1.1.1 Primary, Secondary, Tertiary Users

When looking at produce shortages in urban areas, many people are affected. The primary user would be those living in low-income housing. This could be singles, couples, moms, dads, children and families. The secondary users are the building owners as well as the maintenance workers who work on the building. The tertiary users would be the grocery store workers and owners who might see a decrease in sales when a solution is put in place.

Photo by Kadyn Pierce on Unsplash

2.1.1.2 Demographic

The demographic of people living in low-income housing is pretty broad. Across the USA 45% of tenants are black, 32% white and just over 20% are Hispanic. Those living in assisted housing are considered to be the lowest income in all of the US. 93% of all tenants living in these houses have an income of less than $20,000, this does not vary much with the different races. In terms of gender, women are far more likely to be in this situation than men. Women are approximately 75% more common than men in low-income housing. (BOLTON & BRAVVE, 2012)

Photo by Tom Parsons on Unsplash

2.1.2 Current User Practice

       Currently when someone living in a low-income area needs to go grocery shopping it takes most of the day and requires preplanning as well as a ridiculous amount of money for what is actually being bought. To understand the process people have to take in order to shop for their family, several videos were selected, analyzed and broken down into steps. The steps are as follows:

Step	Description	Picture
1	Find the closest store That sells groceries	
2	Plan commute that could be checking bus schedules and routes or finding someone willing to give them a ride to the store	
3	Gather family to go with them for extra help	
4	make the commute, this could be upwards of an hour for some people	
5	Browse the store for desired produce	

6	compare quality and price to determine how much they can buy	
7	Check out of store and bag groceries	
8	waits for the bus or pre-planned ride with family and groceries in hand	
9	Return home and store groceries (mostly processed and frozen foods) to be used later in the week or longer.	

2.1.3   User Observation – Activity Mapping

PHASE	Planning	Contact	Travel	Shopping	Travel	Storage
User Actions	Find a Grocery store in their area that haas resonable priced produce	Find a friend to drive them to store, or wait for bus/ buses	take buses to store, takes between 45 minutes to 1.5 hours	browse superstore for groceries for family to last until they can go shopping again	take bus home, again between 45 minutes to an hour and a half	pack groceries away in pantry and freeazer to increase shelf life
User Thoughts	Why cant there be any stores closer!	I hope... Is free today I hope the bus isnt too busy or late	Why is that man looking at me like that?	Where is ... Why is this so much!	I hope these bags dont break! Why is that man looking at me like that?	I hope this last us long enough
Story Board						
User Experience	🔴	🟠	🔵	🟠	🔵	🟢
Problems/ Challenges	there are no supermarkets in the area	its difficult to find someone witha a car who is willing to help	staying safe, transfering from bus to bus	finding enough healthy food to feed family that is affordable	haul groceries back on sevral buses	rarely buying fresh produce or anything healthy
Ideas/ Takeaways	more stores would make this easier	very few people in food deserts own cars	more direct routes or even a shuttle would make this much easier	when produce is actually found it is too expensive	users often bring kids with them to help carry groceries on bus	being able to make fresh food last longer would make it more worth it

2.2   Product Research

During this chapter existing products will be reviewed. These products will be an array of

in-home solutions. The products were found from online searches and product pages. Some

of the solutions are fully store-bought kits while others have a more DIY approach.

Photo by Scott Webb on Unsplash

2.2.1 Benchmarking – Benefits and Features of Existing Products

Pictures	Product Name	System Type	Features	Benefits
	Product 1: Scotts Aerogarden Harvest Elite LED	Deep Water Culture	full spectrum 20-watt LED lighting system energy efficient LEDs	grows five times faster than soil 12" (30.4 cm) of growing height just pennies a day to operate
	Product 2: Aspara 16 Hole Hydroponic Indoor Grower	Wicking System	APP CONTROLLED LARGE 16 PLANT CAPACITY 10 built-in smart sensors Fully automated central water system 88 LED light design	Plants grow naturally in water no messy soil, all non-GMO, and free of pesticides or herbicides Monitor and control your aspara grower with the intuitive app 5x faster than traditional methods enjoy a variety of salad greens, herbs, vegetables, flowers and more any time of year
	Product 3:Alfred DWC (Deep Water Culture) 5 Gallon 4-Plant System Kit	Deep Water Culture	the plant roots are suspended in a solution of nutrient-rich, oxygenated water. This direct delivery of vital nutrients	simplest way to grow easy method growing huge no messy soil fast plant growth, lush foliage, and full, heavy flowers
	Product 4: AeroGarden Harvest Elite - Stainless Steel	Deep Water Culture	room for six different plants endless variety of herbs, vegetables, salad greens, or flowers full spectrum LEDs no pesticides or herbicides Built-in sensors	Versatile will inspire you no matter the season Perfect for beginners and experienced growers alike enhance your food, drinks, home and life you'll be enjoying the delicious taste that only comes from homegrown herbs and veggies in no time automatically turn the lights on and off
	Product 5 Click and Grow Smart Garden 3 Indoor Herb Garden, Beige	Deep Water Culture	you just need to plug in the power adaptor, insert the plant pods, fill the water tank don't require you to periodically add nutrient solution unique Smart Soil automatically stabilizing pH levels and oxygenating the root	easy as using a pod coffee maker completely silent indoor grow kit completely silent indoor grow kit No green thumb needed!
	Product 6: VIVOSUN Hydroponic Grow Kit	Nutrient Film Technique	Soilless cultivation Timeable Circulatory System circulation mode can also be set manually or automatically PVC pipe is 4.3 feet(1.3 meters) long and 2.5 inches (6.3cm) in diameter	Clean & Environmentally Friendly yield can be doubled; Requires less water and less space pump more durable saves nutrient solution Simple to Assemble & Use Great for beginners saving time and energy
	Product 7: iDoo Indoor Garden Farm	Deep Water Culture	Plants grow in water mixed with nutrients, supported by degradable sponges 34 Watt LED lights Height up to 26.77 Inches Full control of the growing conditions removable water tanks	No mess, No limitation Perfect for tall plants grow crops year-round enough space for plants
	Product 8: The EVE	Nutrient Film Technique	Plant Capacity: 12 plants Add water every 3 weeks Full spectrum white LED grow lights Solid wood frame, Chrome leg	fit in the tiniest of spaces, without compromising the quality and efficiency

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2.2.2   Benchmarking – Functionality of Existing Products

Product Name	Functionality	Usability
Product 1: Scotts Aerogarden Harvest Elite LED	The plants root sit in nutrient rich water Not the most efficient system, but works for a wide variety of plants	easy to set up and use
Product 2: Aspara 16 Hole Hydroponic Indoor Grower	A timer automatically provides plants with the nutrients needed	comes with a compatible app for monitoring and maintenance
Product 3:Alfred DWC (Deep Water Culture) 5 Gallon 4-Plant System Kit	The plants root sit in nutrient rich water Not the most efficient system, but works for a wide variety of plants	Bigger than most systems, but produces more as well, can be expanded if needed
Product 4: AeroGarden Harvest Elite - Stainless Steel	The plants root sit in nutrient rich water Not the most efficient system, but works for a wide variety of plants	easy to set up and use
Product 5:Click and Grow Smart Garden 3 Indoor Herb Garden, Beige	Plant seeds come in nutrient packed pod, when pods are in system the plants regularly get nutrients	must buy pods from same company
Product 6: VIVOSUN Hydroponic Grow Kit	Nutrient rich water flows over the root systems of the plants, better for leafy greens and herbs compared to fruiting plants	can grow a lot in a small space
Product 7: iDoo Indoor Garden Farm	The plants root sit in nutrient rich water Not the most efficient system, but works for a wide variety of plants	Bigger than many systems, but produces more as well
Product 8: The EVE	Nutrient rich water flows over the root systems of the plants, better for leafy greens and herbs compared to fruiting plants	bigger than other systems, but its fits in to homes more easily with its design

2.2.3   Benchmarking – Aesthetics and Semantic Profile of Existing Products

The products explored previously give a good look into the current market. The aesthetics of the products are more generally neutral tones of whites, grays and black. The overall forms of the products are round with soft edges. The products are pretty simple looking and aim to put more attention on the plants growing in them. When the focus is on the plants, the product is constantly changing with the growth cycles of the plants as well as what's being grown to give each product an individual look compared to others. As for branding, most of the products have little to none on the visible surfaces. These products are meant to go in a home so the lack of branding helps the products blend in with other kitchen appliances.

Photo by Elisa Calvet B. on Unsplash

2.2.3   Benchmarking – Materials and Manufacturing of Existing Products

Most of the products on the market now are mostly injection-moulded plastic, with stainless steel accents. Similarly to the aesthetic profile, these materials match common small kitchen appliances, which allows the products to remain in the kitchens of homes.

Photo by White Field Photo on Unsplash

2.2.4   Benchmarking – Sustainability of Existing products

According to the information presented in "hydroponics at a glance: Sustainable

alternative to soil gardening" hydroponics use approximately 90% less water than regular

farming. In addition to reduced water usage, hydroponic farms produce higher-yielding crops

in a shorter length of time. Another interesting benefit that goes against popular belief is that

soilless cultivation uses significantly fewer harmful chemicals that are used to fertilize the soil.

Hydroponics are also not limited to specific climates or seasons to grow effectively, many

systems also reduce the labour needed by humans, due to the remote monitoring

capabilities. (Hydroponics at a Glance: Sustainable Alternative to Soil Gardening, 2015)

Photo by PHÚC LONG on Unsplash

2.3   Summary of Chapter 2

Based on current research, it is evident that there is an opportunity for innovation in this sector. Many of the current products do not fully serve the user's needs. Although there is much to be learned when looking at current products and what makes them successful. By analyzing the current steps required to source produce, areas of improvement that may not be clear to the primary users can be unidentified which will benefit the users in the end and improve their quality of life.

Photo by Cekreknauts on Unsplash

CHAPTER 3 Analysis

The research presented in chapter 2 will be analyzed in this chapter. By looking at the current products in the market, a better understanding of where improvement can be made will be achieved

Photo by Scott Graham on Unsplash

3.1   Analysis – Needs

3.1.1   Needs/Benefits Not Met by Current Products

Currently there are three types of current solutions, traditional soil gardens, in-home

grow systems and commercial grade grow systems
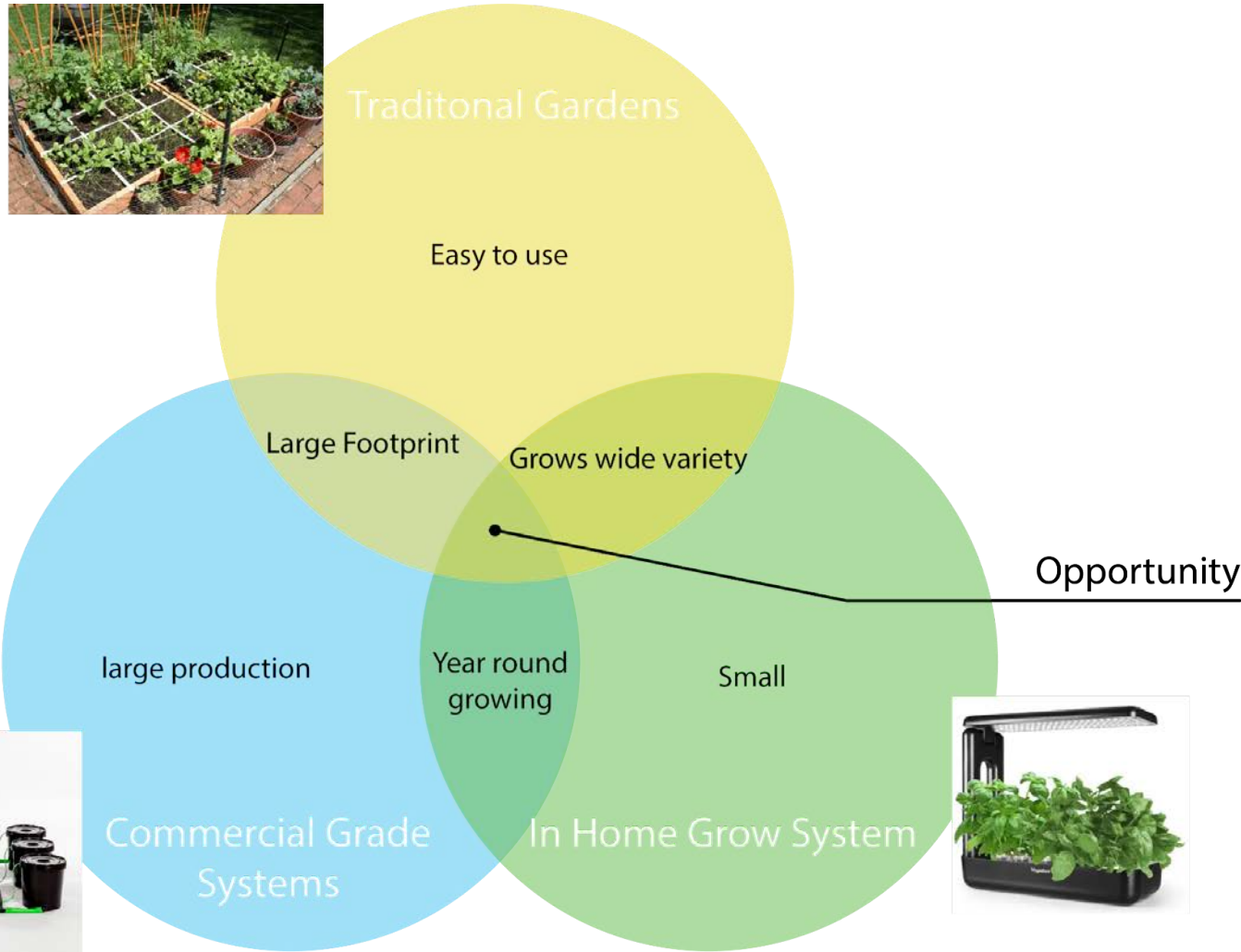
3.1.2   **Latent Needs**

Need	Solution
Users need to eat healthier	The product will provide fresh produce to users.
Users need to develop more self-reliance	The product will allow users to grow their own produce year-round
Users want to be a part of a community	The product will act as a common ground for building tenants

3.1.3   Categorization of Needs

Wishes	Wants	Latent Needs	Immediate Needs
Fresh produce to be cheaper	Be able to support themselves	Be able to support themselves	Feeding themselves and their families
Grocery stores were closer to their homes	Have their family more involved in the cooking process	Not rely on stores for their produce needs	
	Not to rely on handouts/favours		

3.2   Analysis – Usability

3.2.1   Journey Mapping

This is a journey map of the steps that those living in a low-income area must take in order to buy their groceries.

PHASE	Planning	Contact	Travel	Shopping	Travel	Storage
User Actions	Find a Grocery store in their area that haas resonable priced produce	Find a friend to drive them to store, or wait for bus/ buses	take buses to store, takes between 45 minutes to 1.5 hours	browse superstore for groceries for family to last until they can go shopping again	take bus home, again between 45 minutes to an hour and a half	pack groceries away in pantry and freeazer to increase shelf life
User Thoughts	Why cant there be any stores closer!	I hope... Is free today I hope the bus isnt too busy or late	Why is that man looking at me like that?	Where is ... Why is this so much!	I hope these bags dont break! Why is that man looking at me like that?	I hope this last us long enough
Story Board						
User Experience						
Problems/ Challenges	there are no supermarkets in the area	its difficult to find someone witha a car who is willing to help	staying safe, transfering from bus to bus	finding enough healthy food to feed family that is affordable	haul groceries back on sevral buses	rarely buying fresh produce or anything healthy
Ideas/ Takeaways	more stores would make this easier	very few people in food deserts own cars	more direct routes or even a shuttle would make this much easier	when produce is actually found it is too expensive	users often bring kids with them to help carry groceries on bus	being able to make fresh food last longer would make it more worth it

3.2.2   User Experience

This map looks at people's experiences when going through the process of picking produce from a potential solution.

PHASE	Planning	Picking	Cleaning	Cooking	Cleaning	Storing
User Experience						
Goal	Plan what to make for your meal	Go to grow station and pick the produce needed to cook next	Clean the fresh produce that was just picked	Cook your meal using the picked produce	Clean up after cooking	Store leftovers and any extra produce not used
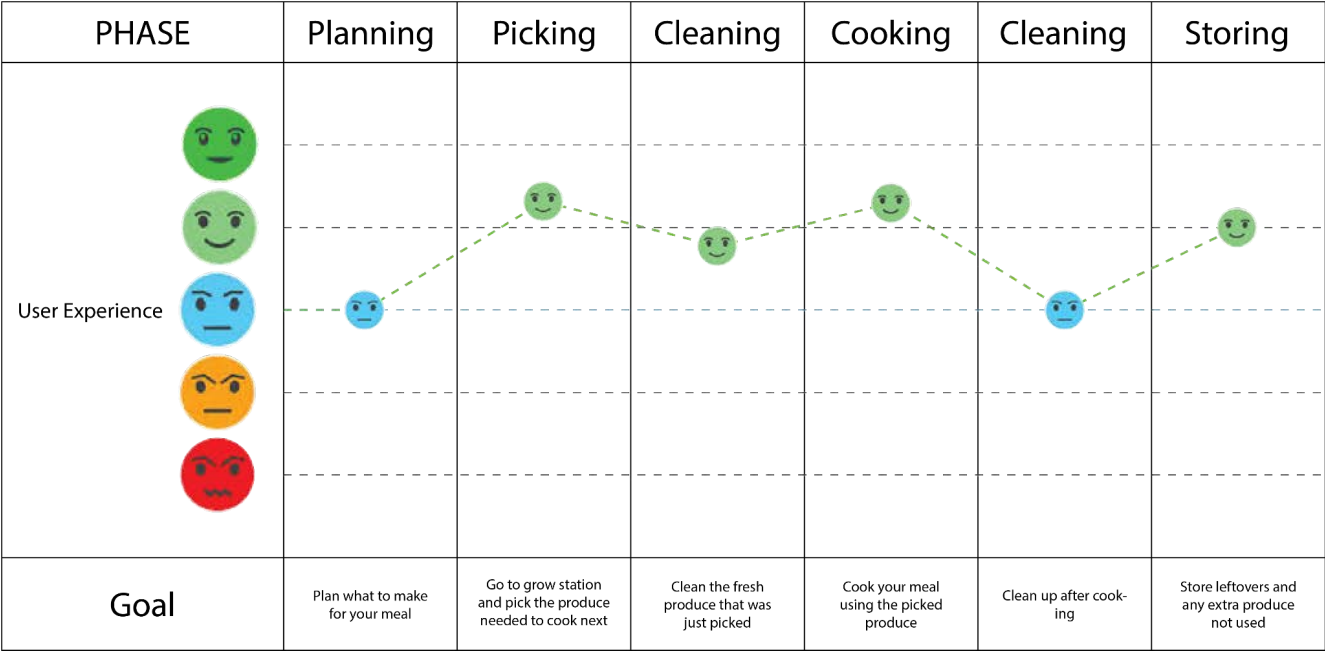
3.3   Analysis – Human Factors

The objective of this analysis is to determine how well humans can interact with the product. At the smaller end of the spectrum, the fifth percentile of women was used and for the larger end, a 95th percentile male was used.

Front View

Leafy Greens (NFT System)	Small Plants and Seedlings (Ebb and Flow System)	Full Plants (Ebb and Flow System)	99 Percentile Male I Percentile Female Water Flow

Side View

Grow Lighs

Grow Medium

Hose

Hose

Hose

Hose

Pump

Pump

Pump

84.6"

75.6"

64.2"

58.1"

12"

Leafy Greens
(NFT System)

Small Plants and Seedlings
(Ebb and Flow System)

Full Plants
(Ebb and Flow System)

99 Percentile Male
1 Percentile Female
Water Flow

3.3.2   Ergonomic – 1:1 Human Scale Study

In order to get a better feel of how it will be for users to interact with the final product, a

full-size ergonomic buck was made.
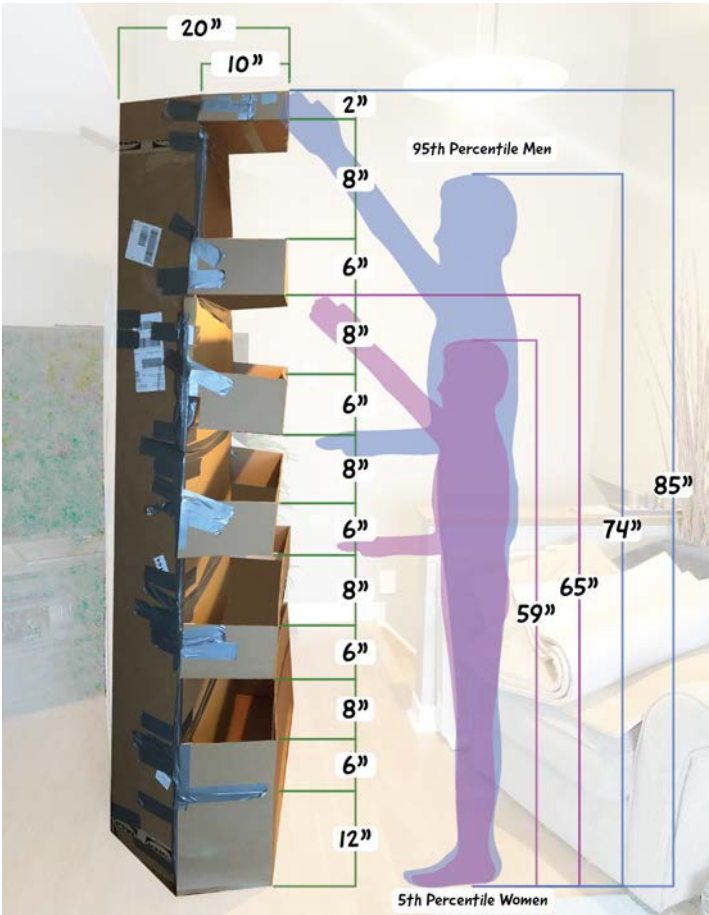
3.4   Aesthetics & Semantic Profile

Most products that have been reviewed fall into two categories, in-home or industrial. The in-home grow systems have soft edges and use more neutral colours such as white black and gray. These products have similar styling to small kitchen appliances and put more emphasis on the beauty of the plants growing inside, making everyone different from each other. On the other hand, the more industrial solutions put a higher priority on functionality rather than form. The spaces that these systems are used generally don't have much foot traffic and need to remain free from bacteria and be easy to clean.

Grow Share's aesthetics take inspiration from traditional greenhouses and beautiful flowers. The main structure uses similar materials as a traditional greenhouse and features a see-through roof. The individual grow pods on the other hand have a more organic free form look, similar to a flowers bulb.

Photo by John Bussell on Unsplash

3.5 Sustainability – Safety, Health and Environment

In order to be considered safe, the materials used must be food safe. Grow Share uses fully food-safe materials. As for the structure, there is a base that can be fixed to the ground of the area it lives in.

In order to grow the produce, Grow Share uses hydroponics. This just means that there is no soil in the system and the plants rely on the nutrients in its water to thrive. There are many nutrients available in the market, all of which have been tested and proven to be safe, in order to be more realistic local suppliers should be found so there is no one brand that will be used, but a variety all of which would be added to the water reservoir by the maintenance workers.
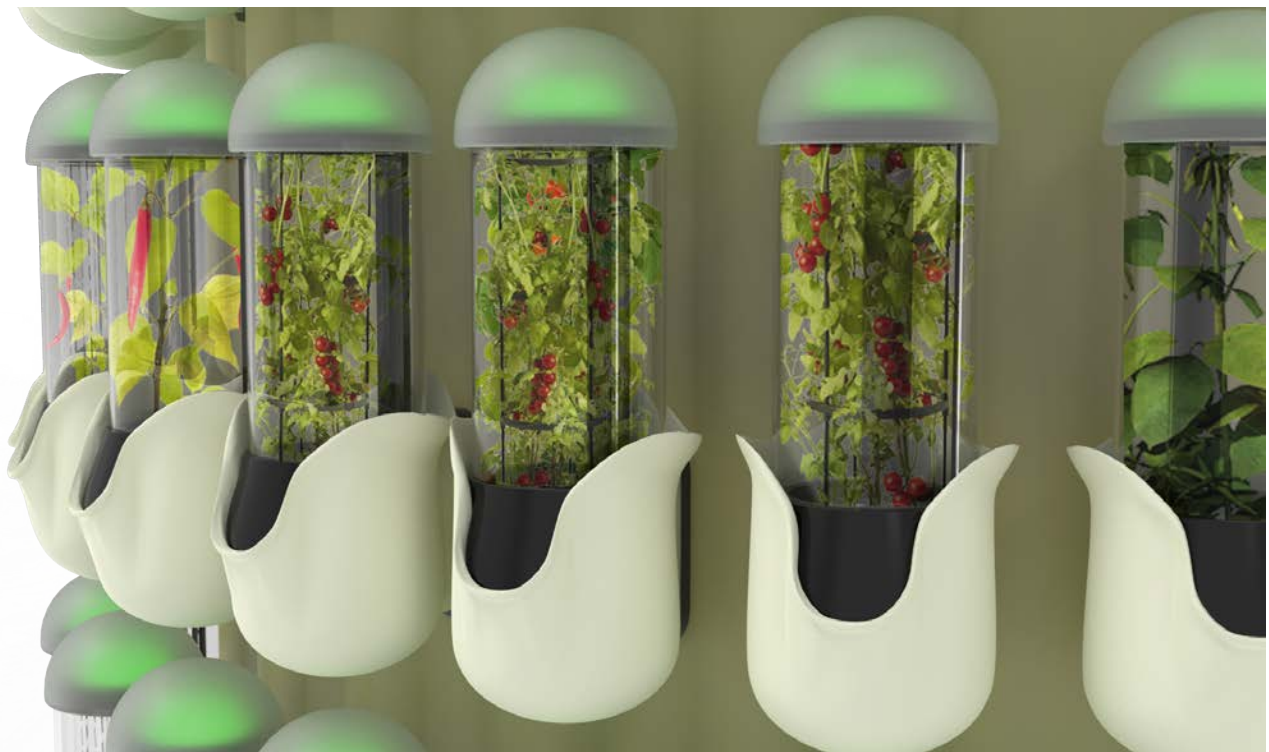
3.6   Innovation Opportunity

3.6.1   Needs Analysis Diagram

Photo by Dan Gold on Unsplash

3.6.2   Desirability, Feasibility & Viability

When deciding on material and manufacturing processes, many factors must be accounted for. The overall safety of the users, as well as the cost of the product, are some of the more important factors. In the current market, most products are injection moulded food-grade plastic with stainless steel accents.

In order to make Grow Share possible, it must be sustainable as well as affordable. Grow Share is meant to live in low-income areas so creating a product that is overly expensive would be counterproductive. With all the findings previously stated, the design should be able to be injection moulded, and thin walls are possible with the material, but not advisable in terms of durability. In terms of waste, the Grow Share system aims to create as little as possible. It uses a recirculating system to reuse the water as much as possible and expanded clay pellets are used as a growing medium and can be reused with each growth cycle.

Photo by Daniel Öberg on Unsplash

3.7   Summary of Chapter 3 – Defining Design Brief

Needs

- The users to need to eat more healthy food and maintain a healthy lifestyle

- The users need to develop more self-reliance to reduce the anxiety of unknown variables

Usability

- The final product should be easy to use and understand for beginners, but also allow more willing users to master the use of

Human Factors

- The final product should allow users of many physical proportions to successfully operate (ie. Kids)

Aesthetics & Semantic Profile

- The final product should integrate into the aesthetics of most buildings

- The final product should be inviting and draw users to discover what its possibilities are

Health, Safety & Sustainability

- The final product should provide fresh healthy produce for users

- The final product should limit waste created by typical grow systems

- Innovation Opportunity

- The final product should help bring understanding to at home gardening

- The final produce should show the opportunities that building owners can help provide for their tenants

- The final product should be treated like other common building amenities i.e.

  pool, gym, laundry room.

CHAPTER 4 Design Development

Photo by Mehdi MeSSrro on Unsplash

4.1   Initial Idea Generation

4.1.1   Aesthetics Approach & Semantic Profile

As previously mentioned, Grow Share takes inspiration from traditional greenhouses as well as more organic forms such as flowers. In order to create a familiarity with users, traditional aesthetics of a greenhouse were used.

In order to not take away from the beauty of the growing plants, neutral beiges were used as Grow shares main colours.
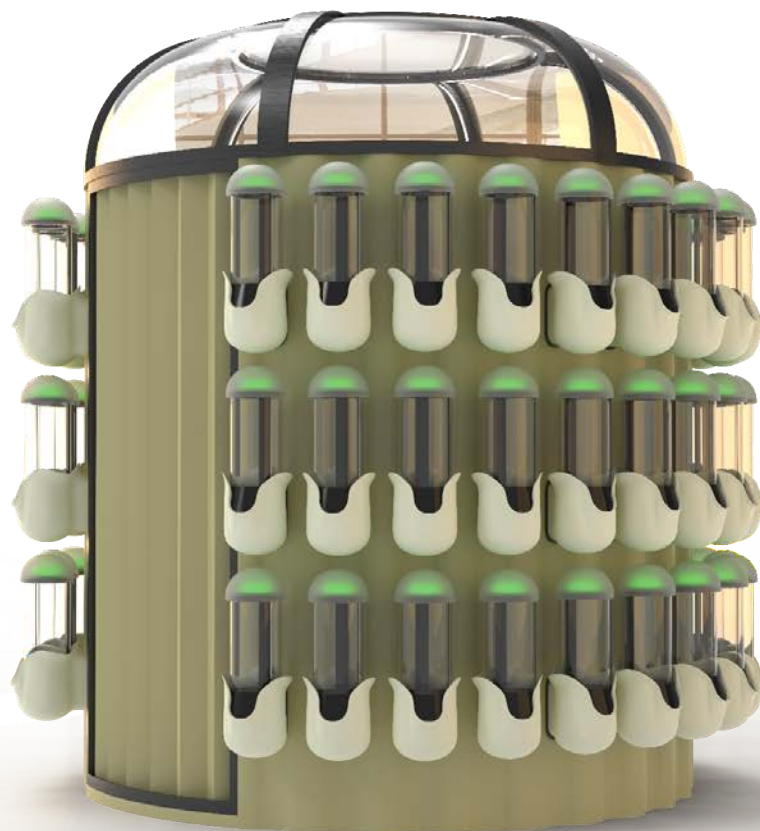
4.1.2   Mind Mapping
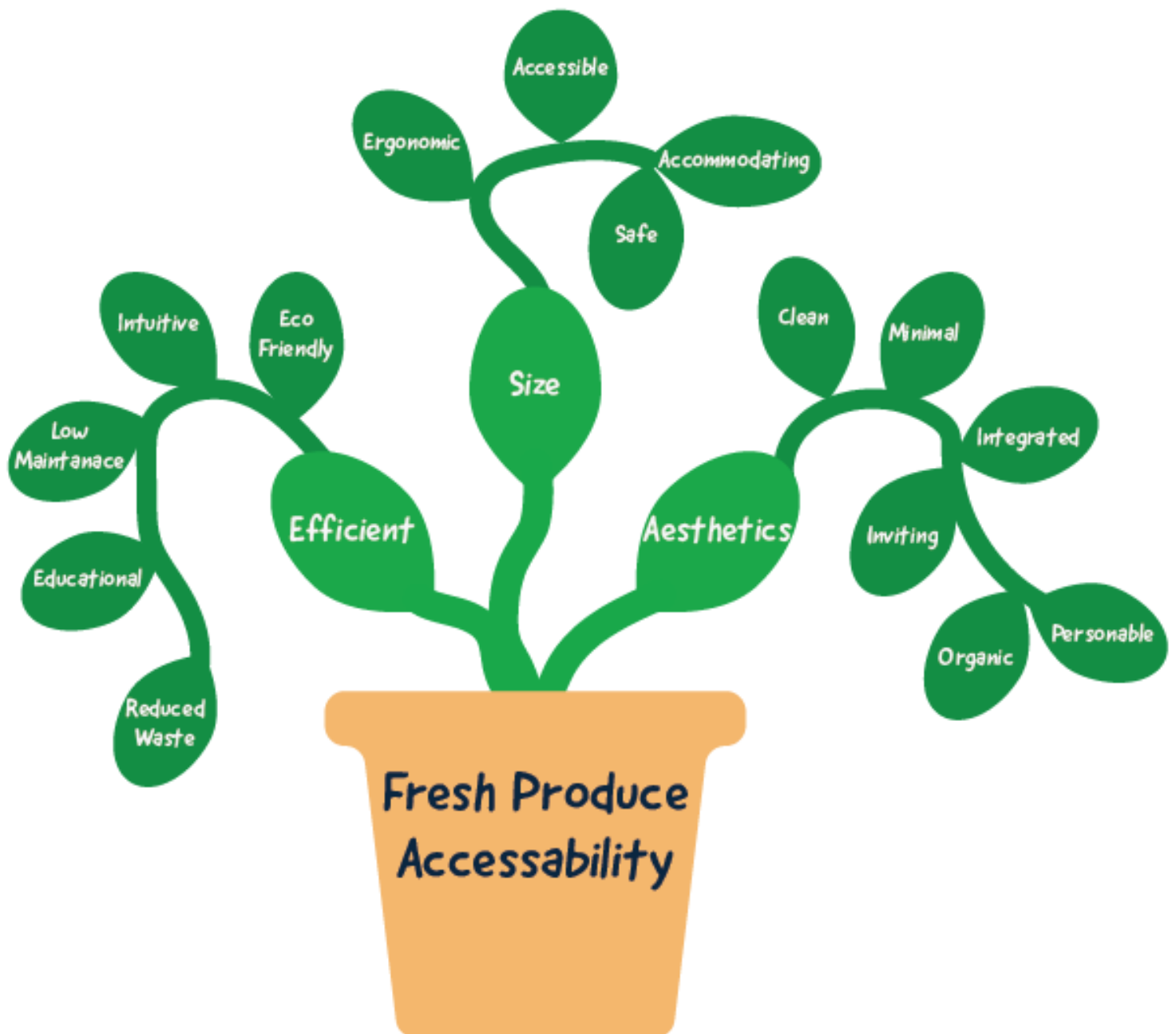
4.1.3   Ideation Sketches
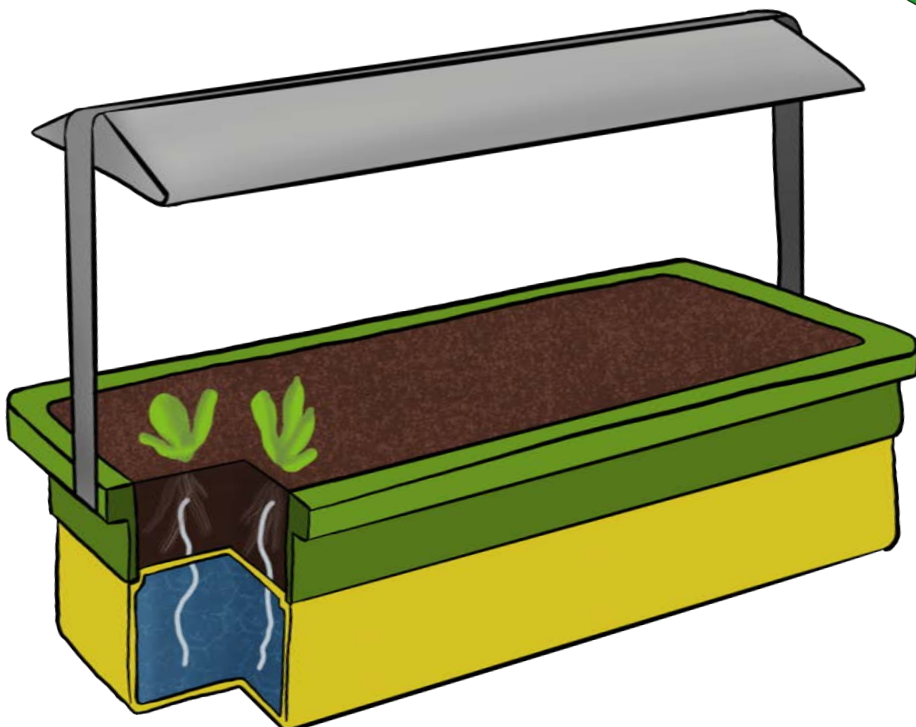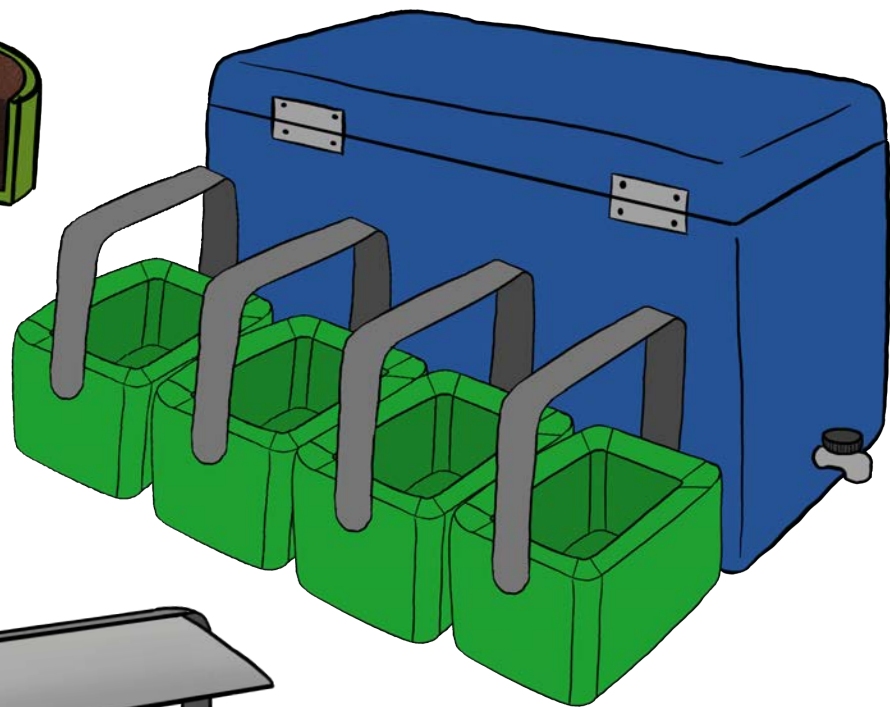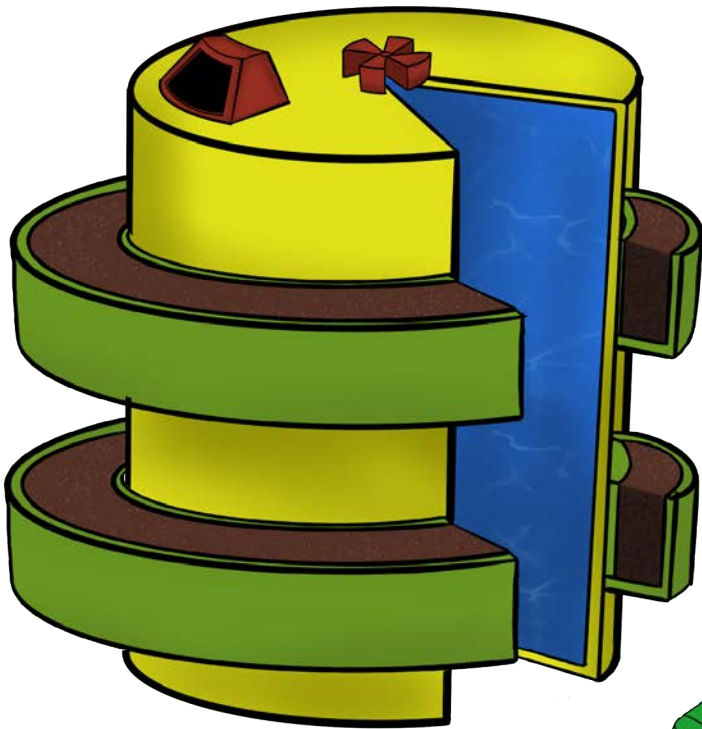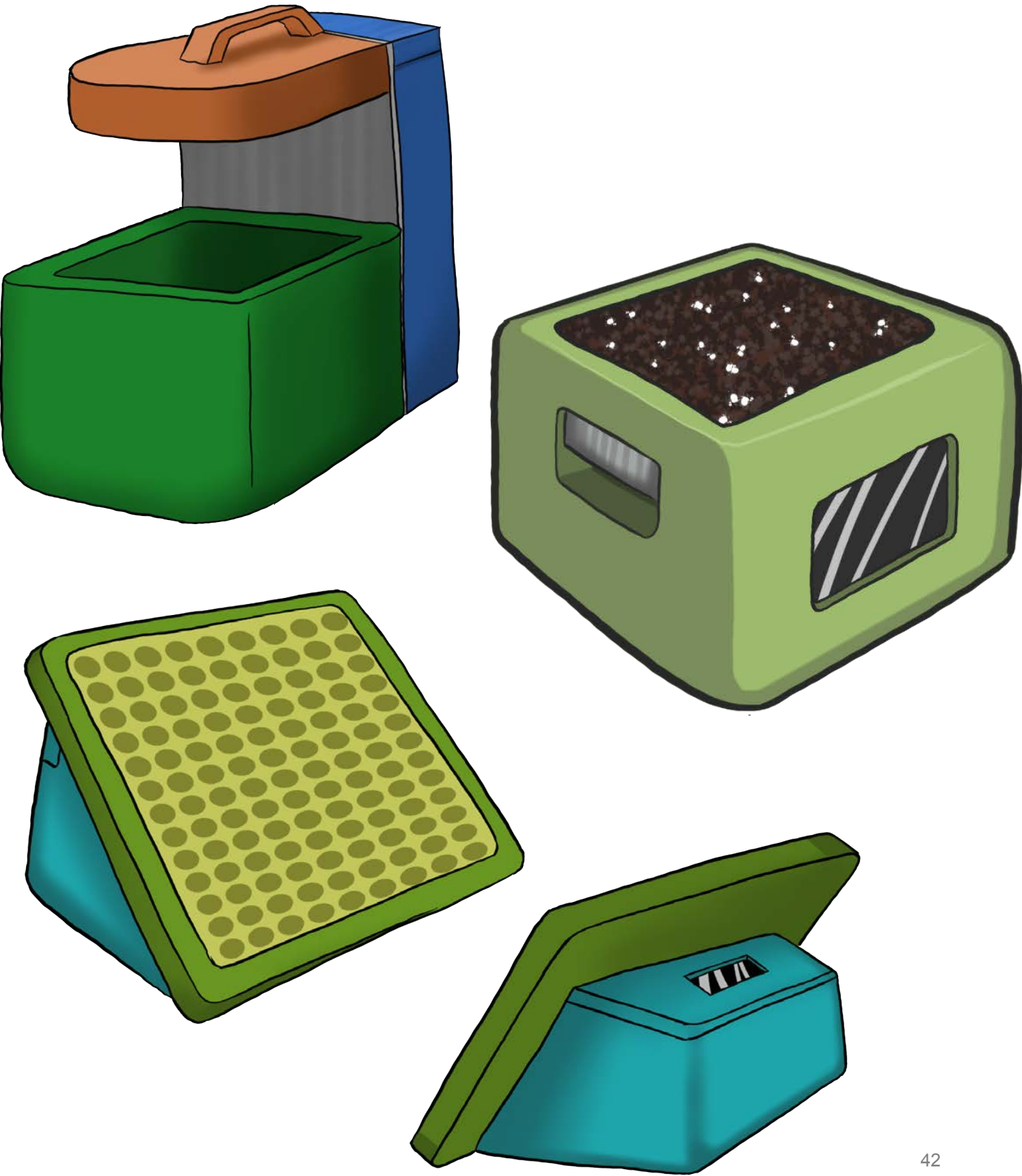
4.2   Concept Exploration
4.2.1   Concept One

Grab and Grow

Logan Smith

Locking and Unlocking System

Numpad For Custom Code

Information Screen

Mounts to Wall
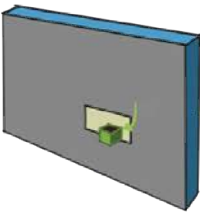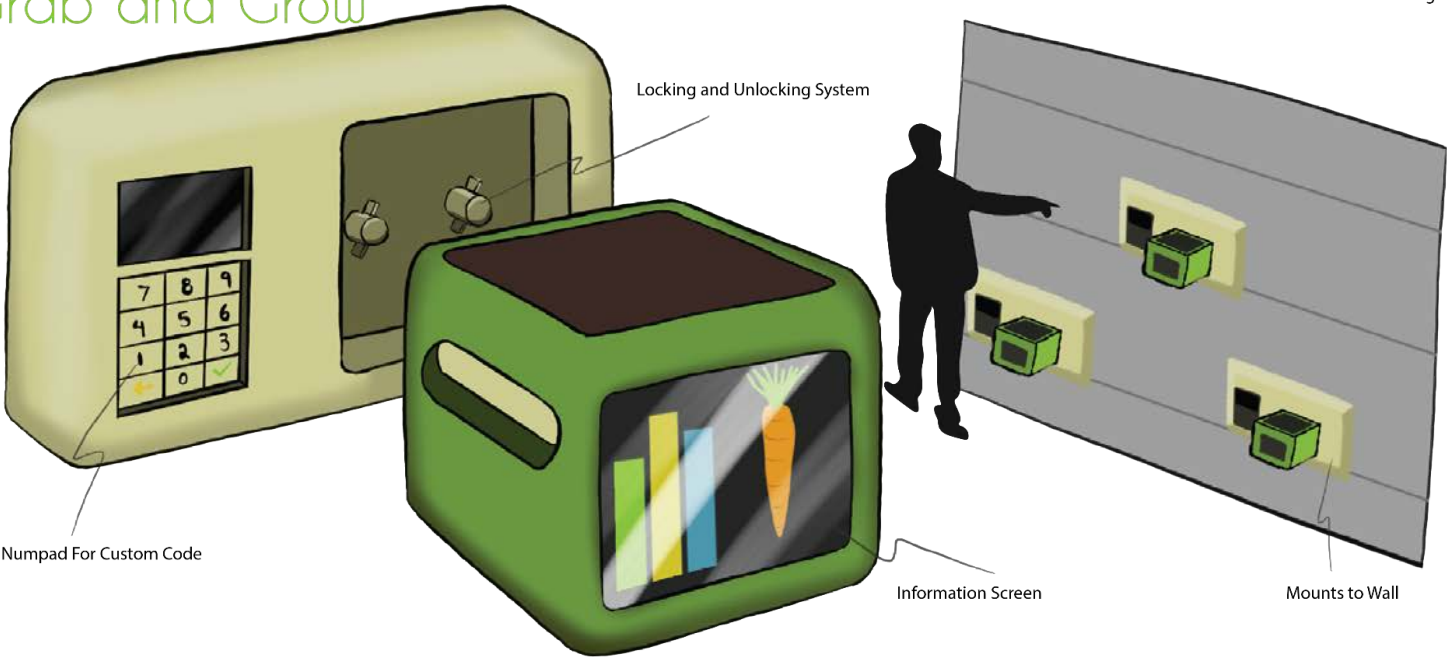
Grow box gets nutrients from wall
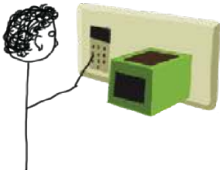
Resident signs out box
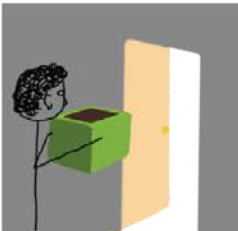
Resident takes box home
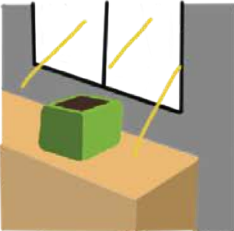
Box uses stored water and sun to grow plants
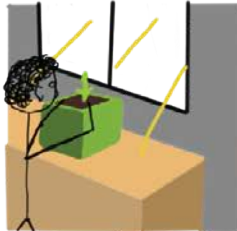
Resident can harvest produce as it grows
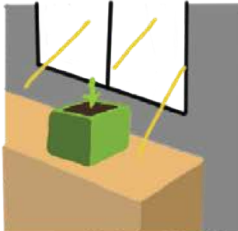
Box warns resident when it is running out of nutrients and needs to be returned

4.2.2 **Concept Two**

Grab and Grow

Coco Coir and Perlite Mix

Full Body Net Cup

Rubberized Grip

Touch Screen

Nutrient Level

Light Level

Water Level

Produce Icon

4.2.3   Concept Three

Group Grow

Logan Smith

Clear Rain Guard

Rain Collecting Downspout

Coco Coir and Perlite Mix

Water Resivior

Wicking System

4.3   Concept Strategy

HexaGrow Logan Smith

Side View

Grow Lighs
Grow Medium
Hose
Hose
Hose
Pump
Pump
Pump
12"

84.6"
75.6"
64.2"
58.1"

Leafy Greens
(NFT System)
Small Plants and Seedlings
(Ebb and Flow System)
Full Plants
(Ebb and Flow System)

99 Percentile Male
1 Percentile Female
Water Flow

HexaGrow Logan Smith

Front View

48"

Leafy Greens
(NFT System)
Small Plants and Seedlings
(Ebb and Flow System)
Full Plants
(Ebb and Flow System)

99 Percentile Male
1 Percentile Female
Water Flow

HexaGrow
Logan Smith

Plan View

36"

13.5"

20.6"

Full System
(Scaled Down)

99 Percentile Male
1 Percentile Female

4.2   Concept Refinement & Validation

Room for Vent

Grow Lights

Clear UV Proof Doors

Grow Medium

Entrance

Water Resevior
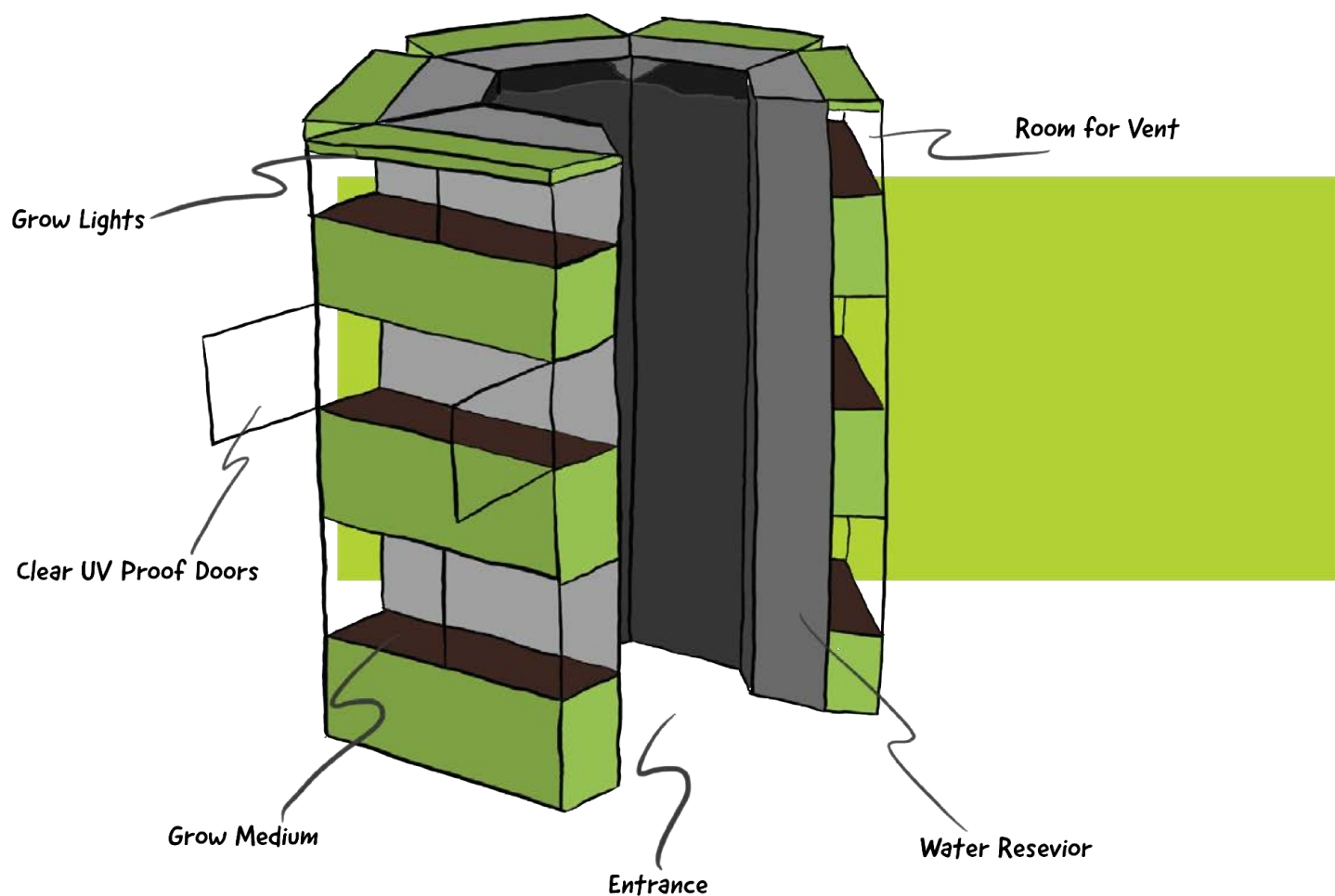
4.4   Concept Refinement and Validation

Colour identifies growth stage

GROW
SHARE

Green– Ready to Pick
Yellow– Almost ready to Pick
Red– Not ready to Pick

Logan Smith

Flood and Drain system

Lowest grow tank

Overflow

Intake

Pump

Maintenance Area

Maintenance Interface

GROW SHARE
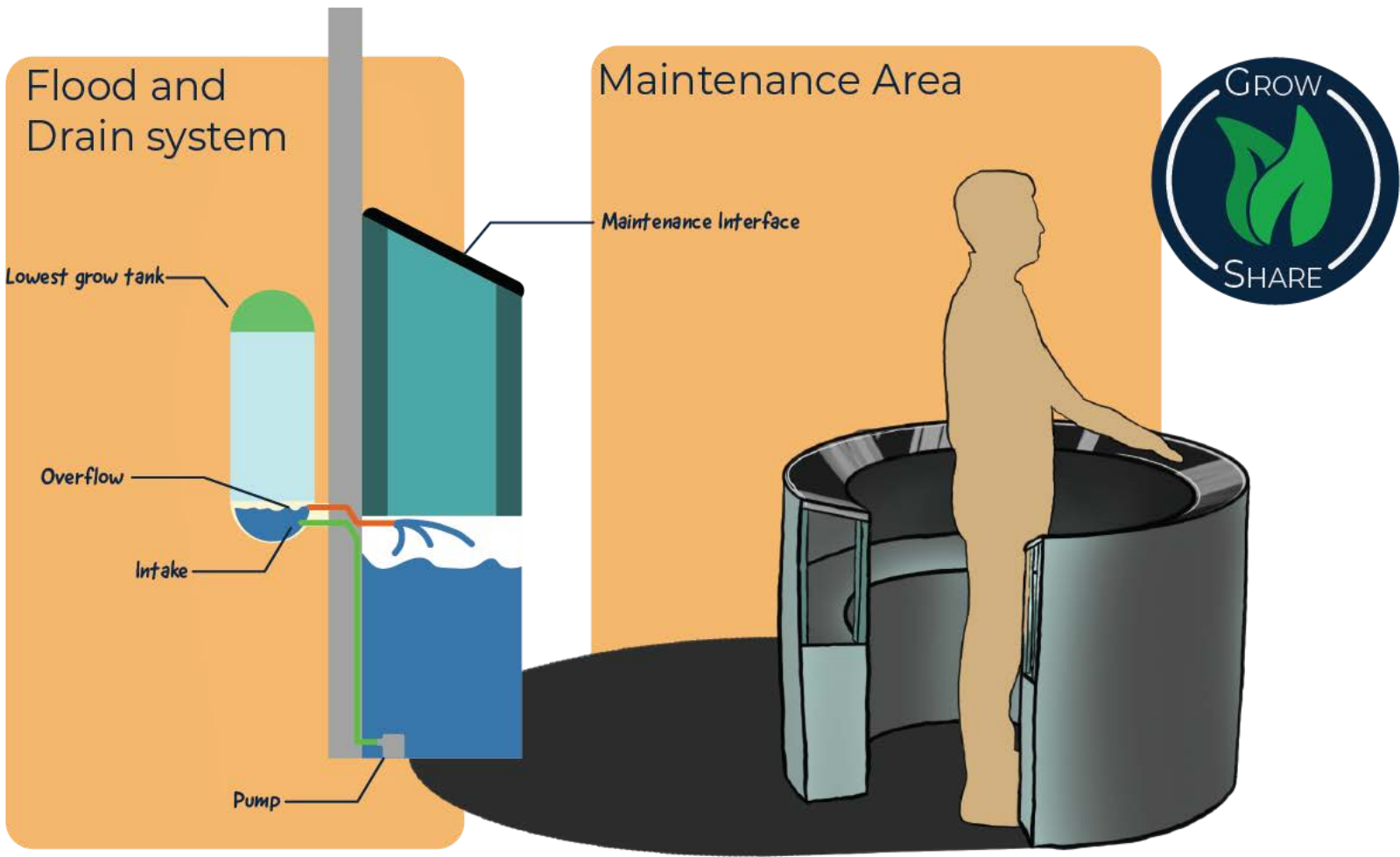
Logan Smith

4.4.2   **Detail Development**
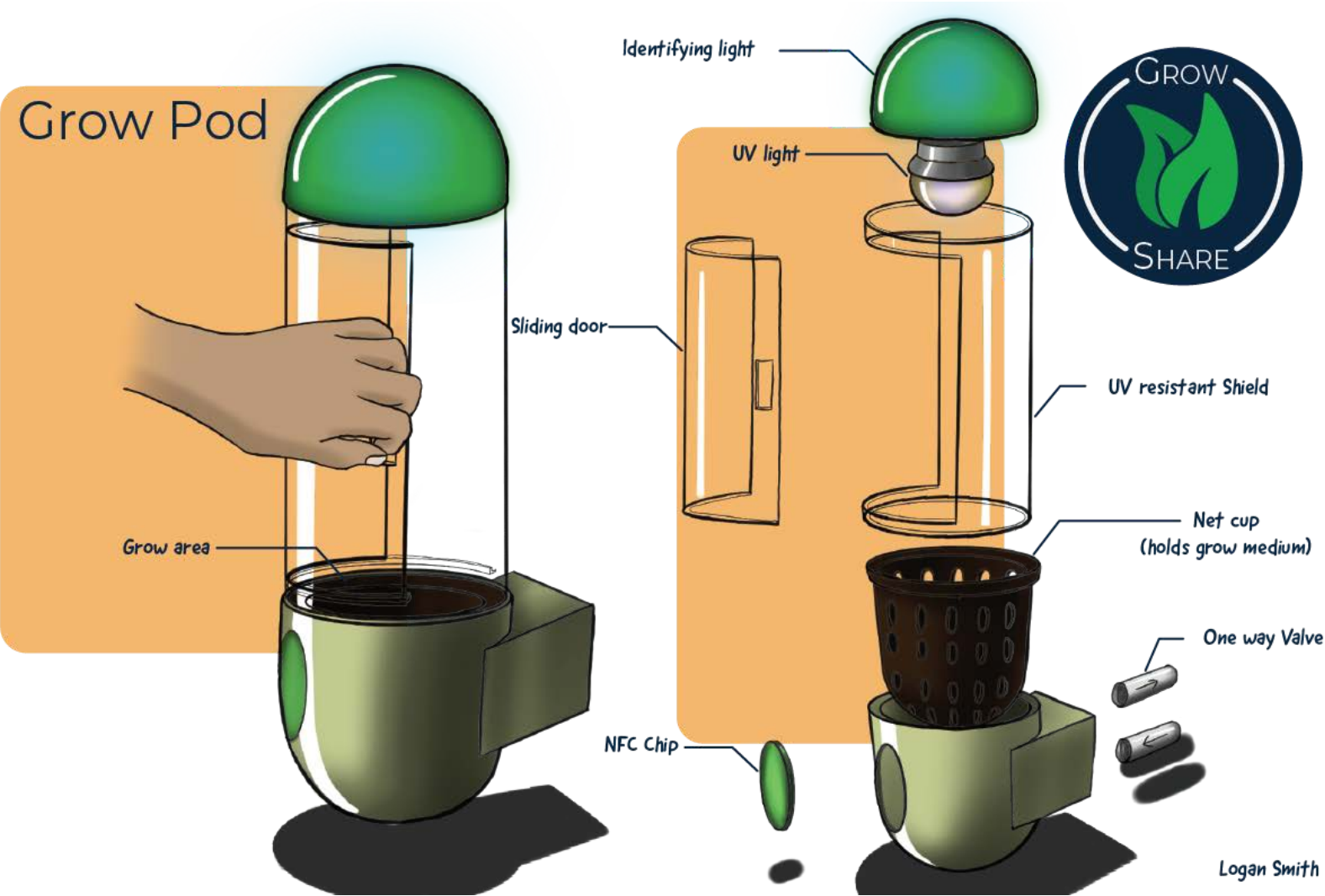
Unlock Screen   Home Screen   Recipe Screen   Browse Screen

GROW
SHARE
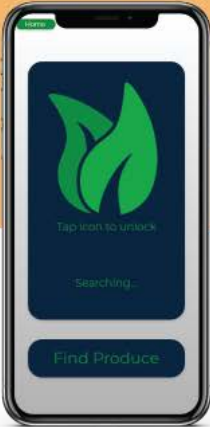
User Interface

Unlock Screen   Profile Screen   Reporting Screen
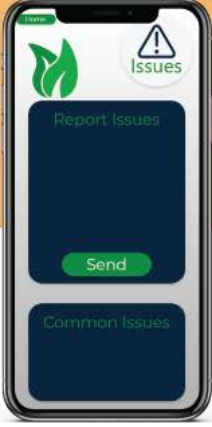
Logan Smith

4.4.3 Refined Product Schematic & Key Ergonomic

Plan View

Logan Smith

Front View

48"   12"

84.6"

75.6"

64.2"

58.1"
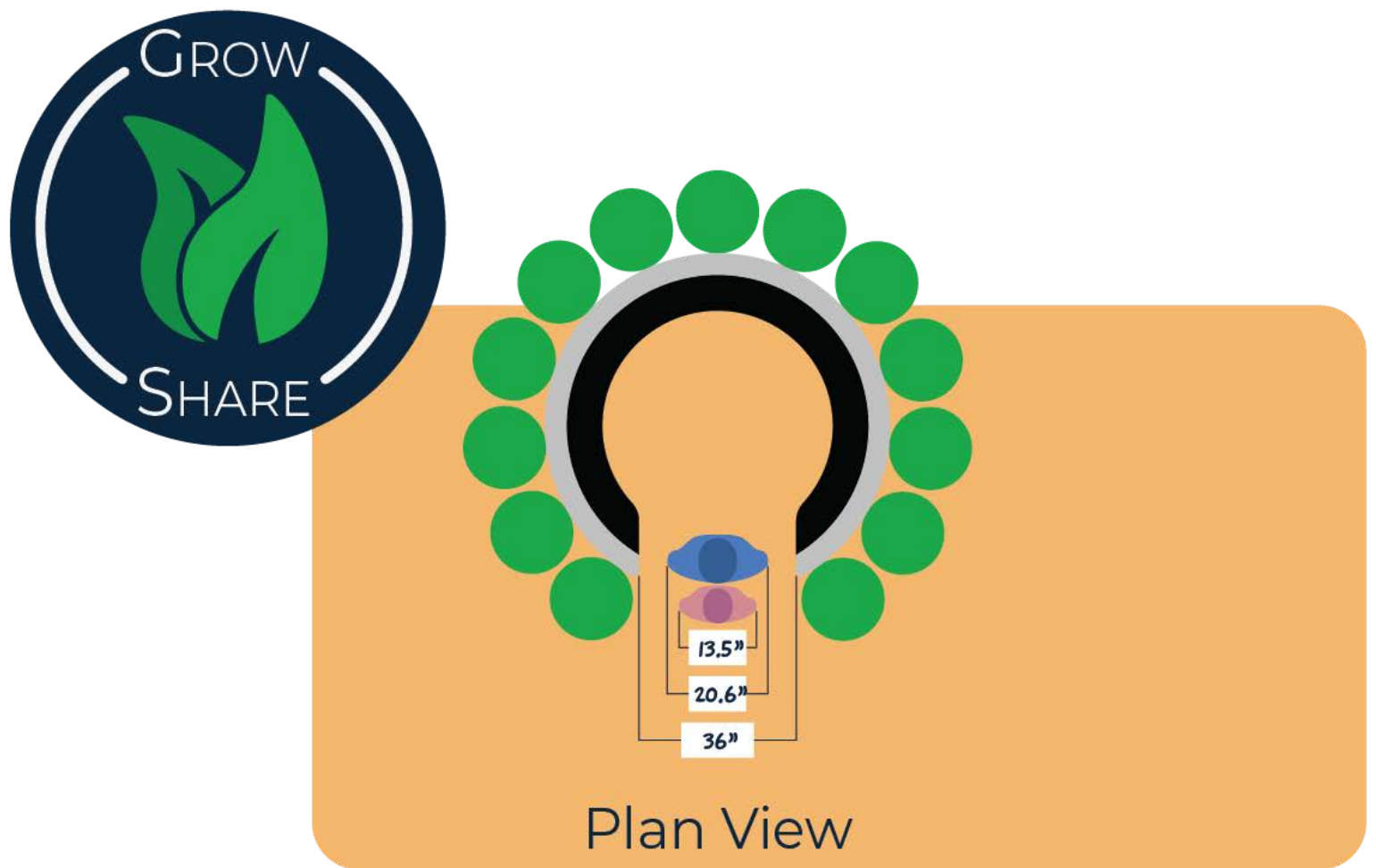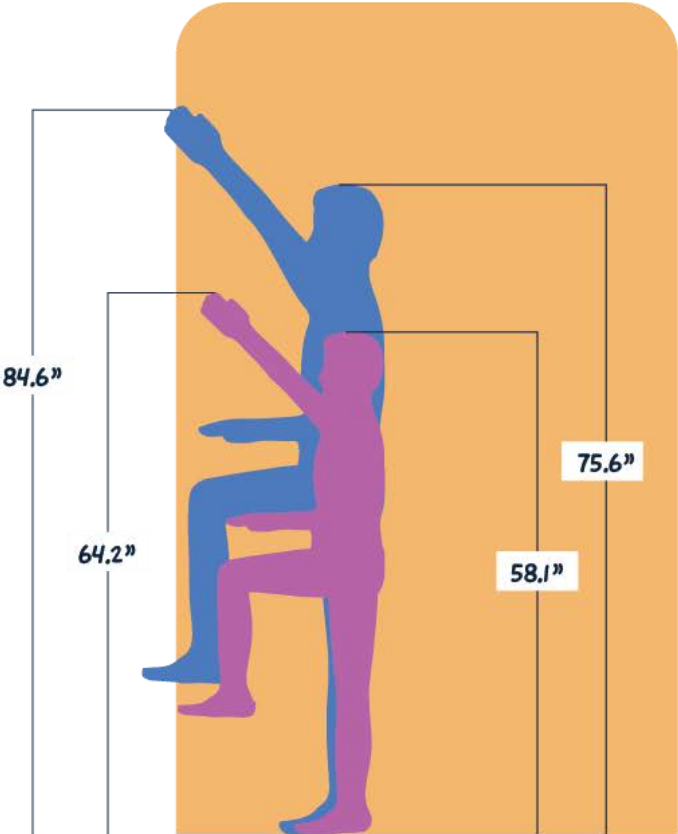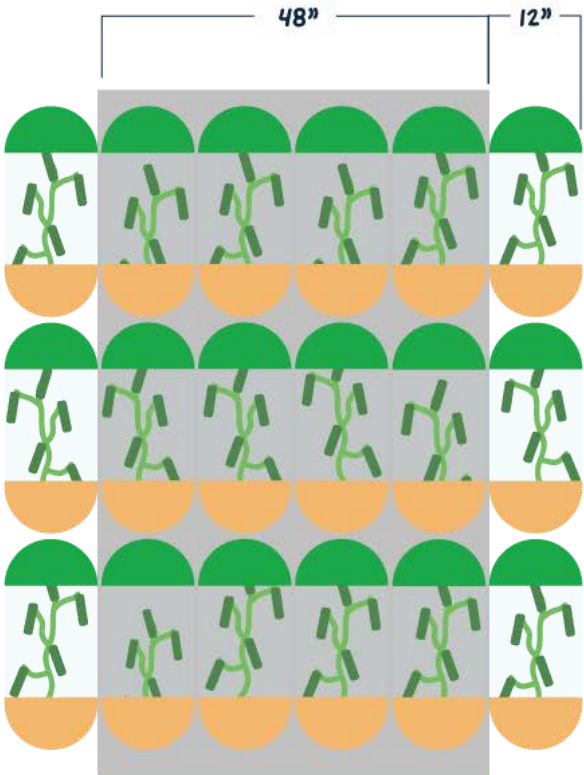
99 Percentile Male
1 Percentile Female

Logan Smith

4.5 Concept Realization

4.5.1   Design Finalization

Grow Share is designed to live in a common area of a building. In order to suit all those that live in a building, multiple sizes of users were taken into account. Anyone from a large adult male to a young child can easily pick their own produce from a Grow Share pod. The neutral tones of the structure help it seamlessly integrate into the aesthetics of existing buildings while still being eye-catching.

The maintenance side of Grow Share is housed in the center of the structure, away from the user side of things. Users will be greeted by the Grow Pods and using their app can unlock the pod and have access to the fresh produce. In terms of cost, Grow share can be treated similarly to a common building amenity such as a gym or entertainment room, so your maintenance fees would cover its upkeep.
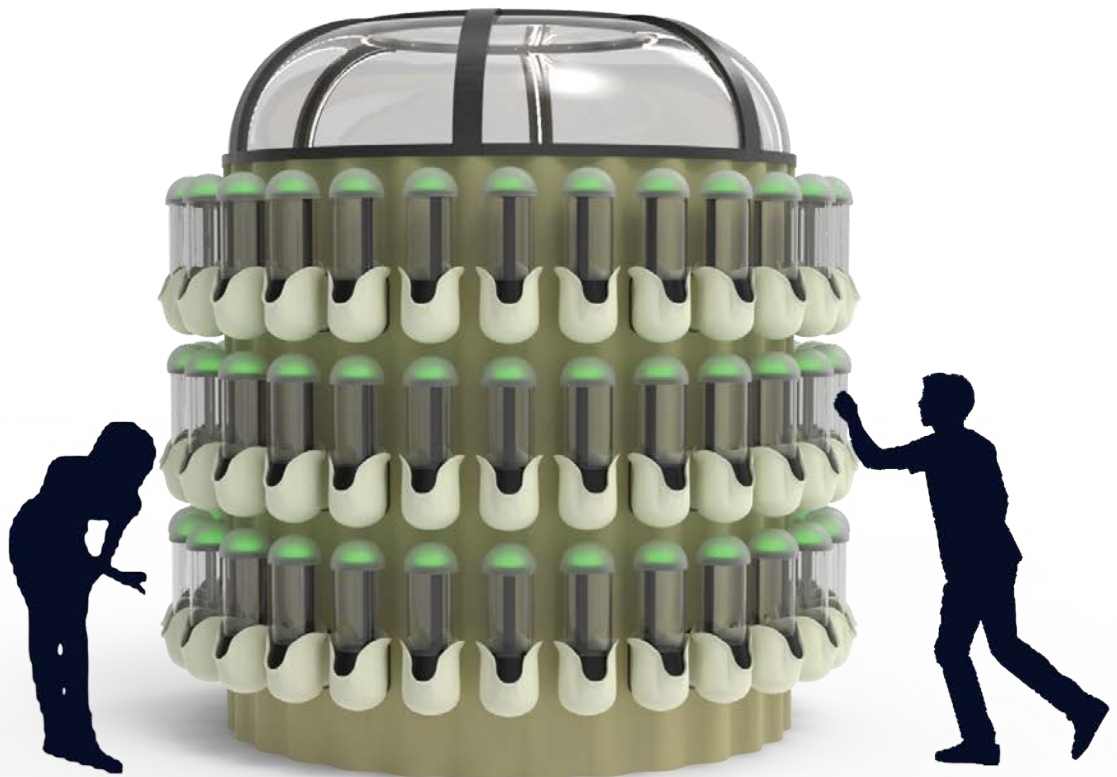
4.5.2   Physical Study Model

In order to get a better understanding of the scale of the final product, an ergonomic

buck was created. This model was made out of cardboard and was not meant to be an

attractive model but rather just to scale. once the model was complete it was clear that the

scale was not right, the levels were not at appropriate heights and left little room for the plants

to grow.

4.6 Design Resolution

In order to access the produce users will use Grow shares app. IN the app they can browse what is being grown, report any issues they see, view announcements from the maintenance crew and find new recipes that use the produce being grown. Once they unlock the pod, they are able to pick the fresh produce.

On the inside of the structure, the maintenance crew can access the reservoir in order to balance PH or top-up nutrients. The maintenance crew also uses the app, but they can see the vitals of the plants, see any reports from the users, post important news and track analytics. The analytics being tracked will give them a better idea of what plants are most popular and when in order to better adapt the system to their building/ users.

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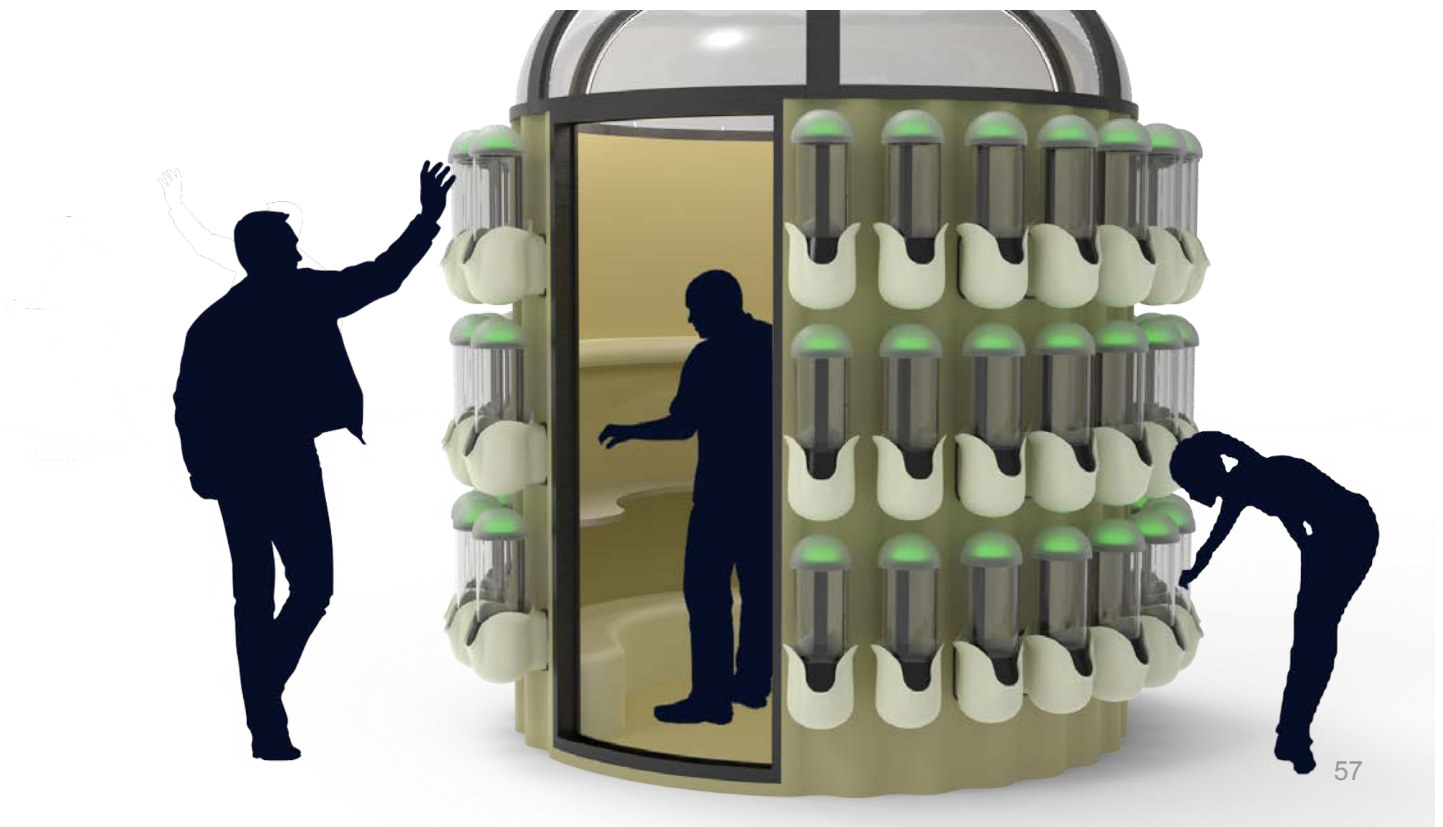
4.7 CAD Development

To begin the CAD development, The centers of the pods were modelled first. Once the design was finalized with them the more organic pod part was modelled. after the entire pod was modelled it was patterned upward so the structure can take shape. the supporting bars that the pods fit into were patterned around to create the main structure. From there the roof and 'skins' were added and the final details were refined.
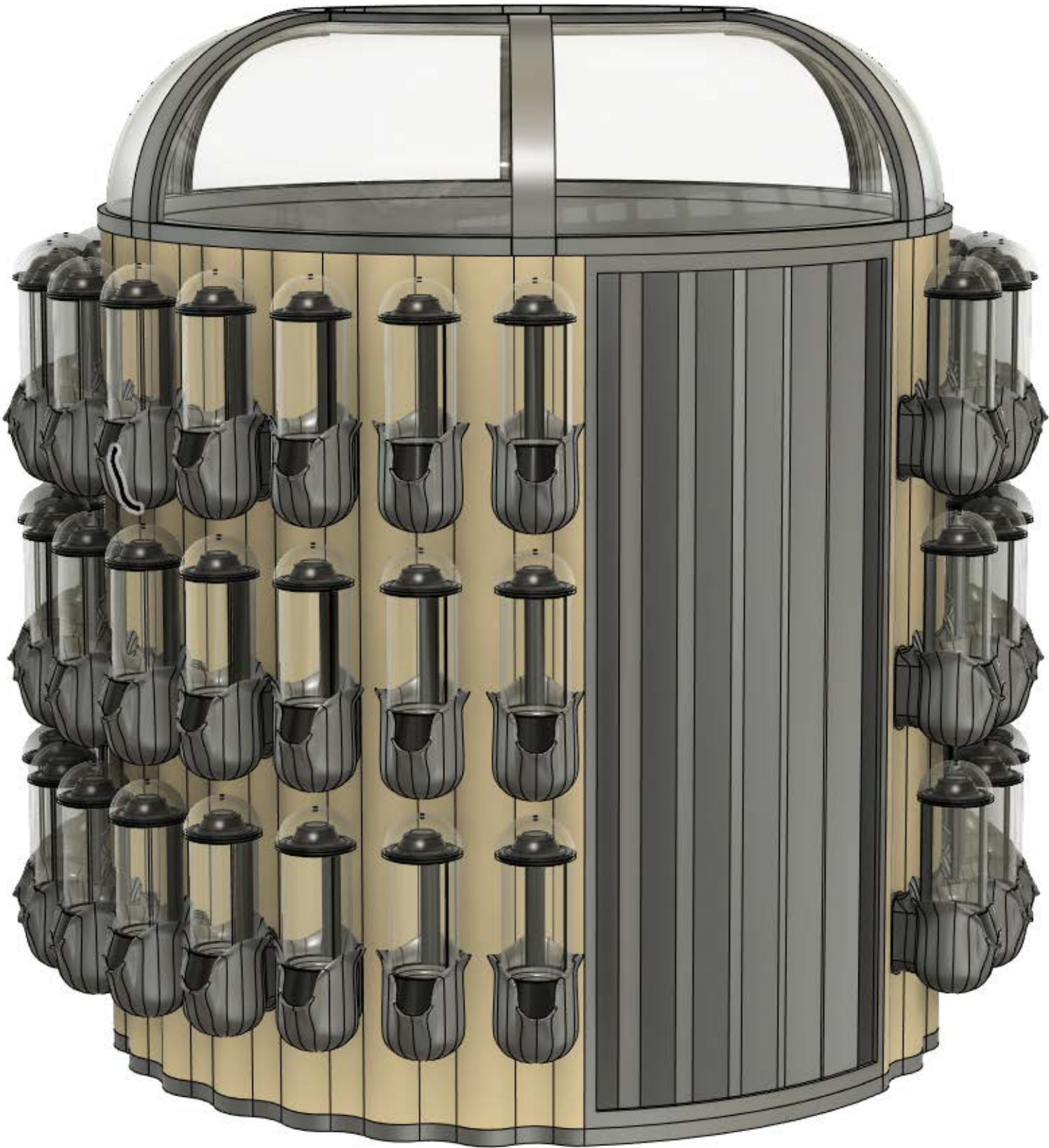
4.8 Physical Model Fabrication

To build the scale model, all individual parts were 3d printed out of resin. Once the parts came off the printer they were cleaned and cured, then sanded, primed, sanded again, primed again, and painted. Once all the parts were painted and fully dry the model was assembled.

These are the centers of the grow pods as they came off of the printer.
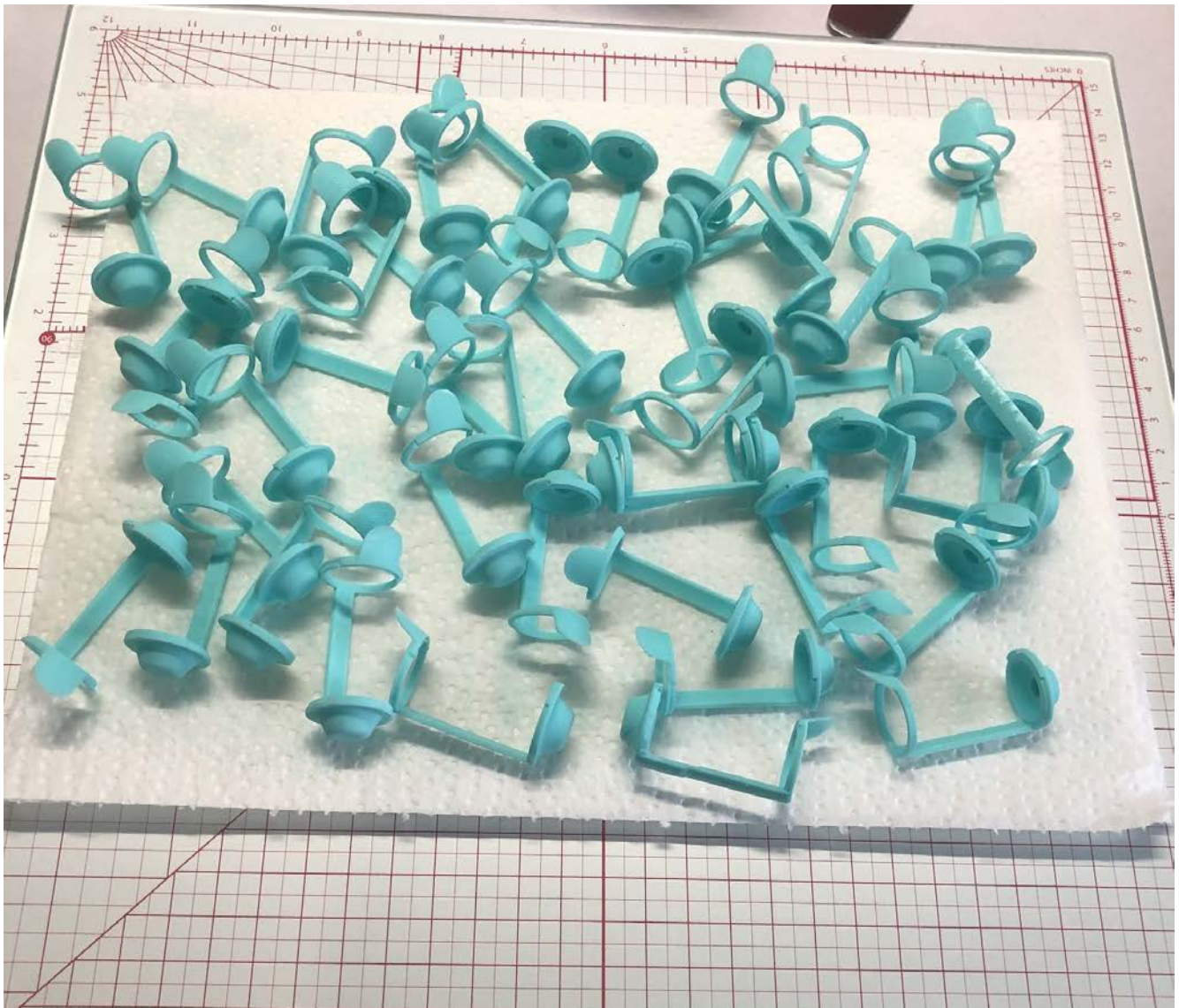
Once the supports were removed, the parts were cleaned with alcohol, then dried.

once fully dry they were UV cured.
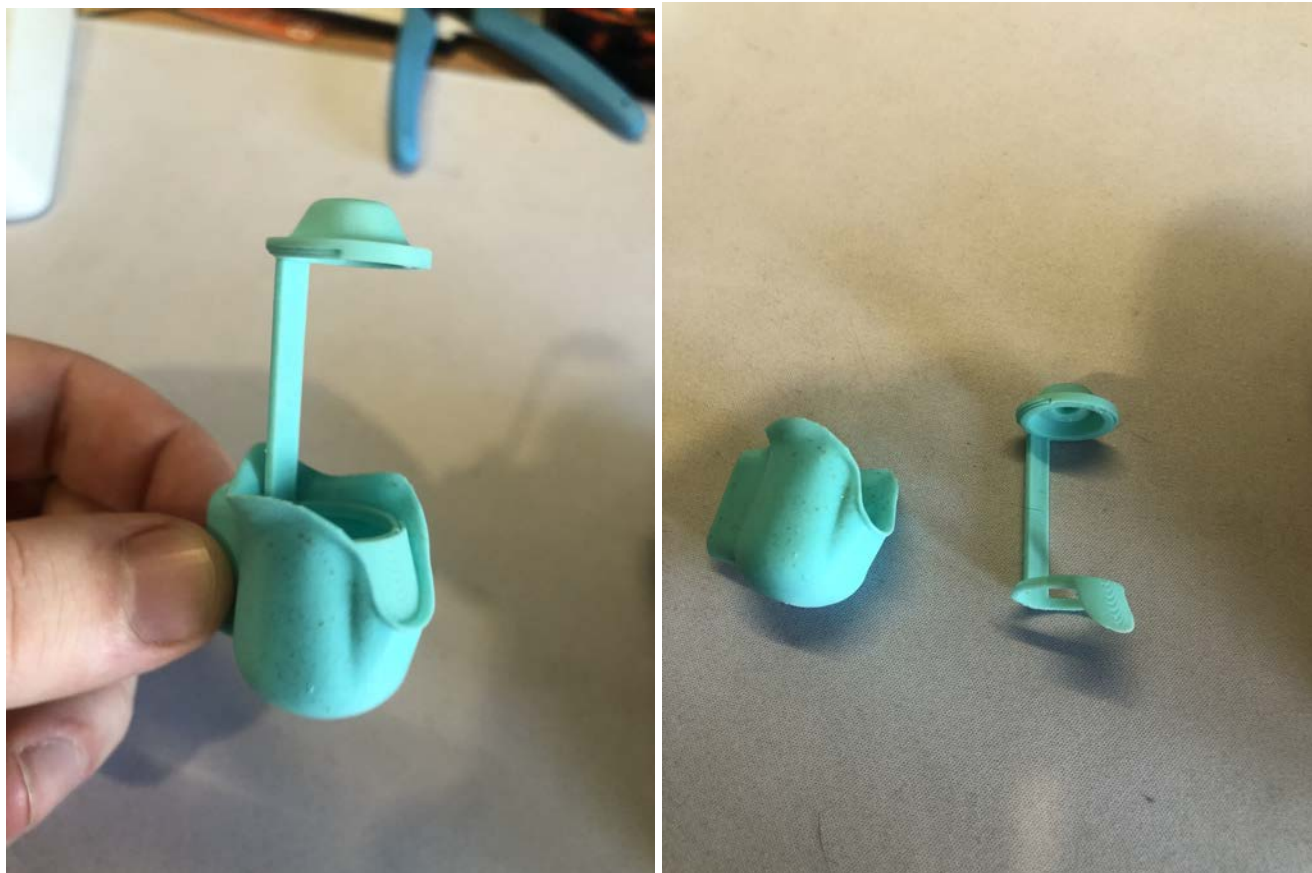
The parts can be mocked up before final painting and sanding.

Chapter 5 - Final Design
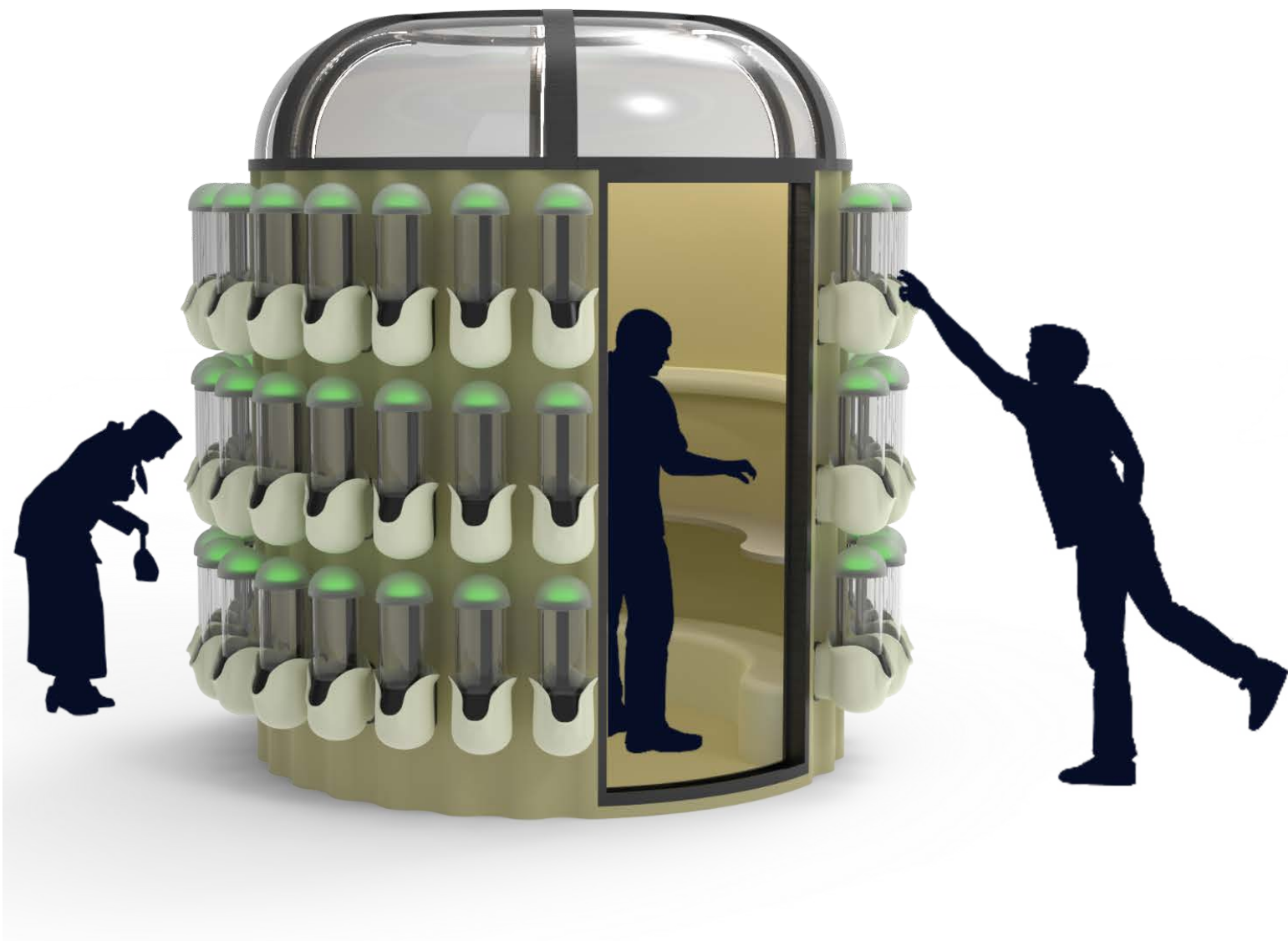
5.1   Summary

Food Scarcity is a worldwide issue, by creating a system that could work in practically any climate Grow share is a cost-effective solution. By allowing the users the freedom to choose what to grow and pick, Grow Share can be customized to fit many cultures and cuisines.

Users interact with Grow share in multiple ways. Grow Share uses an app to allow users to unlock pods or look up information on the produce being grown. Once the pod is unlocked the user can then open the door and pick the produce they want.

Grow Share uses hydroponic growing techniques to grow to produce more efficiently. These techniques are far more sustainable than traditional soil farming: hydroponics uses significantly fewer resources, i.e. water, energy, space, and time.

By creating a way for those less fortunate to easily access fresh produce, Grow Share can have a positive impact on many peoples' lives.

5.2   Design Criteria Met
5.2.1   Full Bodied Interaction Design
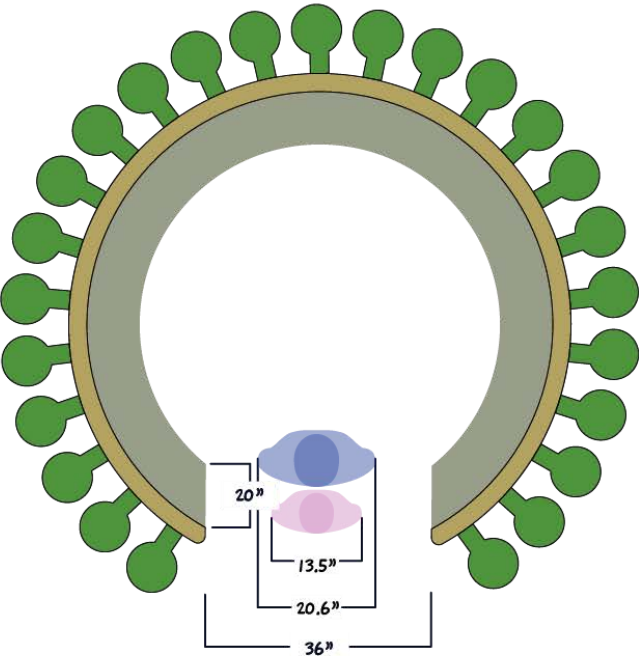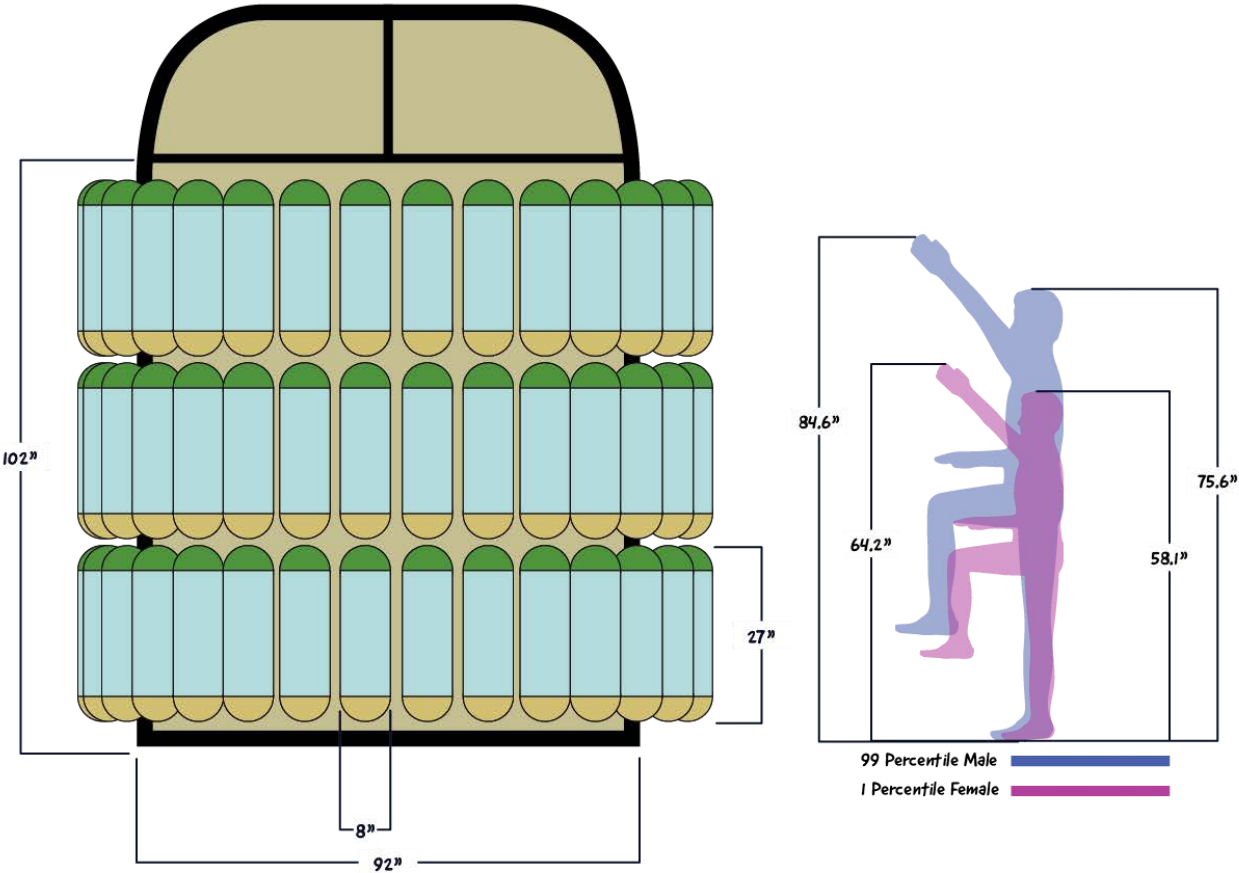
5.2.2 Materials, Processes and Technology

Currently, the material that would have been selected for manufacturing would have

been polypropylene and it would have been injection moulded. Although polypropylene can

be recycled multiple times, the original manufacturer is where the real issues occur. To create

polypropylene a huge amount of resources are used. Petroleum and natural gas are required

as well as large amounts of water and power are used up. Due to the significant energy

usage and greenhouse gas emission produced, polypropylene is not an ideal material for this

application. (Is Polypropylene Bad for the Environment? 2021) To replace polypropylene a

material would need to have its positive features, but by far more sustainable and

eco-conscious. The material selected is EcoAce WB50. This material is a renewable

biocomposite, made from 40-60% wood fibres and bionaphtha. Bionaphtha is a form of

renewable diesel, the one used is extracted from wood. EcoAce can be moulded easily and

the parts are very strong. Due to the use of wood fibres, EcoAce has a soft and warm feel.

The wood fibres are visible in the finished parts, but this gives a modern texture and pattern,

visually similar to terrazzo. Another aspect of the material is that it is food safe, which is very

important in a system that is producing food for communities. In terms of sustainability,

EcoAce is considered to be 100% renewable and it is fully recyclable. (EcoAce WB50 |

PositivePlastics, 2020)

In order to reduce the cost of production, injection moulding is ideal when dealing with

so many of the same parts. Each Grow Share system features 75 grow pods, all of which are

identical. With injection moulding, there is a large upfront cost to making moulds, but then the

parts produced are significantly less than CNC'ing or other processes. In terms of

sustainability, injection moulding produces little to no waste, only the needed amount of

plastics is used and any other material can be recycled for later injection.

5.3   Final CAD Rendering
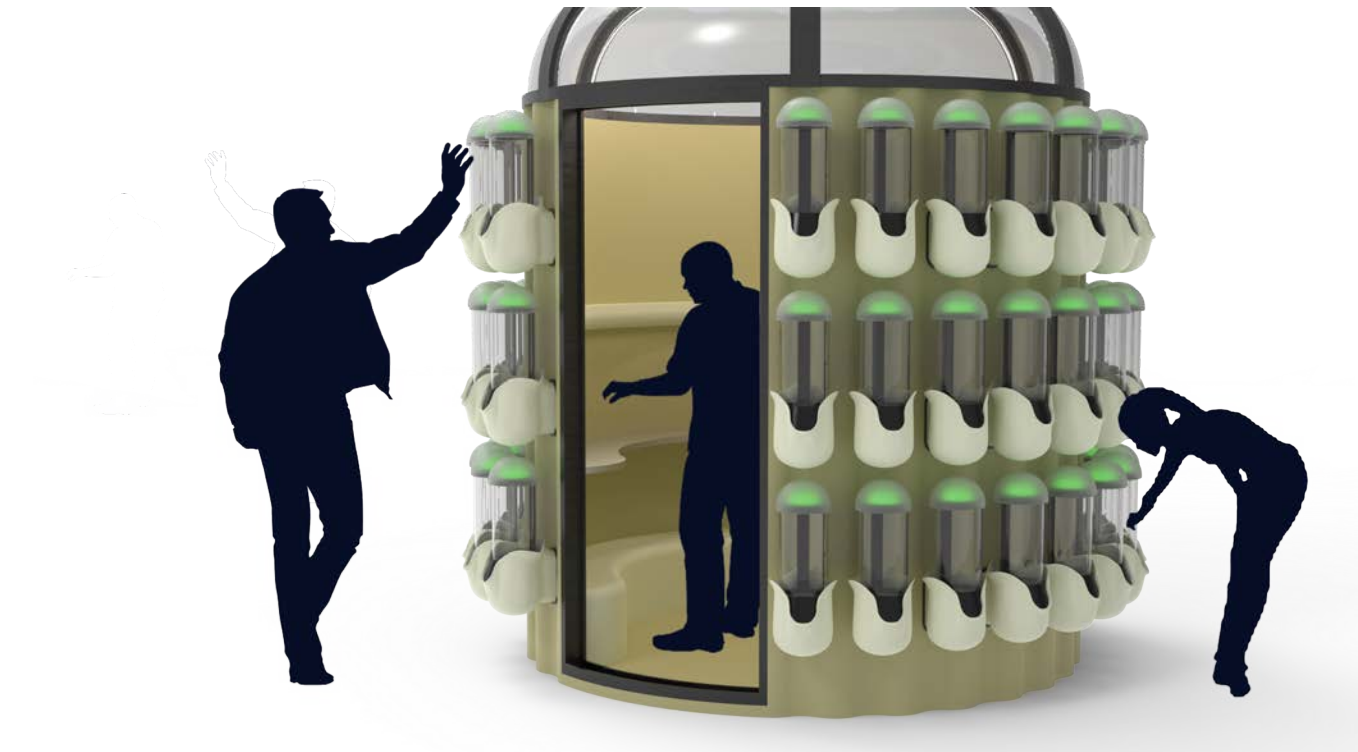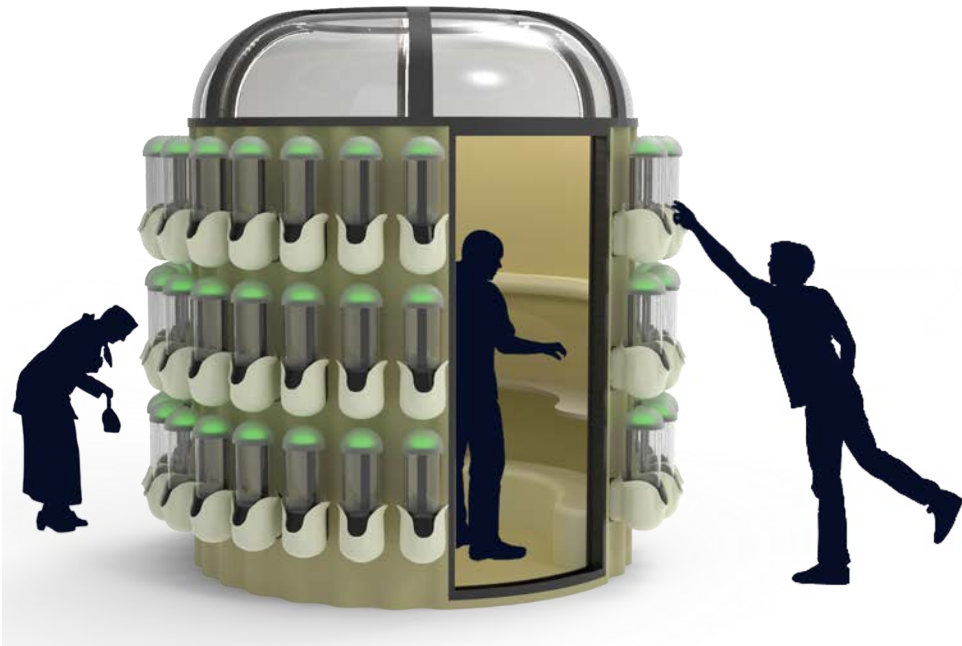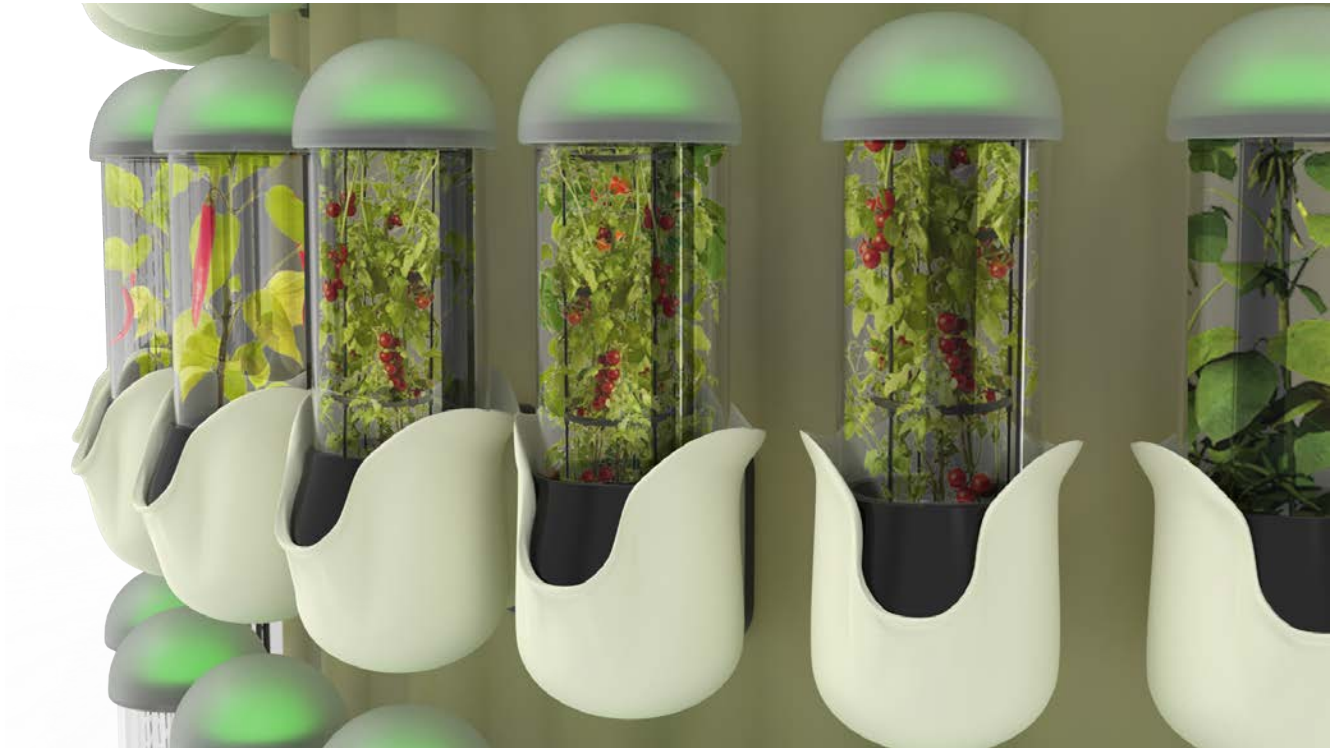
5.4   Physical Model

5.4   Technical Drawings
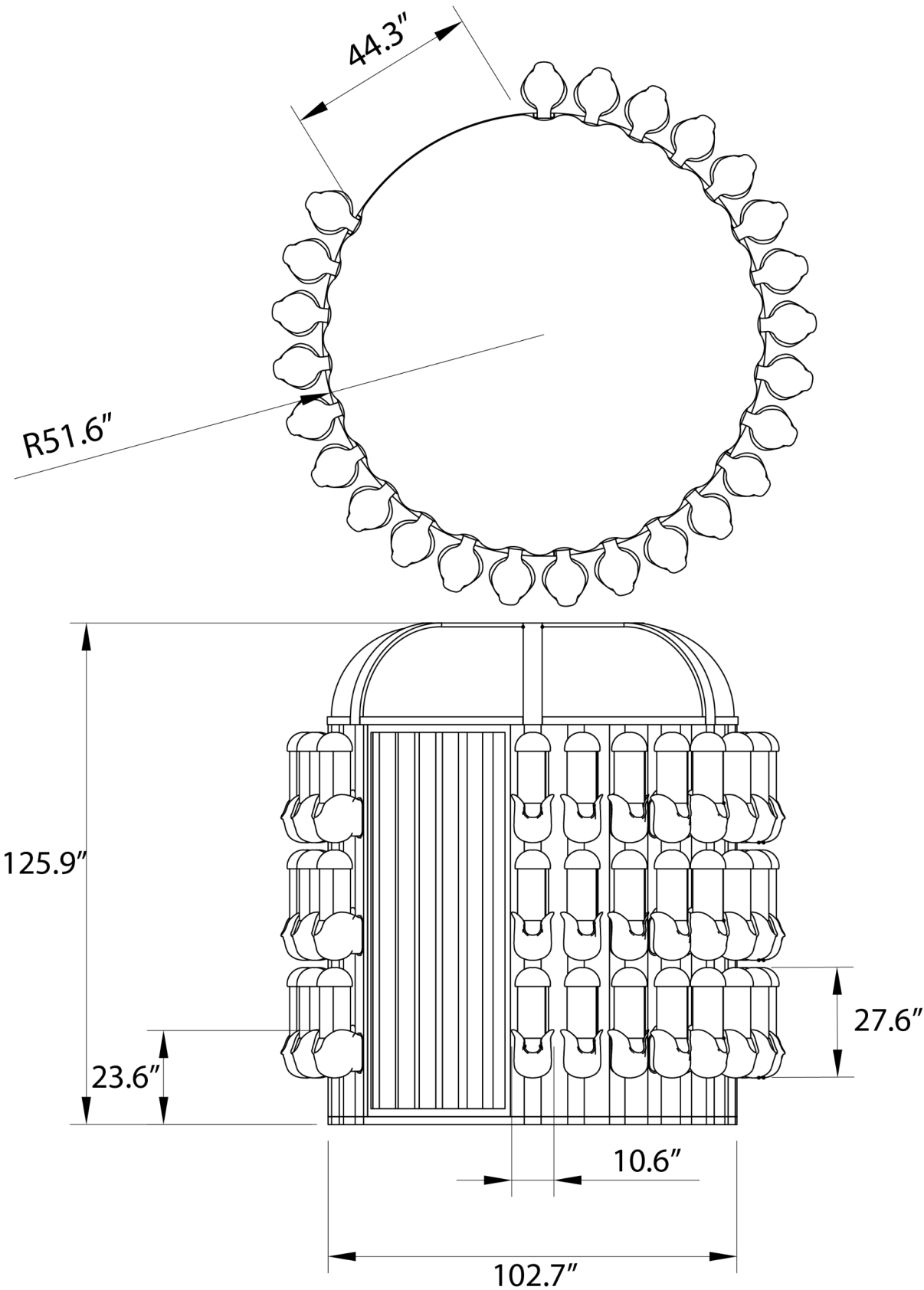
5.6   Sustainability

In order to make Grow Share possible, it must be sustainable as well as affordable. Grow Share is meant to live in low-income areas so creating a product that is overly expensive would be counterproductive. With all the findings previously stated, the design should be able to be injection moulded, and thin walls are possible with the material, but not advisable in terms of durability. In terms of waste, the Grow Share system aims to create as little as possible. It uses a recirculating system to reuse the water as much as possible and expanded clay pellets are used as a growing medium and can be reused with each growth cycle.

Photo by Francesco Gallarotti on Unsplash

CHAPTER 6 - CONCLUSION

According to data conducted by The Food Trust, many consumers have a tough time acquiring fresh, inexpensive produce. A food desert is an area with a big population that is experiencing this shortage. Food deserts are a relatively new phenomenon. Fast-food restaurants are frequently abundant, which is an unhealthy option that many individuals choose since they have no other choice. Food deserts largely harm low-income or minority people, according to The Food Trust. This group is already at a disadvantage, but when you throw in the inability to obtain nutritious food, you have a recipe for disaster. This group of people is compelled to maintain an unhealthy lifestyle, which shortens their lives and lowers their quality of life. The goal of this project is to look into the efficiency of systems that may be set up to manufacture fresh produce for the target audience while using less space, water, and time. Growing approaches that can successfully cultivate produce with seasonal fluctuations, maximizing growth and growing year-round, will be investigated in the studies. Observation and interviews with persons affected by product shortages will give an in-depth understanding of the problems and how they might be solved, which will be used to evaluate viable solutions. This is a solution that could be used on a daily basis. Families would no longer have to worry about where they would get their food and could instead focus on living a healthy lifestyle.

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Appendix A – Discovery

Originally the problems being reviewed had more to do with homelessness. After reviewing articles on homelessness it was clear this is a much bigger issue than this project is capable of solving. A sub-category that was discovered was food scarcity, food deserts in particular.

Appendix B – Contextual Research (User)

In order to further understand the problem presented and possible solutions, people were interviewed.

The people selected live in a low-income area, but not necessarily in government housing. From those

interviews the idea of in-building solutions was brought forward, other concerns were cost and space

allocation.

Appendix C – Field Research (Product)

Current products that are on the market were examined to see where there is an opportunity for improvement.

| Pictures	Product Name	System Type	Features	Benefits
	Product 1: Scotts Aerogarden Harvest Elite LED	Deep Water Culture	full spectrum 20-watt LED lighting system energy efficient LEDs	grows five times faster than soil 12" (30.4 cm) of growing height just pennies a day to operate
	Product 2: Aspara 16 Hole Hydroponic Indoor Grower	Wicking System	APP CONTROLLED LARGE 16 PLANT CAPACITY 10 built-in smart sensors Fully automated central water system 86-LED light design	Plants grow naturally in water no messy soil, all non-GMO, and free of pesticides or herbicides Monitor and control your aspara grower with the intuitive app 5x faster than traditional methods enjoy a variety of salad greens, herbs, vegetables, flowers and more any time of year
	Product 3 Alfred DWC (Deep Water Culture) 5 Gallon 4-Plant System Kit	Deep Water Culture	the plant roots are suspended in a solution of nutrient-rich, oxygenated water. This direct delivery of vital nutrients	simplest way to grow easy method growing huge no messy soil fast plant growth, lush foliage, and full, heavy flowers
	Product 4: AeroGarden Harvest Elite - Stainless Steel	Deep Water Culture	room for six different plants endless variety of herbs, vegetables, salad greens, or flowers full spectrum LEDs no pesticides or herbicides Built-in sensors	Versatile will inspire you no matter the season Perfect for beginners and experienced growers alike enhance your food, drinks, home and life you'll be enjoying the delicious taste that only comes from homegrown herbs and veggies in no time automatically turn the lights on and off
	Product 5 Click and Grow Smart Garden 3 Indoor Herb Garden, Beige	Deep Water Culture	you just need to plug in the power adaptor, insert the plant pods, fill the water tank don't require you to periodically add nutrient solution unique Smart Soil automatically stabilizing pH levels and oxygenating the root	easy as using a pod coffee maker completely silent indoor grow kit completely silent indoor grow kit No green thumb needed!
	Product 6: VIVOSUN Hydroponic Grow Kit	Nutrient Film Technique	Soilless cultivation Timeable Circulatory System circulation mode can also be set manually or automatically PVC pipe is 4.3 feet(1.3 meters) long and 2.5 inches (6.3cm) in diameter	Clean & Environmentally Friendly yield can be doubled, Requires less water and less space pump more durable saves nutrient solution Simple to Assemble & Use Great for beginners saving time and energy
	Product 7: iDoo Indoor Garden Farm	Deep Water Culture	Plants grow in water mixed with nutrients, supported by degradable sponges 34 Watt LED lights Height up to 26.77 Inches Full control of the growing conditions removable water tanks	No mess, No limitation Perfect for tall plants grow crops year round enough space for plants
	Product 8: The EVE	Nutrient Film Technique	Plant Capacity 12 plants Add water every 3 weeks Full spectrum white LED grow lights Solid wood frame, Chrome leg	fit in the tiniest of spaces, without compromising the quality and efficiency

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Appendix E – CAD Development

Appendix F – Physical Model Photos

Appendix G – Technical Drawings

44.3"

R51.6"

125.9"

23.6"

27.6"

10.6"
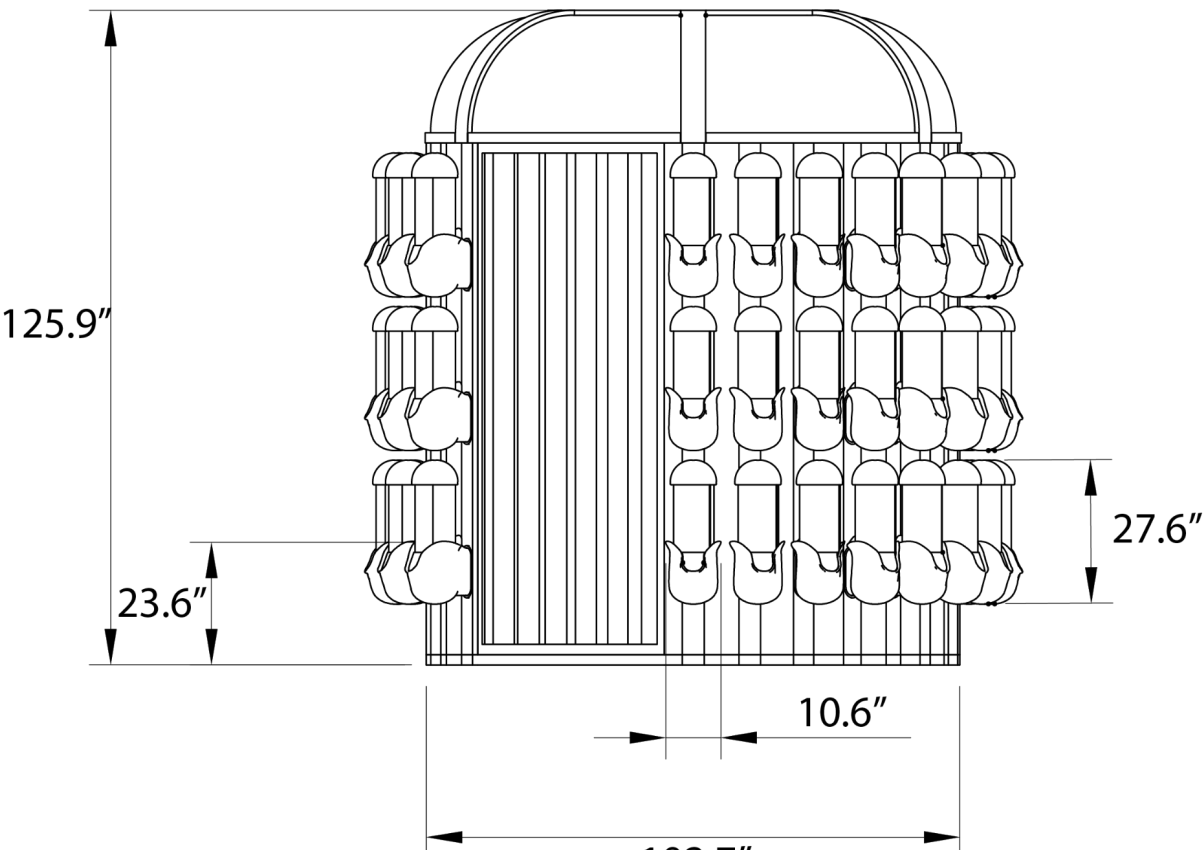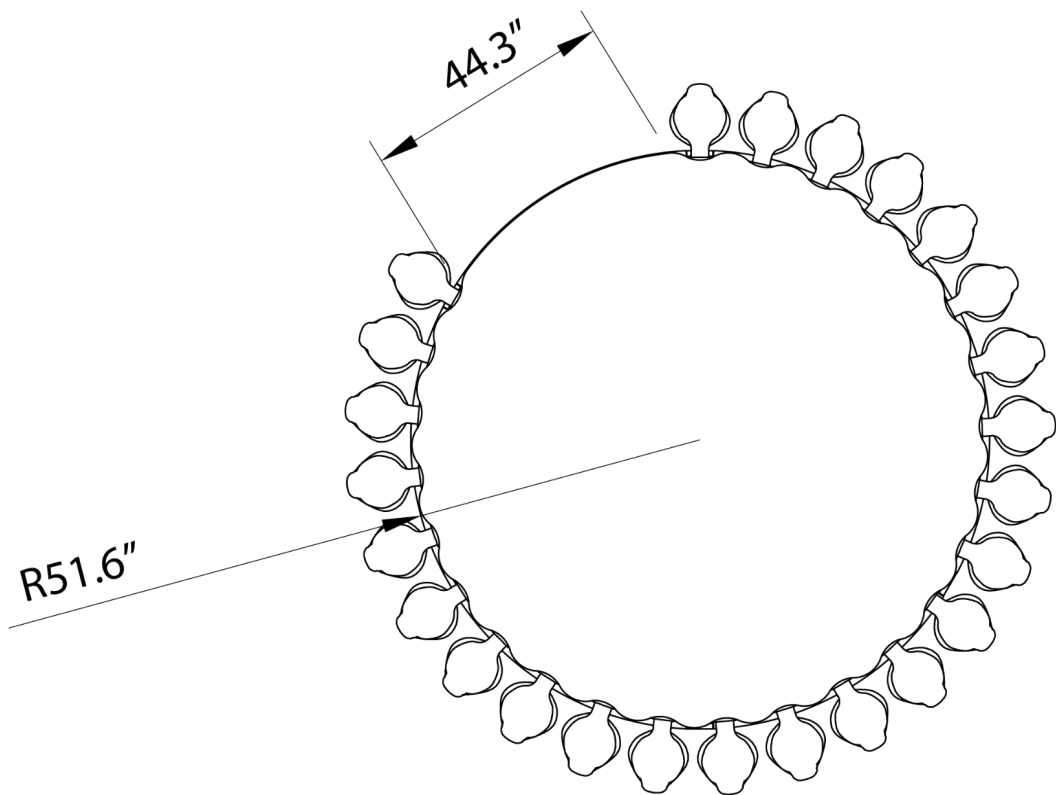
Appendix I – Sustainability Info

EcoAce-

"A brand new biobased product family for 2020's is UPM Formi EcoAce, a

biocomposite which meets even the highest sustainability requirements. It contains certified

wood and cellulose fibers as well as bioplastics sourced from UPM Biofuels plant, BioVerno

naptha. The bionaptha production is certified by ISCC and confirms sustainability of the

material."

Appendix J – Approval Forms

IDSN 4502
SENIOR LEVEL THESIS TWO

Humber ITAL / Faculty of Applied Sciences & Technology
Bachelor of Industrial Design / WINTER 2022
Catherine Chong / Sandro Zaccolo

CRITICAL MILESTONES: APPROVAL FOR CAD DEVELOPMENT & MODEL FABRICATION

Student Name:	Logan Smith
Topic / Thesis Title:	URBAN FRESH PRODUCE ACCESSIBILITY

THESIS PROJECT – DESIGN APPROVAL FORM

Design is reviewed and approved to proceed for the following:	[X]	CAD Design and Development Phase

Comment:	- Initial CAD started well as of week #7/February 22nd, continue with detailing and refinement. - Refinement CAD progress well as of week #8/March 8th, still required some detail refinement.

Design is reviewed and approved to proceed for the following:	[X]	Model Fabrication Including Rapid Prototyping / 3D Printing and Model Building Phase

Comment:	- Once CAD is completed, can move forward to model fabrication from week #9 onward.

Instructor Signature(s):	
Date:	8th March, 2022

Chong, Kappen, Thomson, Zaccolo

PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE

Certificate of Completion

This document certifies that

Logan Smith

has completed the Tri-Council Policy Statement:
Ethical Conduct for Research Involving Humans
Course on Research Ethics (TCPS 2: CORE)