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**01**

# Abstract

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# Abstract

VITALIS is a surgical experience for plants that simulates what a renewed relationship with our natural environment might look like. As the consequences of the Anthropocene unfold, it is imperative that humans nurture a mutually beneficial relationship with the world of plants (and beyond), instead of destructively. When participating in the experience, visitors learn about plant care through a medical guidebook and have the hands-on opportunity to operate on a plant themselves; through this direct sensorial interaction, they hopefully walk away with a feeling of increased kinship for the non-human.

Already, we have seen the impacts of the Anthropocene: rising ocean levels, increased spread of disease, loss of species, and more destructive natural disasters. Yet, as urbanization and technological advancement accelerate, the relationship between human and nature has become even more abstractified. For example, most humans may go on a walk every so often in their curated and well-kempt neighborhood park, but are completely disconnected from the millions of hectares of forest that are being decimated each year. We eat two to three meals a day, and rarely know where the ingredients came from, how many resources went into producing them, or what methods were used to transport them to the table.

The urgency of climate change necessitates a renewed solidarity and kinship between humans and the environment. A symbiotic relationship between the two has been missing from the mainstream for too long, and must be revitalized if we wish to mitigate the already inevitable consequences of our envi-

ronmental destruction and set a new precedent for engaging with nature. But how do we start reversing our direction and switch trajectories?

Donna Haraway, a prominent scholar in the field of science and technology studies, writes that “staying with the trouble does not require such a relationship to times called the future. In fact, staying with the trouble requires learning to be truly present, not as a vanishing pivot between awful or edenic pasts and apocalyptic or salvific futures, but as moral critters entwined in myriad unfinished configurations of places, times, matters, meanings.”<sup>2</sup> Inspired by this quote, VITALIS seeks to provide an interpretation of learning to “stay with the trouble” through the performance of surgery for two main reasons:

1. Since the time of ancient civilizations, surgery has been a human invention to combat disease, heal injury, and facilitate birth. This intervention, paired with technological advancement, has allowed humans to live longer with a better quality of life. What if we extended the scope of this intervention beyond the human?
2. Additionally, the act of cutting through flesh is visceral, resulting in feelings of fascination, disgust, concern, anxiety, relief, and hope about the human condition. Could this extremely direct, sensorial experience act as a vehicle for mediation between human and non-human?

Building upon this long history of innovation and emotional affect, VITAL-

TYLER FAMILY STUDIO

VITALIS

A simple, practical experience for plants





IS simulates the surgical experience for plants by designing a “growroom.” Here, participants of the experience act as growroom personnel-in-training and are tasked with diagnosing, operating, and conducting post-operative care on a plant patient. They are assigned patients that may require procedures such as propagation, grafting, or trauma treatment. Before surgery, they learn through a surgical guidebook about pre-operative examinations, possible diagnoses, surgical procedures, and medical techniques for a variety of plant species. After surgery, growroom personnel-in-training reference the guidebook to determine a plan for post-operative care.

The project facilitates a limited number of surgical operations upon a constrained number of plant types. Further, due to the limitations in plant sensing research and sensor types, VITAL-IS only monitors soil moisture, pulse, and capacitance as vital signs. Moreover, the practice of nurturing plants is inherently a slow process that cannot be fully shown through a two-day showcase. The comprehensive results of practicing surgery and medicine on plants may only become visible on the timescale of months, years, and even decades. Nevertheless, the design of a vitals monitor, surgical guidebook, and operating room for plants is a compelling metaphor for what a preferable future looks like for the relationship between human, machine, and nature. Ideally, visitors of the exhibit should consider: What would a world look like where it was the norm to perform such an intervention as surgery on not only humans, but also non-human beings? Is it possible to develop a kinship with something that may not have the same sentience, body, or language as ourselves?

After the showcase, the project seeks broader impact through greater exposure, such as at major festivals on electronic art and a more robust implementation of plant sensing that rigorously represents a plant’s vitality. It aims to not only spark conversation about our relationship with nature, but also shift mindsets by offering the opportunity to develop an emotional connection with non-human beings.



02

# Precedents

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# Precedents

The domain I am working in stems from the idea of the Planthroposcene, a term coined by anthropologist Natasha Myers. “Planthroposcene” describes an aspirational epoch where solidarities are seeded between humans and nature. However, I would like to bring the idea of the Planthroposcene to the present instead of thinking of it as an aspirational future. VITALIS is influenced by the thinking of scholars such as Donna Haraway, Bruno Latour, and Isabelle Stengers. Particularly, the project draws heavily upon Donna Haraway’s writing in *Staying with the Trouble: Making Kin in the Chthulucene*, where she offers new ways to reconfigure our human and non-human relationships—especially through sym-poiesis, or making-with. Her concept of staying with the trouble is refreshing against a milieu of speculative futures that envision escaping our ravaged earth in space pods, only to bring human destruction to a new planet. VITALIS is an experiment of what it might look like to stay with the trouble—to face the damage that we’ve caused and take responsibility for it.

When looking at precedents for such a project, it was difficult to find any prior art that explores plant surgery. However, there are several related installations, books, projects, and research papers that helped me further develop my design:

1. *Anaesthetics stop diverse plant organ movements, affect endocytic vesicle recycling and ROS homeostasis, and block action potentials in Venus flytraps* (Ken Yokawa) is a research paper that experimented with plants’ sensitivities to human and animal anaesthetics, despite having no structural similarities.<sup>9</sup>
2. *CMD* (Michael Sedbon) is an art piece that examines the biopolitics between natural and artificial systems. It uses the resource of light controlled by an artificial intelligence system to drive the market between two colonies of cyanobacteria, oscillating between collaborative and competitive states.<sup>5</sup>
3. *Core Sample* (Kuan-Ju Wu) is an art installation that responds to several speculative narratives of ecological collapse and offers viewers a glimpse into the enigmatic future of our natural world, and our place within it.<sup>8</sup>
4. *Feral Atlas* (Anna Tsing, Jennifer Deger, Alder Keleman Saxena and Feifei Zhou) is a web-based catalog of ecological worlds that are created when non-human entities develop and entangle themselves in human infrastructure.<sup>6</sup>
5. *The Mushroom at the End of the World* (Anna Tsing) is a book that describes and analyzes the globalized commodity chains of matsutake mushrooms. It takes an ethnographic approach that places the matsutake as the focal point of a critique of capitalism.<sup>7</sup>
6. *On Technical Mediation* (Bruno Latour) is a paper that explores the relations between humans and non-humans. It posits that technologies are mediators that influence our experiences within the world.<sup>4</sup>

7. *Parasitic/Symbiotic* (Ann-Katrin Krenz) is an art installation that carves into trees using a CNC machine. It explores the tension of the digital creation of romantic aesthetics and the physical damage of carving into living material.<sup>3</sup>

8. *Staying with the Trouble* (Donna Haraway) is a book that offers provocative alternatives to our relations with the earth and its in-

habitants in the midst of ecological destruction. It discusses means in which to build more livable and preferable futures that can be cultivated through new ways of thinking in the present.<sup>2</sup>

These precedents helped me not only think through my project conceptually and theoretically, but also provided guidance in terms of aesthetics, spatial design, materiality, and scale.



*Anaesthetics stop diverse plant organ movements, affect endocytic vesicle recycling and ROS homeostasis, and block action potentials in Venus flytraps (Ken Yokawa)<sup>9</sup>*



*CMD (Michael Sedbon)<sup>5</sup>*



*Core Sample (Kuan-Ju Wu)<sup>6</sup>*



*Feral Atlas (Anna Tsing, Jennifer Deger, Alder Keleman Saxena and Feifei Zhou)<sup>6</sup>*



*The Mushroom at the End of the World (Anna Tsing)<sup>7</sup>*

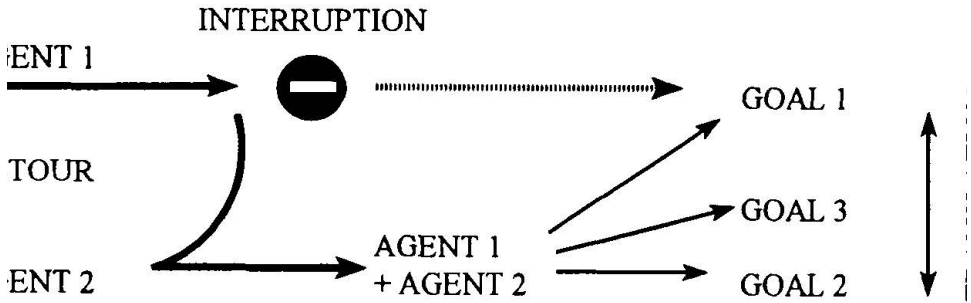
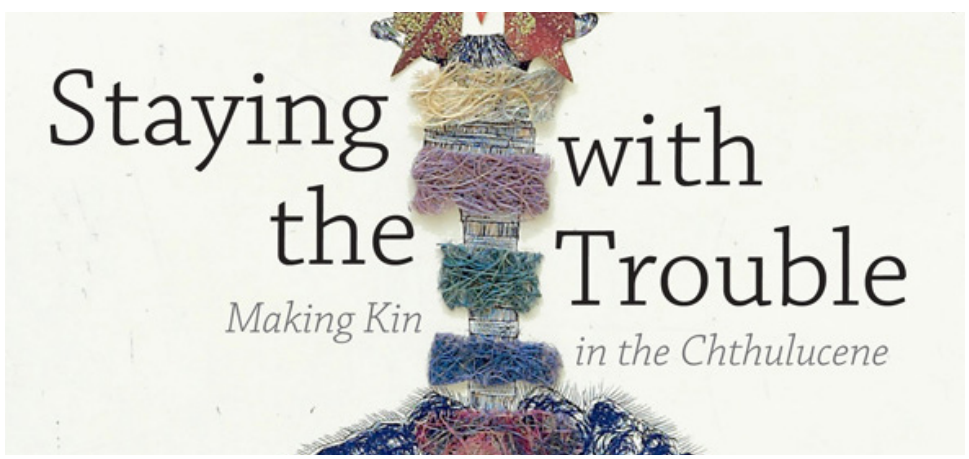


Fig. 1. First Meaning of Mediation: Translation

*On Technical Mediation (Bruno Latour)<sup>4</sup>*



*Parasitic/Symbiotic (Ann-Katrin Krenz)<sup>3</sup>*



*Staying with the Trouble (Donna Haraway)<sup>2</sup>*

03

# Motivation

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# Motivation

For the Capstone Studio class, we were assigned to project clusters of about three to five people. Clusters were loose groupings of like-minded thesis projects, where people could interact and develop their projects with other students who were working in a similar domain. The cluster that VITALIS is a part of is Matter<sup>2</sup>.

Matter<sup>2</sup> is a collective cluster comprising five individual projects. As the name suggests, this cluster is concerned with two dimensions of matter: 1) physical matter, which is rooted in materials and physical artifacts, and 2) matter in the form of impact that each project has. Essentially, the projects in the Matter<sup>2</sup> cluster share a common goal of creating tangible objects, products, and experiences that have environmental or social change. The projects question the traditional practices of design and industry, and offer alternatives to engage with the world through materiality.

The physical dimension of “matter” is explored through materials-driven design, be that crickets, charcoal, mushrooms, plants, found objects, or even the essence of making. As a group, Matter<sup>2</sup> strives to understand materials as technology and create artifacts rooted in materiality. Meanwhile, the impactful dimension of “matter” probes behavioral and mindset changes towards social and environmental issues—inciting curiosity and learning about topics of consumption, circular economies, empathy for non-human beings, and community empowerment.

Each individual project is driven by personal passions, curiosity, research, experimentation, and exploration. The

cluster applies a research-led design process in combination with new approaches for material engagement to demonstrate radical approaches with which designers can make meaningful impact in the world. In doing so, Matter<sup>2</sup> looks to provoke dialogue and actions centered around change. Each project has the potential to incite fundamentally new ways of thinking about design, and to redefine relationships and interpretations of materials, society, the environment, and the design process.

So when given the opportunity to pursue a design project that uses tangibility to produce impact in the world, I immediately thought of how I could contribute to the climate change conversation. I've been interested in sustainability and the natural environment ever since I was a little kid going on family road trips to national parks and forests. This appreciation continued throughout college, where I minored in environment + sustainability and worked for three years at the MIT Office of Sustainability.

While the effects of climate change are becoming more critical, our human relationship with nature is becoming further abstracted. Urbanization and technological advancement have allowed humans to turn a blind eye to the environmental damage that we cause. However, in the near future, it will become necessary for everyone, not just subject field experts, to engage with plants and steward a mutually beneficial relationship with the non-human. But what can art do for the climate crisis problem?

As designers, we are not experts in pol-

icy or engineering; these are the people whose domains have the potential to make technical changes with the systems of our natural world: improving waste disposal, drafting policies for circular economies, manufacturing more efficient clean energy technologies, etc. They approach the climate problem with logic and evidence. However, designers take an alternative approach to the problem at hand: we are skilled empathy-generators. We not only listen

to and understand another's experiences, but also design ways to transpose that empathy to others. Both logical and emotional approaches are needed when facing such a complex issue as climate change. So with my background in architecture, I wanted to use my abilities for spatial design to transport people into an alternative world where they could become immersed in a narrative of kinship and cooperation with the natural environment.



**04**

# Methods

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# Methods

VITALIS uses spatial design as a method of bringing to life an alternative world where plant surgery is a standardized practice of care. By transforming an entire room in Jacobs Hall into a growroom for conducting plant surgery, the project offers participants a new reality—which they hopefully carry with them when leaving the exhibition. In order to create such a compelling room, the project needed to consider aesthetics, props, experiential flow, and division of space.

## Experiential Flow

The first consideration was experiential flow. How is plant surgery conducted? What takes place during pre-operative examinations, surgery, and post-operative care?

When entering the growroom, to get the feeling that they are in a medical setting, participants—or “growroom personnel-in-training”—should be greeted with something that orients them to the presence of patients and hints to the idea that a surgical operation will take place. This became the patient queue monitor, which lists each patient’s ID, variety name, status, and location in the growroom.

During pre-operative examinations, the participants should have a guide that leads them through how to perform screening tests on patients and make a diagnosis. This guide became the Fundamentals of Plant Surgery, a guidebook to plant care that gives an overview of pre-operative tests, diagnoses, surgical procedures, and post-operative care.

Once growroom personnel-in-training have referenced the Fundamentals of Plant Surgery to examine and make a diagnosis, they transfer their patient to the operating table, where surgery is performed. Again, to really make the room feel like a medical environment, I translated certain components of the human surgical experience to VITALIS by incorporating real surgical instruments and developing a custom vitals monitor for plants.

After surgery, patients are then moved to a rehabilitation area to recover from their operation and general medical treatment. Growroom personnel-in-training should reference the guidebook again to determine a post-operative care plan for their patient. This final step would conclude the participants’ interactive experience with the installation.

## Division of Space

The next consideration then was the division of space.

Using conference room 310B in Jacobs Hall, I had approximately a 12ftx15ft or 180sqft area of space to design the VITALIS experience in. Based on the experiential flow I wanted to have, I divided the space into the following areas: a waiting area, a skills lab, an operating table, a propagation nursery, and a rehabilitation area.

## Props

Then, I determined what props I needed to create an atmosphere of medicine and surgery. This became a combination of pre-bought props, custom-de-

signed props, borrowed props, and found props.

The custom props I created were: vinyl signage, a patient queue monitor, a surgical guidebook called *Fundamentals of Plant Surgery*, a vitals monitor, and a laser-cut propagation tube holder.

The pre-bought props included: plant pots, a bookshelf, a metal wire shelving unit, grow lights, soil, Leca, neem oil spray, gardening gloves, propagation tubes, glass vases, a mister, surgical instrument kit, and a seedling kit. Some props that are available to MDes students that I also used for the VITALIS exhibition were: three 30inx60in rolling tables, an iPad, a rolling TV monitor, and two white pedestals.

Big thanks to Georgios Grigoriadis and Jan-Simon Veicht, fellow classmates, who lent me audio and lighting equipment for my project. Georgios gen-

erously let me borrow his MOTU M4 audio interface and stereo speakers for the vitals monitor I created. Jan designed a hanging linear light for a previous showcase that I ended up using as a spotlight for the operating table.

## Aesthetics

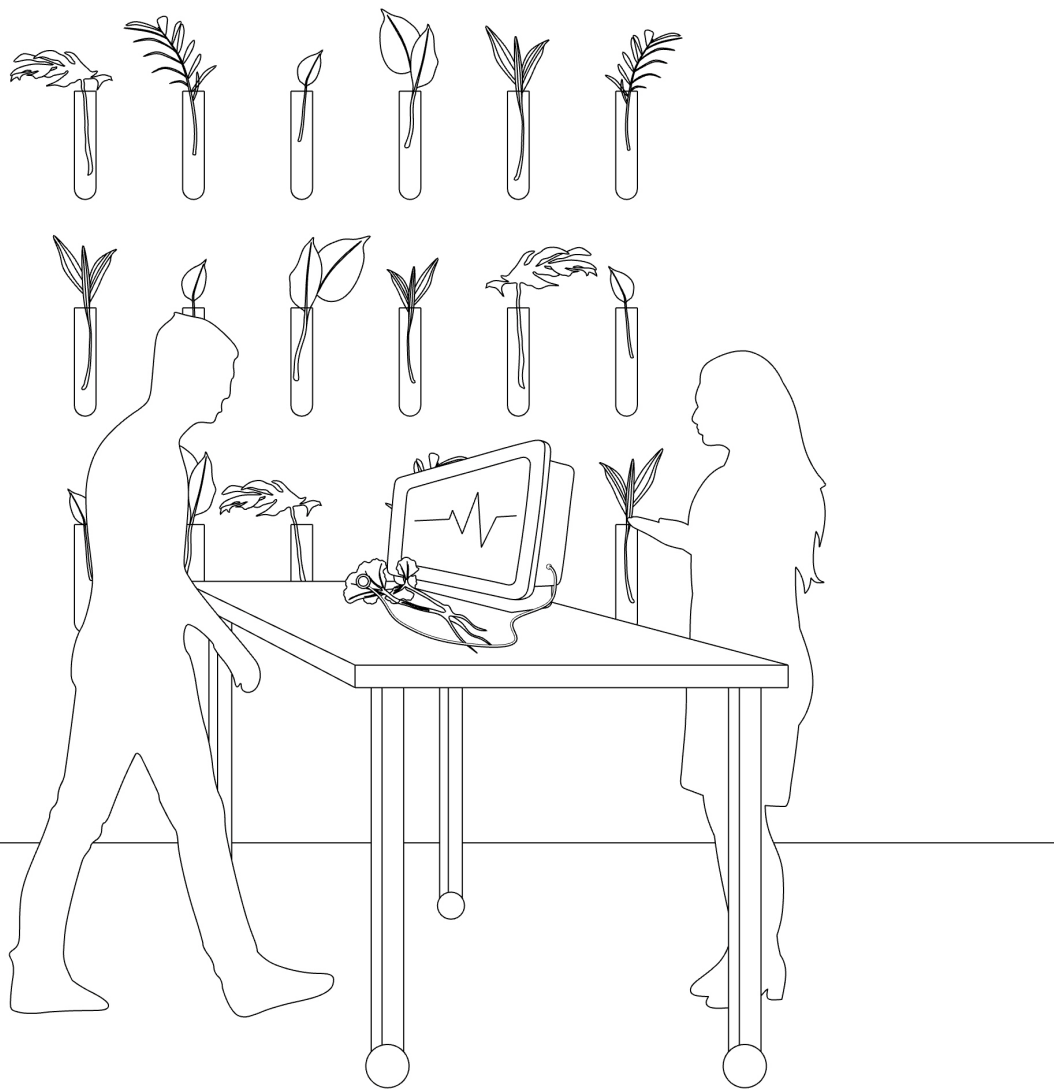
Finally, I needed to consider the aesthetics of the exhibition. How do you design a space that feels surgical? What can I do to make the room feel cohesive?

I went with a very white and industrial material palette to give a sterile, medical feel to the space. The tables were covered using a matte white vinyl application and black vinyl signage was applied on top to label different areas of the room. I used the Monument Grotesk font family for any text that was present to give a cohesive visual identity to the growroom.



*Aesthetics inspiration for VITALIS'*







05

# Process

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# Process

As an overview, I split the semester into three main phases: research, concept development, and execution. I dedicated about a month to each phase, which I will expand upon below.

## Research

In February, I mostly read and thought. Due to the unconstrained nature of the capstone studio and my cluster, this was probably one of the most difficult months in the project. I had the opportunity to do pretty much anything, which made it extremely challenging to choose something. I constantly thought about questions like: What do I want this project to represent about me as a designer? What trajectory do I want to set for myself based on past and present interests? What issues motivate me as a designer? This line of thinking led me to the general topic of environmentalism and creating empathy for nature. Eventually, when trying to concretize and narrow down my concept, I became fascinated with surgery for: (1) its viscerality, and (2) its ability to heal and reproduce. From there, VITALIS began to emerge as an interactive experience of performing surgery on plants.

## Concept Development

In March, I experimented. VITALIS, as described in the previous Methods section, required several custom-designed props. The most involved prop was the vitals monitor, since it required hardware, software, and visualization experimentation. The idea behind the vitals monitor was to emulate the vitals monitor used in human surgery, which displays live data about a person's heart rate, blood pressure, and body tem-

perature. So to translate this to VITALIS, I began by researching what sensors I could use to represent data about a plant's vitality. I ended up using a pulse sensor amped and a soil moisture sensor, which gave information about the plant's growing environment and, hypothetically, the movement of nutrients and water through the plant's xylem and phloem. I then used Max MSP, a visual programming tool for music and multimedia, to take the input from the sensors (controlled by an Arduino) and output the data as audio and visuals.

In addition to experimenting with plant sensing, I also needed to perform experiments in plant surgery. Grafting is a very common technique in botany and agriculture that can be considered a surgical procedure for plants. However, beyond grafting, there are not really any other techniques that have been translated as plant surgery. Thus, I began to research and perform my own procedures on plants to study what may be useful to include in a surgical guidebook.

## Execution

Finally, as April and May rolled around, I needed to start thinking about execution. This is when I nailed down the spatial design of the room, every component and prop that I needed to either acquire or create myself, and the visual identity of VITALIS. While I finalized the vitals monitor, surgical guidebook, patient queue monitor, and additional props, I also set-up the room in 310B of Jacobs Hall. I brought up all 18 plants I had with me in the MDes studio, covered the tables and pedestals in matte white vinyl, disassembled and reas-

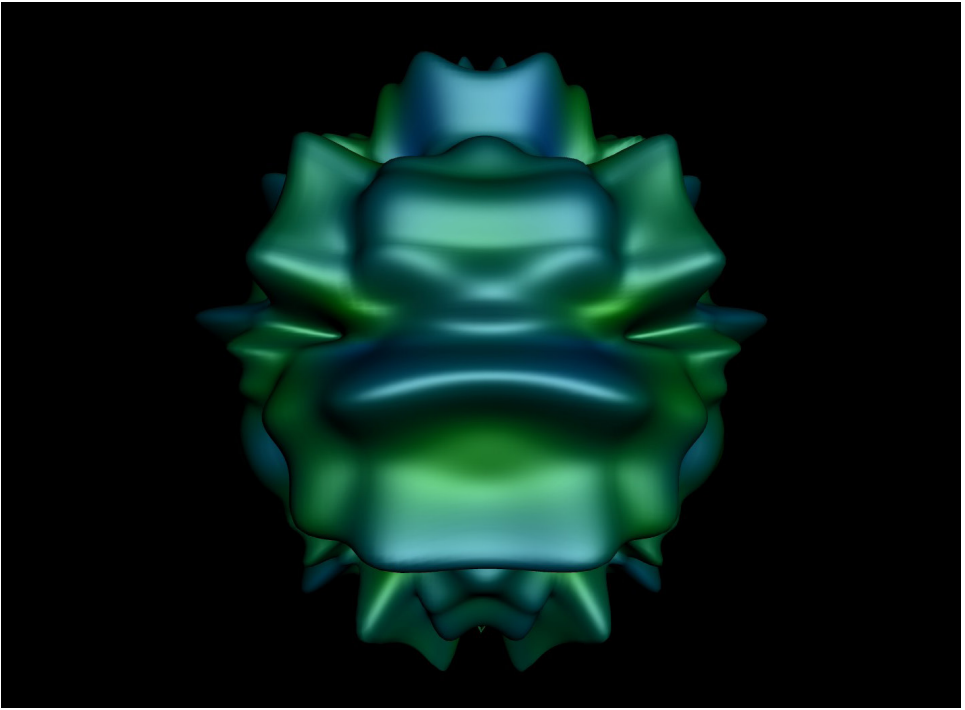
sembled the metal wire shelving unit and bookshelf, and planted seeds in the seedling kit under the grow lights. Once the props were finished and placed in

their respective locations within the growroom, the installation was ready for showcase.

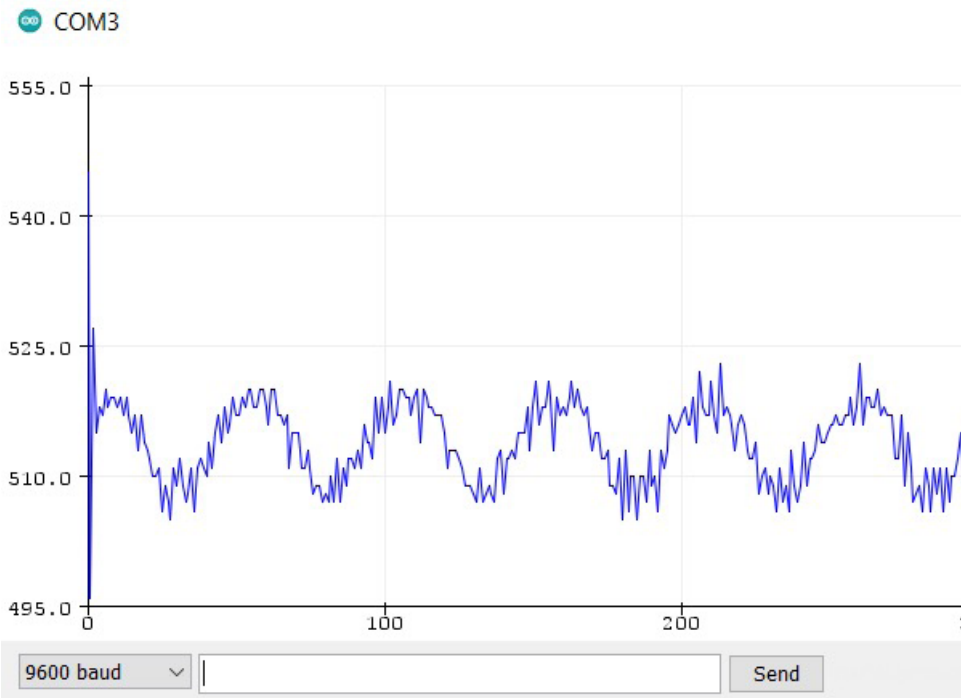


*Initial audio experiments with soil moisture sensor and Max MSP*

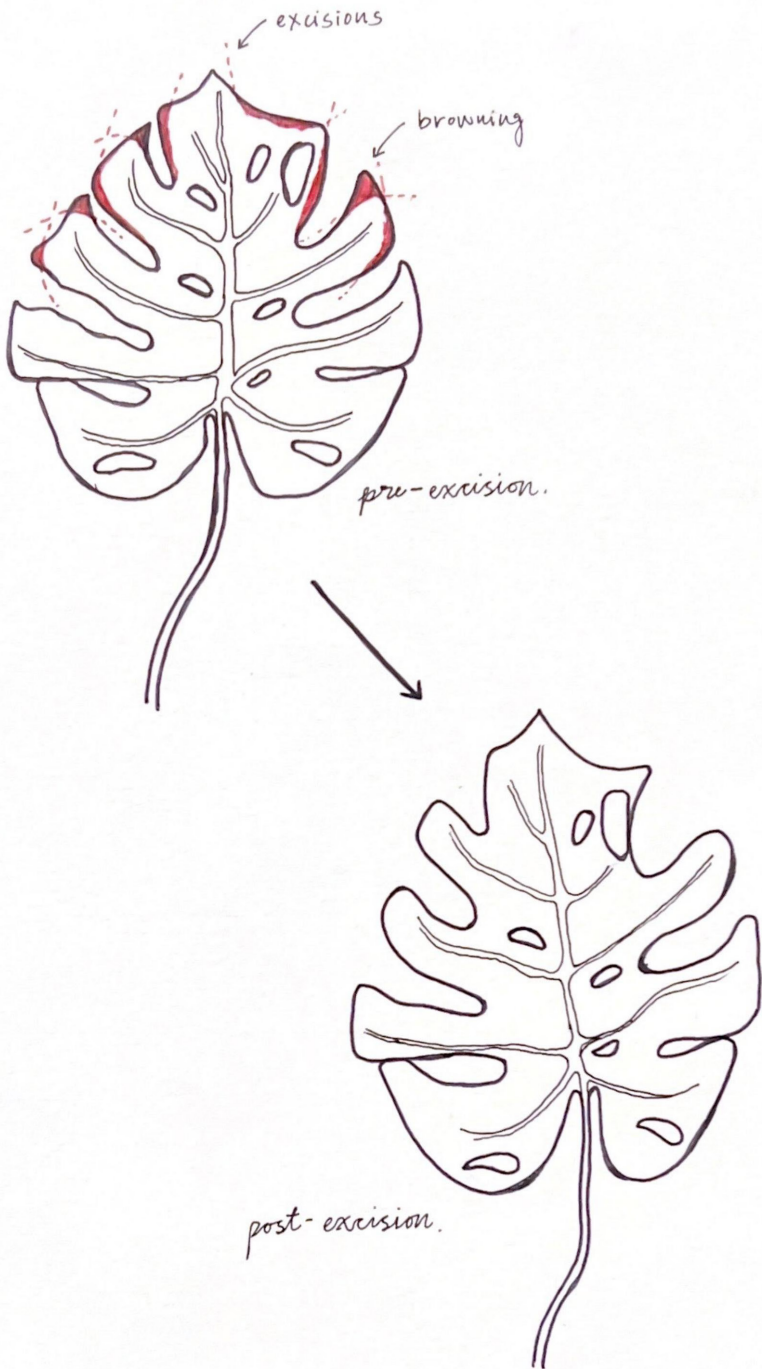




*Final vitals monitor graphic visualization*



*Data collected from pulse sensor amped*



Early sketches of a browning procedure



*Initial surgical experiments, conducted on a Monstera deliciosa*



06

# Final Design

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# Final Design

The final design of VITALIS can be described through breaking down the various components of the growroom. The growroom is where all plant care activities occur, including patient intake, skills training, examinations, surgery, rehabilitation, and propagation. Though each variation of a growroom may have slight differences, the following sections provide an overview of the typical components found in such a room.

## Waiting Area

The waiting area is where patients first arrive and get entered into the patient queue. Here, they are evaluated through screening tests and a diagnosis is determined. If the diagnosis is non-surgical, the patient is moved to the rehabilitation area where they are given a plan of treatment, usually involving nutrients and fluids. If the diagnosis is surgical, the patient is prepped for the operating table.

## Patient Queue

The patient queue is a monitor that summarizes the status of each patient and their location. Patients may be labeled as stable, prepped, in surgery, recovering, or propagating and their possible locations are the waiting area, operating room, rehabilitation area, or propagation nursery.

## Skills Lab

The skills lab is where growroom personnel can study from a library of medical textbooks, practice surgical techniques, and acquire materials for surgery and general care. For VITALIS,

this includes the Fundamentals of Plant Surgery, which is a guidebook on plant care.

## Vitals Monitor

A vitals monitor is present on every operating table. It provides audio and visual feedback on a patient's health status by monitoring soil moisture levels and pulse data. For soil moisture, the shininess of the visualization on the vitals monitor indicates how wet or dry the patient's soil is. For pulse sensing, the regularity or irregularity of the visualization's undulation indicates how calm or agitated the patient is.

## Operating Table

The operating table is where surgery is conducted. A teacher often accompanies learning growroom personnel and verbally guides them through surgical procedures until they are ready to perform operations on their own. A sterile field must be maintained on and around the operating table, especially the surgical instruments that are being used for surgery, so as to prevent the spread of disease and infection. In the same vein, growroom personnel must sanitize their hands and wear nitrile gloves before engaging at the operating table.

## Propagation Nursery

When patients are receiving a propagation procedure, they are transported to the propagation nursery post-operation to develop roots. Once their roots have grown enough, they can be transplanted into a pot and transferred to the rehabilitation area.

# Rehabilitation Area

The rehabilitation area is where patients receive post-operative care, recover from any afflictions, and continue to grow. They are monitored on a regular basis and nurtured based on a personalized treatment plan of care.

In addition to the description of VITAL-IS' components, the Fundamentals of Plant Surgery goes into detail about the specific surgical and medical methods that were developed throughout the process of this thesis project. The latter part of this section features pages from this guidebook.



Waiting Area



Skills Lab

PATIENT ID	VARIETY	STATUS	LOCATION
001	<i>Monstera deliciosa</i>	Stable	Waiting Area
002	<i>Ficus lyrata</i>	Stable	Waiting Area
003	<i>Syngonium podophyllum</i>	Prepped for repotting procedure	Waiting Area
004	<i>Monstera deliciosa</i>	Stable	Rehabilitation Area
005	<i>Epipremnum aureum</i>	Prepped for propagation procedure	Waiting Area
006	<i>Monstera deliciosa</i>	Prepped for browning procedure	Waiting Area
007	<i>Monstera deliciosa</i>	In recovery	Rehabilitation Area
008	<i>Hypoestes phyllostachya</i>	Prepped for repotting procedure	Waiting Area
009	<i>Dracaena warneckii</i>	Stable	Rehabilitation Area
010	<i>Monstera deliciosa</i>	Stable	Rehabilitation Area
011	<i>Dracaena trifasciata</i>	Stable	Rehabilitation Area
012	<i>Spathiphyllum hybrid</i>	In recovery	Rehabilitation Area
013	<i>Ficus lyrata</i>	In recovery	Rehabilitation Area
014	<i>Ficus lyrata</i>	In recovery	Rehabilitation Area
015	<i>Epipremnum aureum</i>	Propagating	Propagation Nursery
016	<i>Epipremnum aureum</i>	Propagating	Propagation Nursery
017	<i>Monstera deliciosa</i>	Propagating	Propagation Nursery
018	<i>Philodendron erubescens</i>	Stable	Rehabilitation Area

Patient Queue



*Vitals Monitor*



*Operating Table*



*Propagation Nursery*



*Rehabilitation Area*



# FUNDAMENTALS OF PLANT SURGERY

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A guidebook to plant care

by Effie Jia



# Contents

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# 02.

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## The Growroom

- + Waiting Area
- + Patient Queue
- + Skills Lab
- + Vitals Monitor
- + Operating Table
- + Propagation Nursery
- + Rehabilitation Area

# 03.

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## Pre-operative Examination and Diagnosis

- + Screening Tests
- + Diagnoses
- + Pre-operative Safety

# 04.

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## Surgical Procedures

- + Propagation
- + Grafting
- + Trauma Treatment

# 05.

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- + Nutrients and Fluids
- + Signs of Healing

# 06.

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## Conclusion

# 07.

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## Appendix

**01**

# Preface

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