

GROW UP

To meet the growing need for food and to restore the lost connection to food production this project imagines a vertical indoor garden for city center apartments where the consumer can grow their own greens 365 days a year.

DSKD

Helena Lehn
BA 2022



At the Micro-Greens facilities



1st draft at the z-model

INDEX

FIELD OF INTEREST	1
TOPIC.....	2
MOTIVATION.....	3
PURPOSE & DELIVERY.....	4
DESIGN CHALLENGE.....	5
STAKEHOLDERS.....	6
TARGET GROUP.....	7
PARTNERS.....	8
KNOWLEDGE BASIS.....	9
AGRICULTURE - TRADITIONAL VS. VERTICAL FARMING....	10
AESTHETIC SUSTAINABILITY.....	11
PRODUCT EXPERIENCE.....	12
METHOD AND PROCESS.....	13
MY DESK.....	14
6C MODEL - COLLECT & COMPREHEND.....	15
SEEDS & GROWTH.....	16
CONCEPTUALIZE.....	17
CREATE.....	18
Z-MODEL.....	19
DOUBLE DIAMOND.....	20
FURTHER PROCESS.....	21
PARTIAL CONCLUSION.....	22
TIMESCHEDULE.....	23
REFERENCES.....	24

FIELD OF INTEREST

TOPIC
MOTIVATION
PURPOSE & DELIVERY
DESIGN CHALLENGE

GROW UP

For this project the focus was on how to grow leafy greens in a domestic setting, with inspiration from vertical farming. Making it possible for the user segment to grow nutritious greens including spinach, kale, romaine, watercress, and arugula, that are very rich in a combination of vitamins A, C, K and several B vitamins. Not only are these greens healthy, but they are also fast growing, making the consumer able to harvest after 30-45 days from sowing. Large quantities of vegetables will be difficult to grow indoors due to space restraints, but the leafy greens can make up for that with the nutrition they produce. Although it is important for the project that sufficient vegetables can be produced for the design to fulfill its function.

Personally, it is a central wish for the design to create awareness of what we eat and how its grown, generating a more direct link between the consumer and the food. Not only would it help the environment to take ownership of your own food production, it would also benefit your health since no pesticides will be used and you control every step of the plant's growth. Being able to produce your own crops would make the consumer more conscious and might even make them regain an appreciation of nature. Our food production is out of sight and so is nature in the city centers. I want to create that connection again.



Micro-green root net

MOTIVATION

My main drive for this project is to accommodate and communicate the a way in which we produce and eat in the 21st century. There is a grand seperation between the production of the food and where it ends up. I want to make it more transparent and invite people to take ownership of their own vegetable production.

The current world population is 7.9 billion people, with an estimated increase of 81 million people per year. That means by the time we get to the 2030s we are expected to reach almost 9 billion people (Worldometers. (2022)). To feed that population we won't be able to grow crops the traditional way, meaning we need to innovate where and how we grow our produce. Not only will it be difficult, if not impossible, to find "new farmland" to grow traditionally since most of the worlds arable land is already cultivated, but we are also reaching the limit of freshwater consumption. I believe that we need to change our habits in order to secure the future.

I am vegan and firmly believe that eating plant based is our best bet at solving the problems mentioned above and reduce the climate crisis most rapidly. Not to talk about how we could reduce the CO2 emissions if traditional animal farming decreased plus we could reduce the farmed land globally. Just think about how much lost wilderness could be restored and brought back as compensation for the loss of biodiversity due to farming. I am aware that changing people's habits and patterns, not to talk about the cultural aspects of eating, will be difficult to shift. But enabling them to grow their own produce could be a step in the right direction, and maybe make them comfortable with the thought of minimizing their animal product intake.



PURPOSE

For this project i wish to challenge myself and my process. I haven't focused so much on 3D modelling and wish to become better at CAD. Therefore, I will strive to visualize my designs in Rhino before I go further with them. Although I wish for there to be a balance between analog and digital work as they shed light on different stages of the process. Furthermore, I wish to create visual content supporting the design and presenting the attributes through key shot or small rendered videos. How you present a design can be crucial for the understanding and perception of it, so I will work towards creating nice presentation material. I wish to achieve a design that speaks to a large target group through a simple design, enabling the design to fit into the homes of many so they can benefit from it. I want to reach this goal by working on shapes and really challenge myself to think outside of the box.

DELIVERY

I wish to deliver a modular design solution enabling users to grow vegetables indoor in their apartments. I want the design to be simple but intriguing, gracing the wall and acting as decoration as much as a functioning growth apparatus. Since the design is modular, I expect to have several pieces so they can be shown singular but also in a group. Since a great focus has been on the pattern the pieces would make, it would be beneficial to have finished more than one. Furthermore I wish for the design to be made in conscious materials.

Design Challenge:

How might I design an indoor hydroponic system to grow leafy greens vertically.

Research questions:

- How do I design for longevity?
- How can I make the product easy in use?
- How do I make the design modular?
- How can i focus on resources in the design?

STAKEHOLDERS

TARGET GROUP
PARTNERS

TARGET GROUP

TARGET GROUP

My target group is individuals in Scandinavia in the age of 23-80. People that want to take ownership of their own vegetable production. Since the product is not a very personal thing, the target group is mostly for functional consideration. How they would use the product and their habits.

The early 20's is the age where some young people gain consciousness about the impact their food habits have on the environment and try to act on it. *Or at least it was around that age that me and my friends started to think about the impact our actions had on the world.* They have more independence and maybe a steady income to make a change. The younger segment of the target group are very conscious people studying, working and living in the big city, but has a dream of a future in harmony with nature. They are aware of the resources they use and takes their bike or public transport everywhere. They buy most of their clothes in thrift stores and buy used electronics to not support consumerism. They follow social medias sharing information about how to live more sustainable and are constantly exposed to graphic images of pollution and animal farming. They are starting to have a shift in mentality towards a more curious and enlightened understanding of the world. They want to change the things they can, close to home, starting with their own eating habits.

The middle of the user segment is grownups and parents. They want to educate their kids on nature and give them positive experiences with growing their own food. They want to make sure they don't expose their kids to unnecessary pesticides and like the feeling of growing something themselves. They like the look of fresh greens in the kitchen and think it adds a feeling of ecology to the room. They want to invite nature inside and also benefit from it. The age limit of 80 is set due to the big interest amongst that age group for growing their own fruit and vegetables. They have more time to immerse themselves in those activities and enjoy sharing their grown goods with their family.

CONTEXT

The focus area of the design will be in city center apartments with no garden or terrasse area to grow on. With the rising numbers in population, I foresee that future generations will live as packed as we do now in the cities. Therefore, it must be a design that fits in a small apartment, not taking up too much space, but still able to produce enough food that it fulfills its purpose. Due to space restraints, there is a wish to make the system modular, enabling the user to up- and downscale the design.





PARTNERS

As for partners in this project I have a collaborative agreement with Micro-Greens DK. Micro-Greens deliver greens to restaurants across Denmark and have their own vertical farm in Ringe. Their main focus is to think sustainability into every step of their process. From using ecologically sources seeds to using trays of robust recycled material and developing LED lights that uses the least amount of energy. Their business strategy is heavily influenced by the global goals of UN. Micro-Greens are very interested in possibly expanding their offers from being business to business solutions (B2B) towards solutions to the private sector. The team at Micro-Greens consists of water-technicians, engineers, blacksmiths, farmers and more, making it possible to get knowledge about every step of the process from seeds to production methods. Alex Pichardt, the administrating director, has knowledge about the technical properties of the machinery, making it possible to create a functional prototype. Micro-Greens will act as the main sparring partner in the project, giving good advice and helping with the manufacturing.

For interior design consultancy I have Levina Putri from STUDIO.TALK in Jakarta, Indonesia. I chose to have a second partner that could inform me about interior design, since the finished design will both be functional but also decorating the wall. Levina will help me with consultancy on minimalistic interior pieces and knowledge about how this design can fit into an already existing interior context and become something more than just a farming device. I find great inspiration in STUDIO.TALK'S atmosphere that combines old Indonesian furniture traditions with minimalistic and playful organic shapes. A goal for my finished product would be if the design could be considered a possible addition to STUDIO.TALK'S interior universe.

KNOWLEDGE BASIS

AGRICULTURE
AESTHETIC SUSTAINABILITY
PRODUCT EXPERIENCE



Traditional farming



Vertical farming

TRADITIONAL VS. VERTICAL FARMING

To get knowledge about traditional farming and vertical farming I read many internet articles and used my own knowledge on the subject. Since the start of my twenties, I have been conscious of my own impact on the environment and when I became vegan it was very important for me to know about agriculture and livestock farming and their impact on the environment. So to understand the need for my design I had to dig deep and gather more information to support my arguments.

Traditional farming is done in horizontal areas, taking up a lot of space and destroying the biodiversity. Traditional farming leads to deforestation due to needing more land and a loss of nutrients in the soil as an effect of intensively farming the same crops repeatedly, called monocultures. Globally the agricultural land area stands for approximately 38% of the global land surface. (FAO. (7. May 2020)) 55% of these crops are consumed by people, the remaining 45% goes to animal feed and biofuels. Feeding animals with the grown crops is an indirect way of getting the calories we need. For instance, it takes 100 calories of grain to produce 12 calories of chicken or 3 calories of beef. (Emily S Cassidy, P. C. (2. May 2013)) Eating directly from the source instead of letting it pass through another animal's system is there for the most efficient way of feeding the planet. Not to talk about how that would reduce the CO2 emissions in traditional animal farming plus we could reduce the farmed land. Minimizing, or entirely ruling out, the livestock business and eating more vegetables would be our best bet at living as logical and sustainable as possible. (unknown. (22. februar 2021))

By farming vertically on a bigger scale, we can grow crops in a controlled environment utilizing the same horizontal area multiple times. The production warehouses can be placed anywhere meaning less transportation time and more nutrients in the food since it doesn't have to travel the long distance from farm to store. Furthermore, it is possible to establish a vertical farm almost anywhere in the world, making it possible to grow crops where there is no arable land available. This could for example be the case in deserts or Antarctica, provided that there is a reliable water source. The farming wouldn't need pesticides since the produce are less prone to bacteria and insect infestations, due to the safe enclosure. Vertical farming doesn't have to use soil for growing as there are many growth mediums such as coconut husk, different foams and discarded mattress methods available. The seeds only need a firm medium for keeping them out of the water and their roots close to the nutrient rich water. In terms of water consumption vertical farmers usually collect the used water in tanks and reuses it. Since the water is in movement it's nutrients can be obtained by all the plants in the system, not wasting a drop of water. (CambridgeHOK. (21. January 2020))

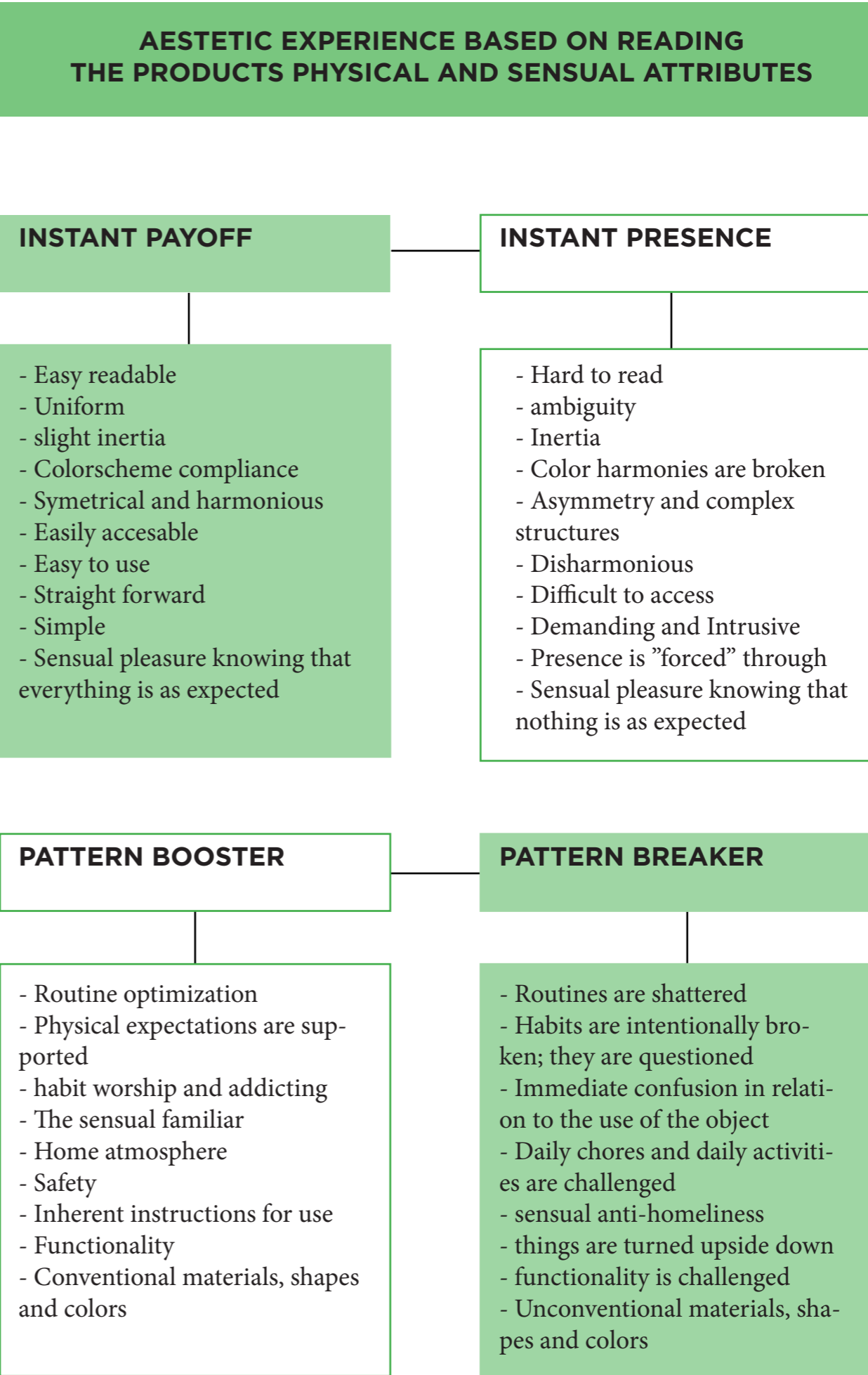
AESTHETIC SUSTAINABILITY

It is important for me that what I design has a place in this world. I do not wish to contribute with short lifespan products that are discarded when they go out of style. Therefore, I read certain chapters from the book Aesthetic sustainability by Kristine Harper, that described how to design for longevity. When designing for longevity I believe it's a good idea to think sustainability into the design from the very start. This can be done in different stages (of throughout) the process, such as material choices, manufacturing, or general aesthetic. It was most important for me during the form giving of the design, since I want to make it relevant for a broad target group and learn what semantics to use according to what I want to achieve.

People have different preferences when it comes to the design of the objects they use in their everyday life or decorates their house with. Their preferences are subjective and emotional and hard for the designer to accommodate, but Harper describes that there is a certain synthesis of diversity with common denominators of beauty experiences amongst humans. These can make the experience of a product relevant, seminal, and durable. By generalizing universal themes, the object can please the recipient aesthetically if it's experienced and communicated as relevant to them. My personal goal is to encapture vertical farming in a small scale, pay homage to the beautiful giving nature and give gratitude to be able to grow vegetables that gives nutrients to your body in the design. This might be subjective, so to make it more general i have to translate it to words like: "vegetables" and "grow". that way people can integrate their own perception and story with those words. (Harper, H. K. (s. 198- 199, 2015))

When talking about human nature, we want to take the shortest route, jump the fence, and always choose the easiest option available. To make the design as accomodating as possible I wish to communicate that it is easy to use and maintain and can fit in anywhere. That way it won't seem daunting to put in use. I want the product to change people's behavior around food in a positive way and their mindset from thinking that it is difficult and time consuming to grow your own vegetables, to thinking that it's a walk in the park.

Based on Harpers model for aesthetic strategies, My aesthetic strategy on the designs physical and sensuous attributes, will focus on instant payoff and pattern breaking. With instant payoff I want the design to be easily readable, symmetric and easy to use. And with Pattern breaking focus on challenging the daily routines of the user and intentionally question their patterns. (Harper, H. K. s. 206 (2015))



PRODUCT EXPERIENCE

AESTHETIC EXPERIENCE

EXPERIENCE OF MEANING

EMOTIONAL EXPERIENCE

PRODUCT EXPERIENCE

A beautiful object doesn't have much use other than decoration if it doesn't have a function. Although it is important to think of the form and overall aesthetic, it is most important to think of what function it plays into, as Peter-Paul Koch and Professor Jan Michl says:

"If the form of a design becomes a goal in itself, instead of a means to an end, the product will fail."

- Koch, P.-P. (6. February 2003)

"The chosen aesthetic solution must support the non-aesthetic purpose the product is supposed to fulfill"

- Michl, J. (30. January 2018).

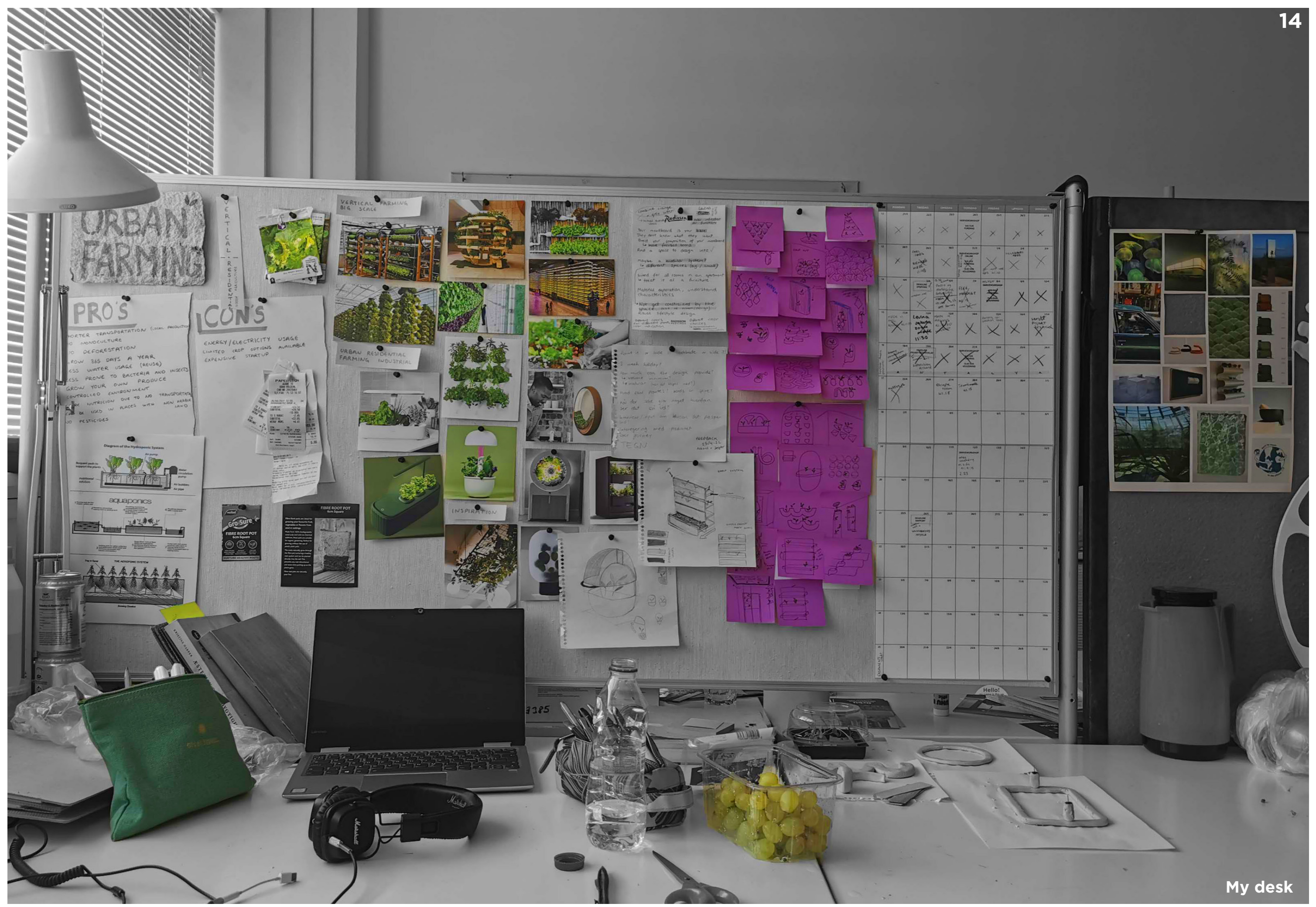
When thinking of aesthetic sustainability and longevity I think it is important to have in mind what and why you are designing an object. It is very important to define these to create the most considerate design solution for people and the planet. Another thing that is crucial for a good product is how the user interacts with the product, the user-product experience.

In the article Framework of Product Experience by Pieter Desmet and Paul Hekkert they explain that there are three components of the product experience: the aesthetic experience, experience of meaning, and emotional experience. Whereas there is a direct link between the three of how we encounter and use a product. Reading this text, I was able to pin point what I wanted to achieve in the three stages of experience. This helped me to define what was important in the design and where to place my focus (Hekkert, P. D. (20. March 2007)).

I want to please the users aesthetic experience by making a product that is simple yet intriguing in its form. As for the experience of meaning, I want to appeal to the idea that the user can define the use of the product by growing what they want, where they want. For the emotional experience I want to leave the user with a feeling of ease when using the product and with a thought of "why wasn't this in my life before". All three phases of experiences can influence each other to create an overall understanding of the product.

METHOD & PROCESS

6C MODEL
CO-CREATION CARDS
DOUBLE DIAMOND
EXPERIMENTS



URBAN FARMING

VERTICAL RESOURCES

VERTICAL FARMING BIG SCALE



URBAN RESIDENTIAL FARMING INDUSTRIAL



Combine change...
 Redesign...
 Your notebook is your bible...
 They don't know what they want...
 Build your reputation...
 Find a space to design into...
 Maybe a woodwork system?
 Used for all rooms in an apartment...
 Maximize expansion, understand characteristics...
 Non-space constraints by the...
 Rethink electric design...
 Research costs...
 Research...
 Research...



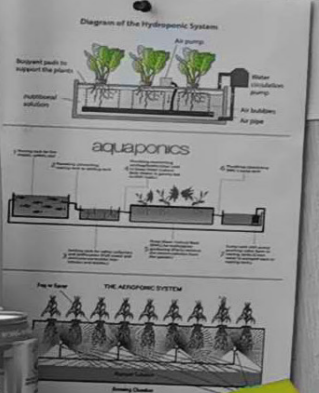
MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
21.0	21.5	22.0	22.5	23.0	23.5	24.0
24.0	24.5	25.0	25.5	26.0	26.5	27.0
27.5	28.0	28.5	29.0	29.5	30.0	30.5
31.0	31.5	32.0	32.5	33.0	33.5	34.0
34.5	35.0	35.5	36.0	36.5	37.0	37.5
38.0	38.5	39.0	39.5	40.0	40.5	41.0
41.5	42.0	42.5	43.0	43.5	44.0	44.5
45.0	45.5	46.0	46.5	47.0	47.5	48.0
48.5	49.0	49.5	50.0	50.5	51.0	51.5
52.0	52.5	53.0	53.5	54.0	54.5	55.0
55.5	56.0	56.5	57.0	57.5	58.0	58.5
59.0	59.5	60.0	60.5	61.0	61.5	62.0
62.5	63.0	63.5	64.0	64.5	65.0	65.5
66.0	66.5	67.0	67.5	68.0	68.5	69.0
69.5	70.0	70.5	71.0	71.5	72.0	72.5
73.0	73.5	74.0	74.5	75.0	75.5	76.0
76.5	77.0	77.5	78.0	78.5	79.0	79.5
80.0	80.5	81.0	81.5	82.0	82.5	83.0
83.5	84.0	84.5	85.0	85.5	86.0	86.5
87.0	87.5	88.0	88.5	89.0	89.5	90.0
90.5	91.0	91.5	92.0	92.5	93.0	93.5
94.0	94.5	95.0	95.5	96.0	96.5	97.0
97.5	98.0	98.5	99.0	99.5	100.0	100.5

PRO'S

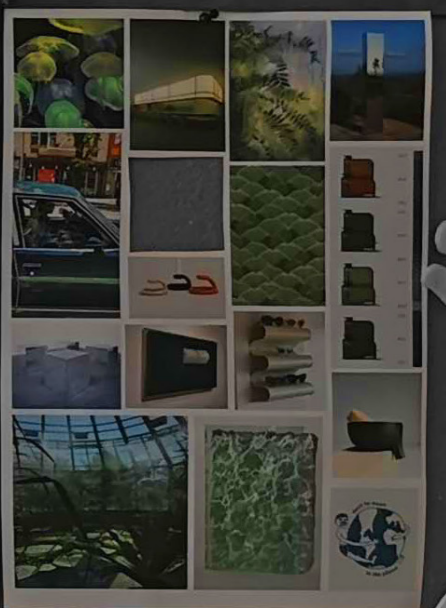
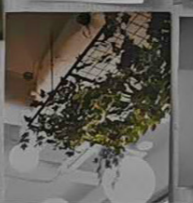
- SHORTER TRANSPORTATION (LOCAL PRODUCTION)
- NO MONOCULTURE
- NO DEFORESTATION
- GROW 365 DAYS A YEAR
- LESS WATER USAGE (REUSE)
- LESS PRONE TO BACTERIA AND INSECTS
- PRODUCE
- GROW YOUR OWN
- CONTROLLED ENVIRONMENT
- BETTER NUTRITION DUE TO NO TRANSPORTATION
- CAN BE USED IN PLACES WITH NEW ARABLE LAND
- NO PESTICIDES

CON'S

- ENERGY/ELECTRICITY USAGE
- LIMITED CROP OPTIONS AVAILABLE
- EXPENSIVE STARTUP



INSPIRATION



My desk

COLLECT

Throughout my process i have worked using the 6C model as a guideline and co-creation cards by Silje Friis. The co-creation cards were great to have at hand during the collecting and comprehending stage of the project. I am aware that the cards are mostly for group projects, but I like the simple descriptive cards to help structuralize the project (Friis, S. A. (2016)).

My process started out with desktop research about traditional farming and vertical farming. I had to really understand the subject before I dived into the creative process. It was interesting to gain knowledge about how people have grown crops throughout the years to get a deeper understanding and inspiring perspectives. This was great to understand the past in order to investigate future solutions. I feel that it is helpful for me to understand everything about a topic before I dive into innovating on the subject, although sometimes it can act as an obstacle to know too much. I researched about different watering systems, such as hydroponics, aeroponics, aquaponics and more to understand the possibilities for the finished design.

COMPREHEND

All this research ended up in pictures on my pin-up board to comprehend the development in the agricultural industry. This also acted as a visual reminder of the context in which I was designing. Photos of both industrial vertical farms, but also existing solutions for the private sector. Before I started brainstorming on designs, I wanted to know what products were already available on the market. Therefor I made a market research to gain insight of how other designers have tackled the problem. I did this by making a Photo Inquiry with pictures of the existing designs side by side to look at similarities and patterns. I made a pro's and con's list of every design to evaluate and identify patterns. A lot of these products were made for a tabletop or for the floor, taking up a lot of space. And with my chosen environment being a small apartment in the city center, people can't afford to lose table-, or floorspace.

That defined my first criteria for the product, that it should be wall hung. That way people don't lose space, and it could even have a secondary function as decoration.

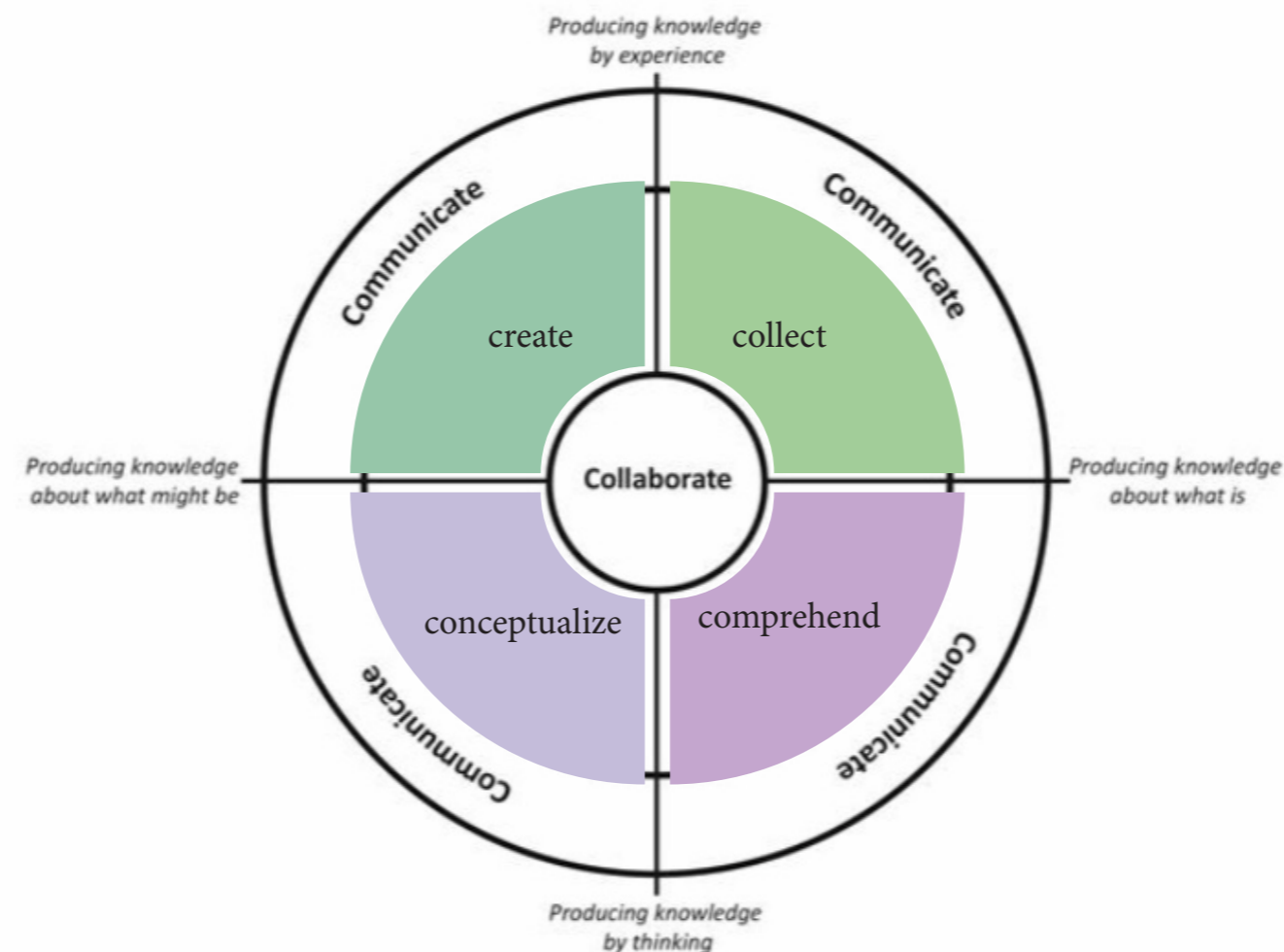
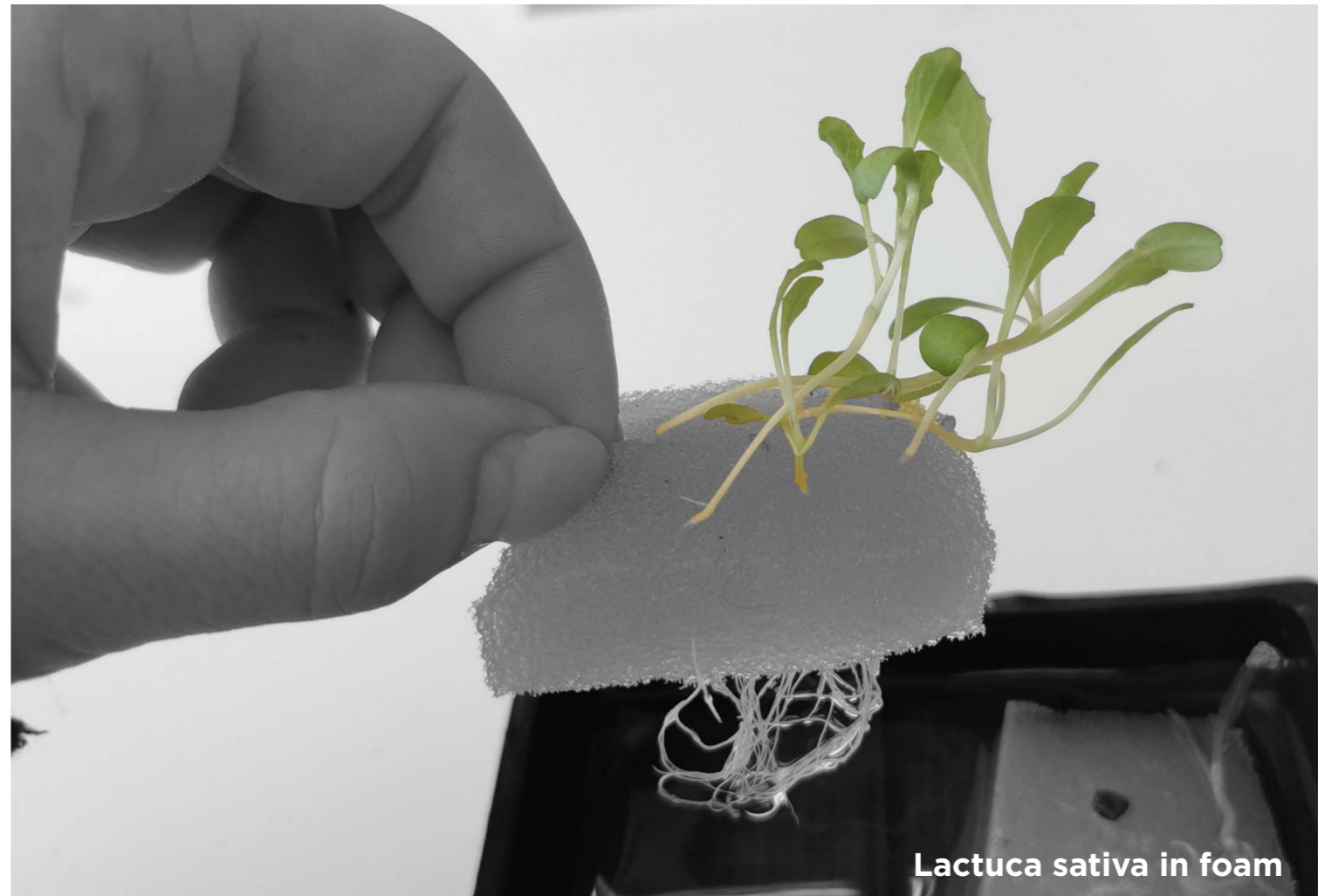


Figure 1: The 6C Model illustrates different approaches to knowledge production in design processes.
Source: Friis 2015, based on Friis and Gelting 2014

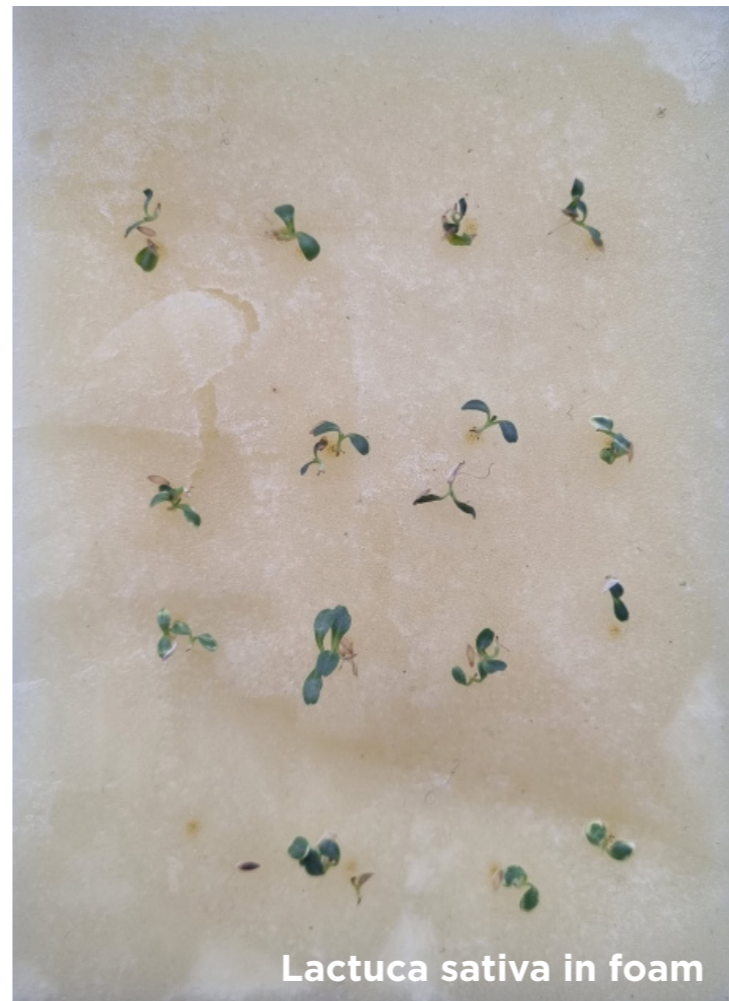
SEEDS AND GROWTH

SEED GROWTH

As a little side project, I planted seeds of salad, spinach and basil to see which growth medium worked the best for propagation. I tried planting them in Soil, compost discs and an old mattress cutoff, although there is a dozen more options. To my surprise they grew best in different growth mediums. The Basil and spinach grew the best in the compost discs and the salad in the mattress cutoff. This taught me that depending on what leafy green you want to grow there are different options of growth mediums best suited for them. Furthermore the seeds only need a medium to latch onto so their roots can get nutrition from the water. Therefore the "holes" for the plants in the finished design doesn't need to be big. The picture in the upper right corner is from a test in an old mattress material where the roots of the plant is visible. I made this experiment to understand the context in which I was designing, and invited it into my workspace.



Lactuca sativa in foam



Lactuca sativa in foam



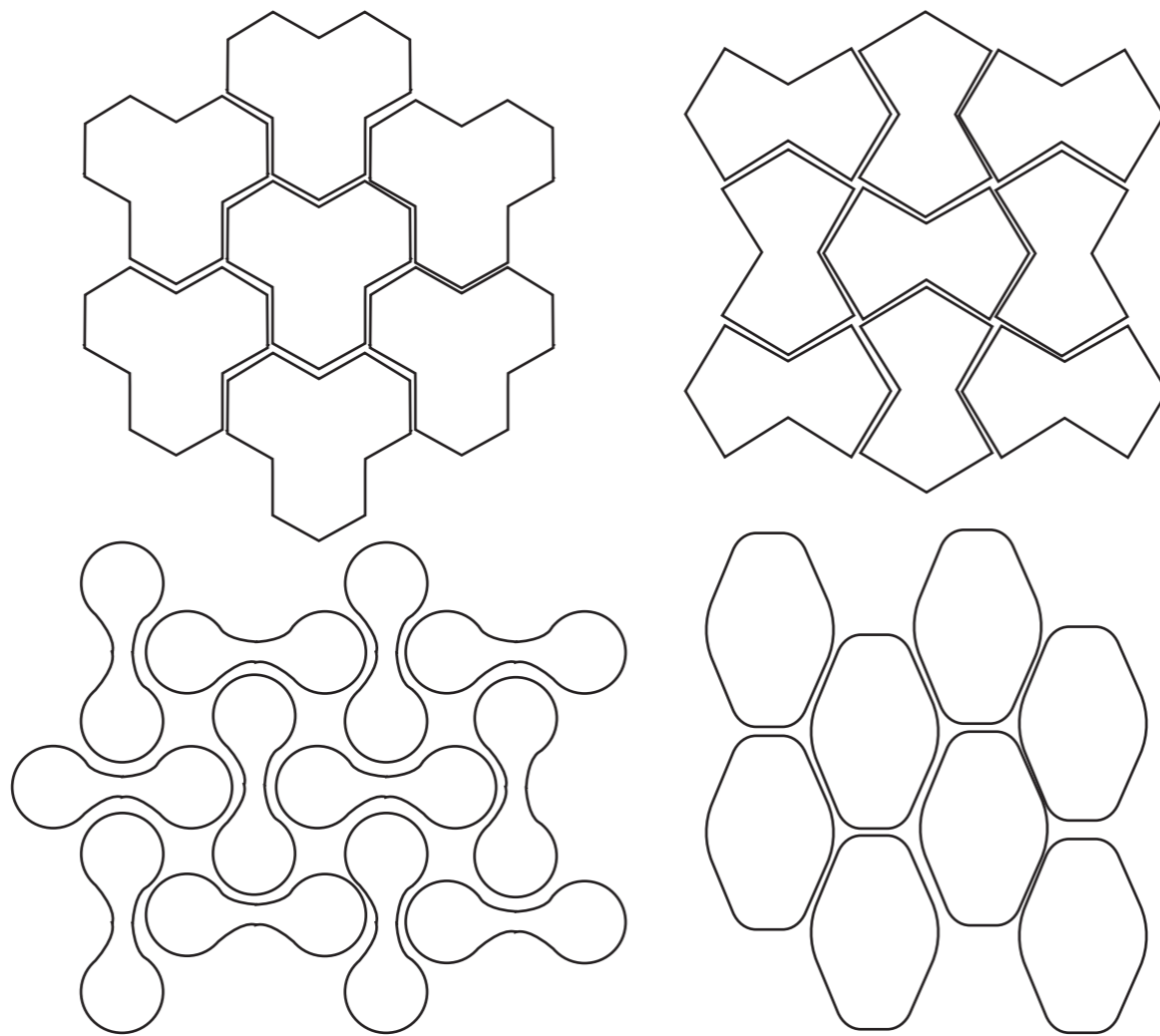
Pea shoots in coconut husk

CONCEPTUALIZE

CONCEPTUALIZE

Then I started rapid sketching in post-its, making as many crazy ideas as possible. Here I didn't focus on making quality drawings but more on quantity. This gave me new ideas and made it possible for me to join several ideas together. I don't like to sketch. It has never been my forte, so I usually always go straight to prototyping, but here I tried to have fun with it. I sketched from organic to geometric and from highly functional to poetic. When I had sketched all my initial ideas I made a cross scale to see where they were situated to both clear my mind and sort them into categories.

Not only did I sketch possible designs I also sketched geometric and organic patterns that fit together in a grid. This was to see if any of the shapes were interesting for the modular design in singular but also in a grid of many. I turned to Illustrator for precision in the pattern making and for drawing some of the post-it ideas more clean.





CREATE

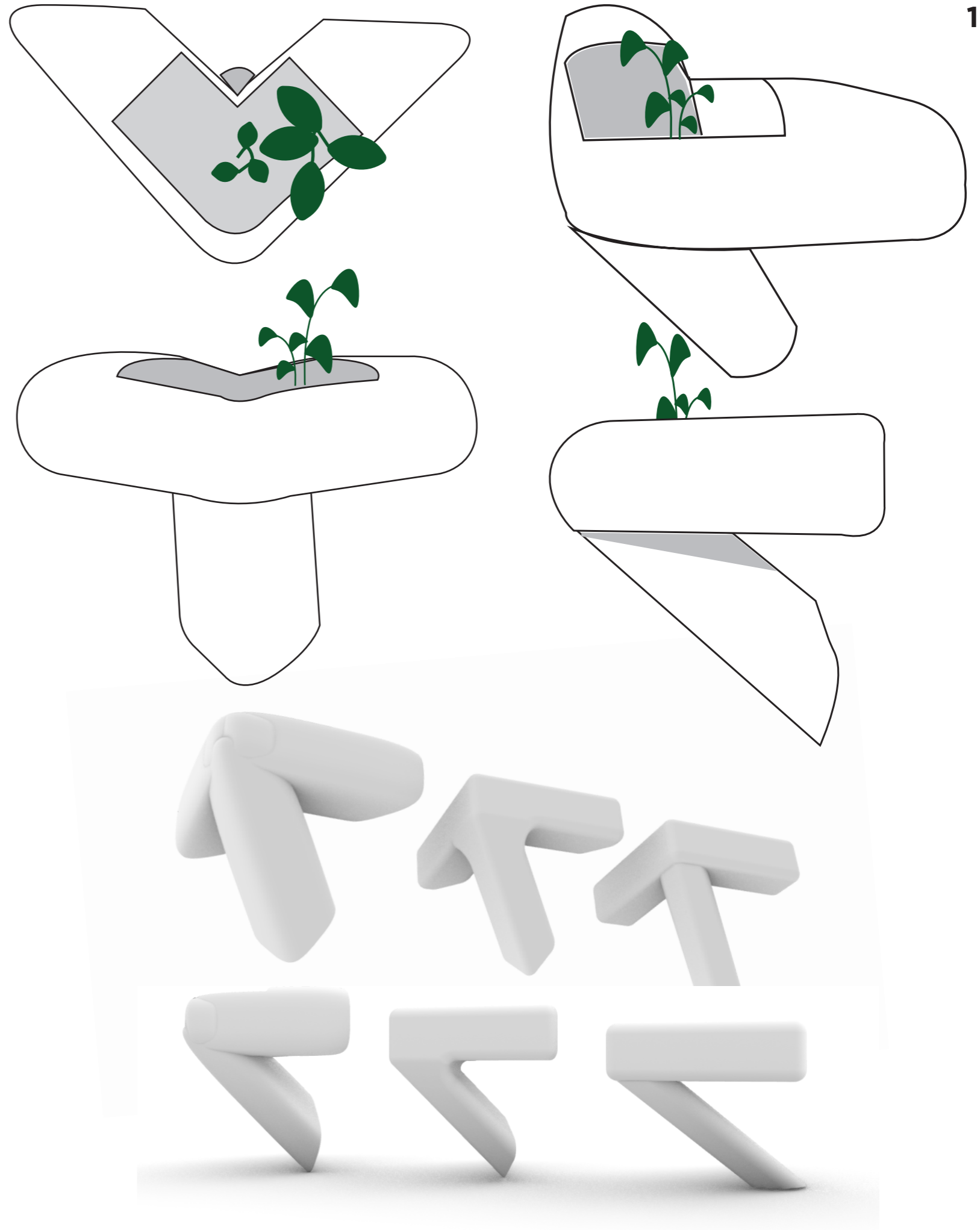
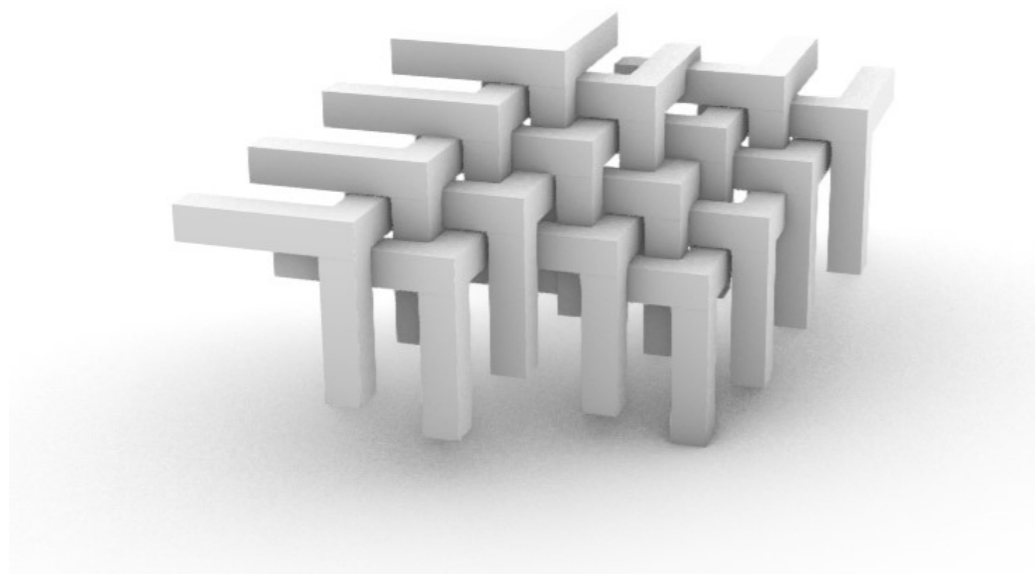
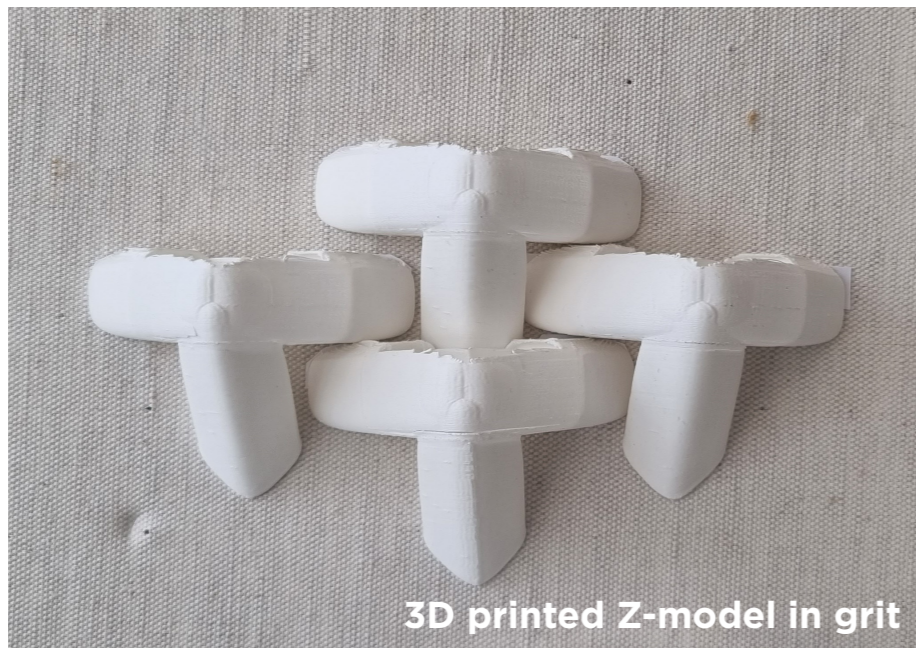
When I got tired of working on paper and wished to work more hands on, I made clay models. For me it works better to visualize something in 3D and use my hands. Not that the models are particularly beautiful, but they give me an understanding of the shape and dimensions. To get a more finished feel of the designs I found interesting, I drew in Rhino and made several drafts of different designs and chose to 3D print two of them. One which was more poetic and conceptual, being a hand holding the plant. This idea came to life because of the Danish saying: “At tage hånd om naturen”. To care for something, depicted in a gracing hand. I really like this idea as I think it is a nice message. The second design I chose to 3D print was a modular system looking like spread-out fans. I printed this design to see how they physically would work when I hung them up. That made me get a better understanding of how much room is needed around the growing plants. I diverged more and made more drawings and even more models in Rhino.



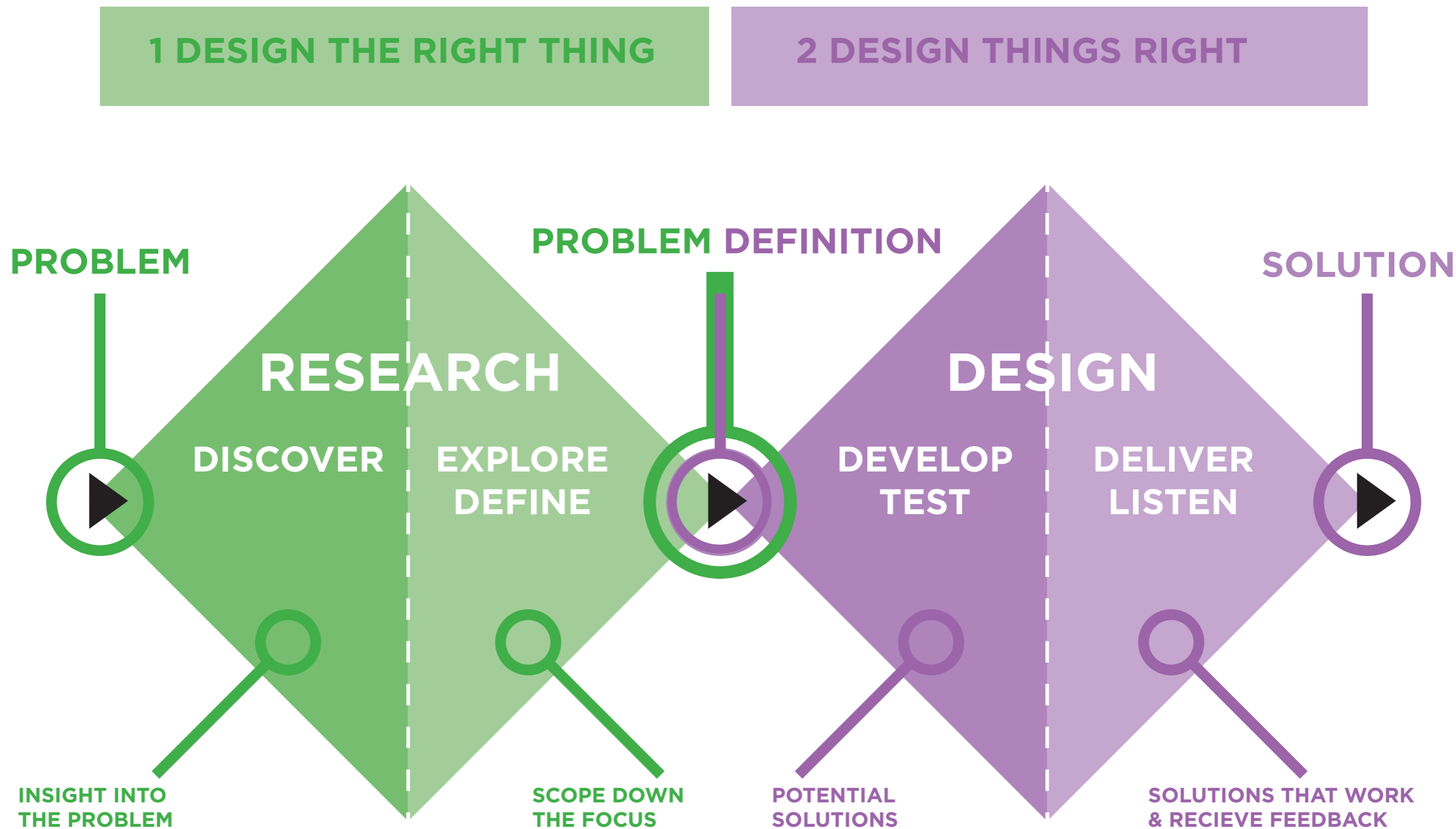
Z-MODEL

Z-MODEL

I was made aware that I design with focus on the x- and y-axis, therefore I tried focusing on the z-axis of a wall hung object. Thinking how it emerges out from the wall and into the room. It was interesting for me to change my mindset and focus on how one axis can change the whole design. I made the Z-model which came to be my favorite and most dynamic design suggestion. The shape is deceptively simple and harmonic. From that converging choice of going with the Z-model I again diverged and made different alterations to the shape to work on the expression, both in Rhino and through sketching.



DOUBLE DIAMOND

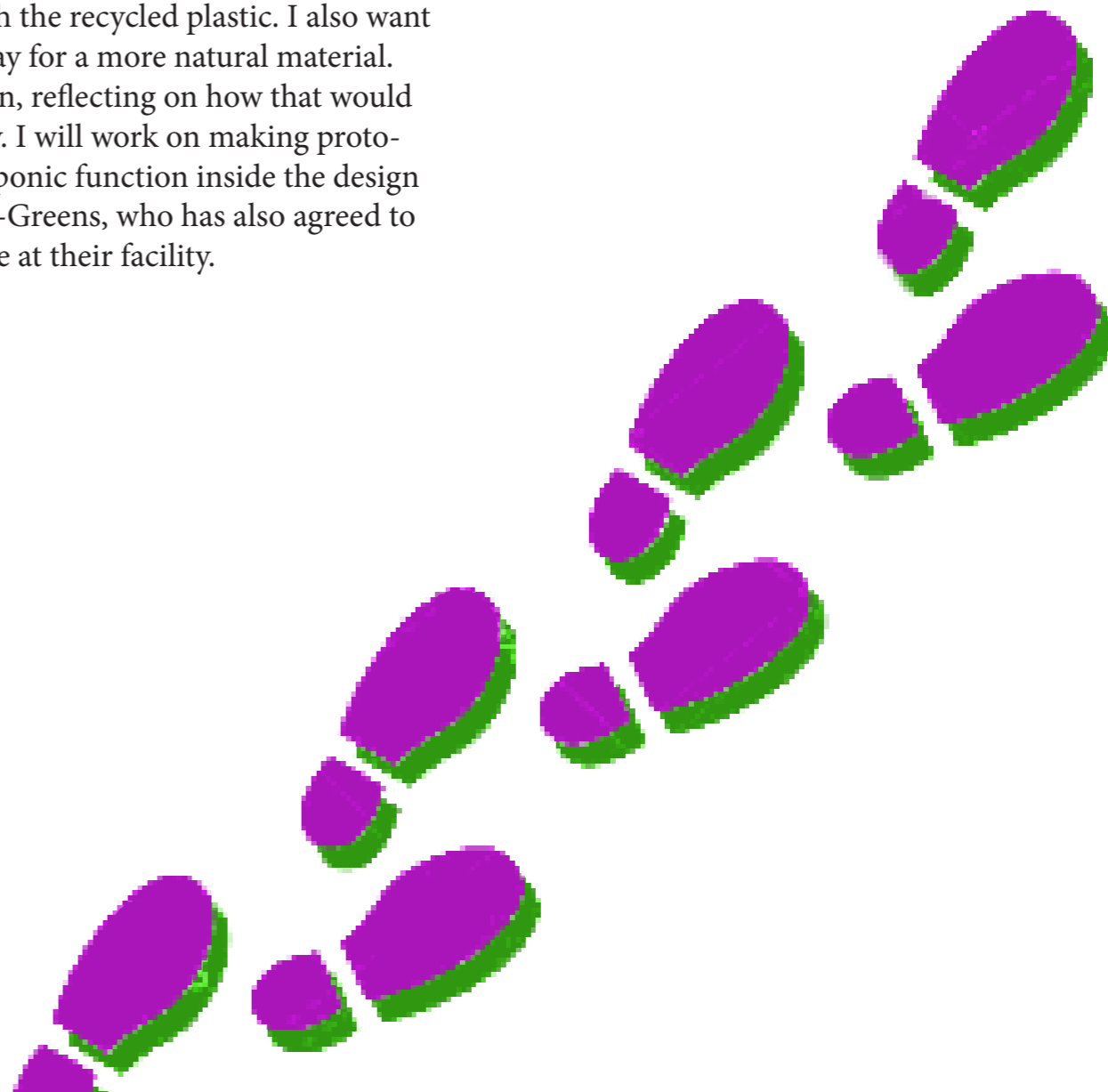


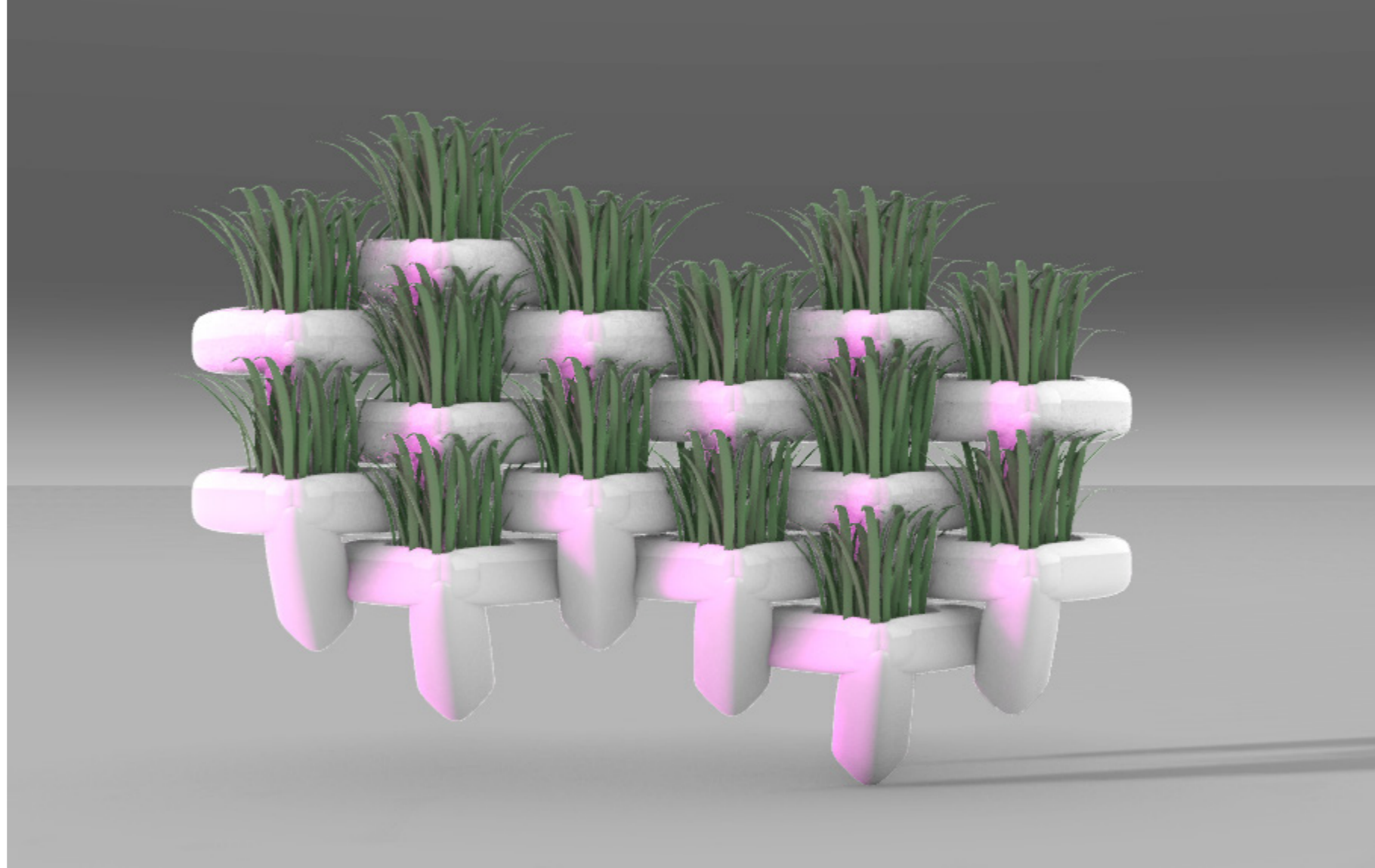
The 6C-model has shed light over the same themes as the research fase of the first diamond, as well as the develop and test fase of the second diamond. I had a lot of sketches and ideas for the design, and I am right now located in the converging fase of further developing the z-model. Which means that the process is situated in the very center of the purple diamond.

This way of using the double diamond method in the process is great for me because it allows me to have great brainstorm and then put them behind me when I find my focus. That way I can move on with a given choice without being disturbed by the former thoughts and ideas.

THE NEXT STEPS

The next steps in the process will be investigating material choices for the design. There are a few criteria for the material such as being waterproof and easy to clean. I have gotten some recycled HDPE and PP granulate from A Circular Design Studio Cph that i want to test as a possible material. I will explore manufacturing options such as blow molding and injecting molding for plastic. And have a look at the possibilities of using those manufacturing options with the recycled plastic. I also want to investigate Gesso molding with ceramics and clay for a more natural material. Furthermore, I wish to play with color in the design, reflecting on how that would affect the shape and the products aesthetic strategy. I will work on making prototypes testing the scale of the design. For the hydroponic function inside the design i will get expertise from Alex Pichardt from Micro-Greens, who has also agreed to help me produce the prototype in the ways possible at their facility.





PARTIAL CONCLUSION

In this project I set out to create a modular hydroponic plant system, for growing leafy greens and vegetables in small apartments. Through the subtle shape and design, it is supposed to feel relevant for a large target group, and resistant to the test of time, resulting in aesthetic longevity and sustainability. As for the resources used in the hydroponic system, there is a heightened focus to reuse and recirculate the water. This essay exposes my approach to creating the final design all the way from early research to narrowing down to the final design: the Z-model. Through study phases, I have unfolded and tested idiom and through several analysis phases compared choices. Although the process is not done yet, it still sheds light over the most dominant stages of the process.

TIME SCHEDULE	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
12 Research & contact	27	28	29 Print calendar	30 Research, contact partners and buy seeds	31 Go to plant center, plants seeds
13 Research & contact	28	29 Supervision market research contact Micro-Greens	30 attempt to seed in old mattress, process mapping	31 Writing workshop, plant investigation & water use efficiency	1 contact aquaponic garden club, process mapping
14 research and choosing a partner	29 Supervision, contact Nordic grow, work in Rhino	30 Synopses deadline, moodboard	31 Supervision, meeting with Micro-Greens, find literature	1 Write design manifest, seed	2 Choosing Micro-Greens as my collaboration partner
15 Preliminary meetings	7 Meeting Micro-Greens	13 Meeting StudioTalk	19 transcript meetings, research literature	26	28 Send project description
16 Vacation	18	19 Deadline project description Supervision	VACATION		21 Writing workshop 22 Prepare presentation
17 sketching and conceptualizing	29 Midway presentation sketching and moodboard in clay	30 geometric patterns, sketching	37	38 Send material for exhibition, CCMW LP	39 design particular solutions
18 visualization	31 3D drawing and printing the hand concept	31 3D drawing and printing the fan concept	4 Discuss project with fellow students from CLEARW, CCM	5 working on report	6
19 sketching and choosing final design	31 sketching and scanning paper	10 writing sketches in a graph	11 Supervision, design in Rhino, Rhinoceros and 3D print	12 Choosing a design, illustrator and Rhinoceros drawing	13 Write on report
20 Report writing and meetings	18 Supervision	17	18 Meeting w. Micro-greens and studio-talk	19	20 42 cash deadline
21 Research & contact	29	30 Deadline report	35 Supervision	REMAINING TIME	
22 Research & contact	30	31	1	2	3 Midway presentations
23 Research & contact	6	7	8	9	10
24 Research & contact	13	14	15	16	17

REFERENCES

CambridgeHOK. (21. January 2020). Hortidaily. Hentet fra Hortidaily : <https://www.hortidaily.com/article/9183371/the-10-biggest-advantages-of-vertical-farming/>

Emily S Cassidy, P. C. (2. May 2013). IOPScience. Hentet fra IOPScience: <https://iopscience.iop.org/article/10.1088/1748-9326/8/3/034015>

FAO. (7. May 2020). FAO. Hentet fra FAO: <https://www.fao.org/sustainability/news/detail/en/c/1274219/>

Food nation Denmark. (u.d.). Hentet fra Food nation Denmark : <https://foodnationdenmark.com/news/one-of-europes-biggest-vertical-farms-to-be-established-in-denmark/>

Friis, S. A. (2016). The 6C model. Hentet fra Design Principles and Practices: DESIGNPRINCIPLESANDPRACTICES.COM

Harper, H. K. (2015) Æstetisk bæredygtighed. Samfundslitteratur.

Hekkert, P. D. (20. March 2007). Framework of Product Experience. Hentet fra IJDesign: www.ijdesign.org

Koch, P.-P. (6. February 2003). Digital Web Magazine. Hentet fra Digital Web Magazine: https://www.digital-web.com/articles/form_follows_function/

Lefteri, C. (2014). Materials for design. London: laurence king.

Michl, J. (30. January 2018). Jan Michl. Hentet fra Jan Michl: <https://janmichl.com/eng.fff-hai.html>

Plumer, B. (16. December 2014). Vox. Hentet fra Vox: <https://www.vox.com/2014/8/21/6053187/cropland-map-food-fuel-animal-feed>

unknown. (22. februar 2021). Eden Green . Hentet fra Eden Green : <https://www.edengreen.com/blog-collection/environmental-impact-of-traditional-and-vertical-farming-2021-report>