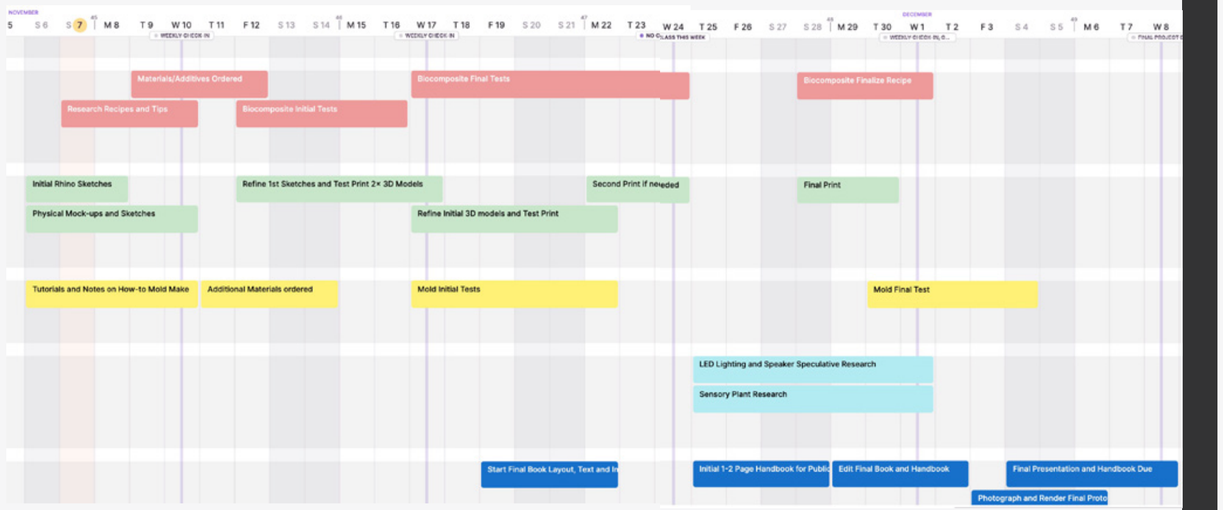
BioComposite Garden

DSRE625 TECHNOLOGIES OF MAKING

FINAL PRESENTATION

MARY KAHLE



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1. Biomaterials
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URBAN LIVING

Not just a house plant: Urban dwellings often lack the benefits of the outdoors in terms of sight, sound, smell, touch and taste leading to negative impact on mental and physical health. How can we bring more of the outdoors indoors?

SUSTAINABILITY/ ACCESIBILITY

Utilizing biomaterials that are made from accessible food waste and affordable additives. Consider what will happen to the product throughout its lifecycle

BENEFITS OF GREEN SPACE

Looking at how the sights/sounds/tastes of gardens benefit mental/ physical health. Working with our hands, hearing the sound of rustling leaves, smelling flowers, seeing the sun shine through the trees and cast shadows.

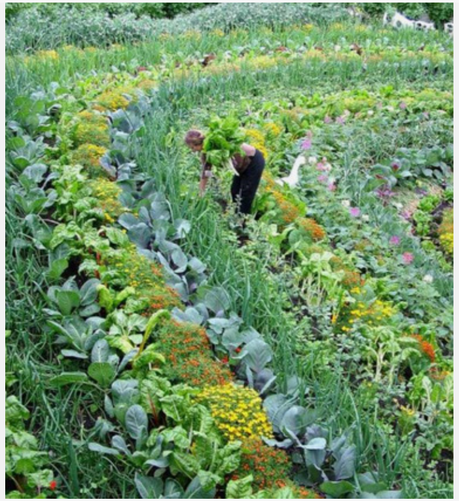
Outdoor Space: Impacts on Human Mental and Physical Health

During the 2020 Covid-19 lockdown I lived on the 3rd floor in a tiny railroad style apartment in Brooklyn, NY. The only interaction I had with the outdoors was from sitting on my fire-escape, overlooking the patchy Brooklyn backyard that had two trees and some squirrel-friends for entertainment. Before this time, I took my walks through parks for granted. I didn't realize just how important those sensory experiences were for my mental health and I never imagined not being able to experience them for weeks on end. Some things as simple as listening to the wind blowing through trees, smelling flowers or pine, and seeing color and texture in nature.

In addition to missing these sensory outlets, I was concerned with food supply and security. The grocery stores near me were constantly wiped out and when there was produce it was in bad shape. Prior to the pandemic, the grocery stores already struggled to supply fresh produce in the low-income neighborhood I was living in.

To offset some of my insecurity in lockdown, I bought window growing trays, dirt, along with radish, arugula, and tomato seeds (to name a few) so I was able to grow some food staples in my apartment.

But I was still missing sights, sounds and smells of the outside world.



COMMUNITY GARDENS

"Community and home gardens represent a promising approach to foster healthy behaviors. They represent everyday landscapes that connect people to nature, require active and sustained involvement by participants, and enable participants to engage with others directly and indirectly, thereby gaining knowledge about ecological systems, the growing and preparing of food, and, more broadly, about health and wellness. "

The Influence of Social Involvement, Neighborhood Aesthetics, and Community Garden Participation on Fruit and Vegetable Consumption.

- American Public Health Association

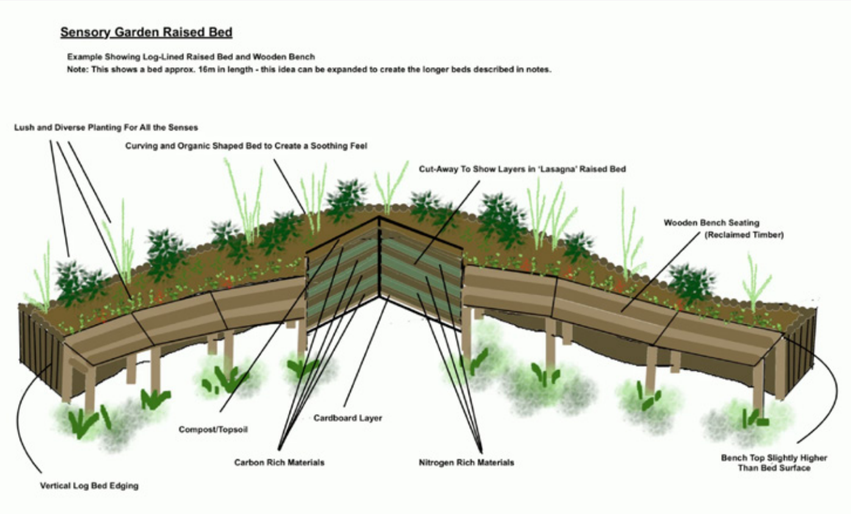
""Environmental aesthetics" refer to the ways we respond to and give back to our surroundings, including the social and physical environments in which we are immersed. From a public health perspective, experiences of neighborhood environmental aesthetics have been shown to influence health behaviors, such as the walking habits of adults in various urban environments in the United States and Australia, and obesity among urban adults.

Several studies in different US urban settings suggest that gardeners have healthier diets than do people who do not garden. In Philadelphia, Pennsylvania, gardeners consumed more vegetables such as dark leafy greens, eggplant, and tomatoes, and fewer milk products, citrus fruits and sweet foods, and drinks than did non- gardeners."

https://ajph.aphapublications.org/doi/full/10.2105/AJPH.2010.300111

Precedent Research

Case Study: Sensory Garden For a Community Garden in Wales



**ADD images of plant types described

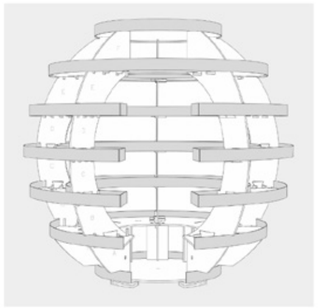
The planting scheme for the sensory garden included:

- A range of flowering shrubs and herbaceous perennials. (Sight.)
- Carex, salix etc.. (Sound.)
- Lavender, aromatic herbs etc.. (Smell.)
- Lamb's Ear/ Mullein etc.. (Touch.)
- Strawberries, herbs etc.. (Taste)

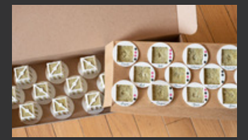
The Growroom: Exploring How Cities Can Feed Themselves

"The Growroom is an open-source, spherical garden that enables people to grow food locally and sustainably. An urban farm pavilion and example of food-producing architecture, it was designed to trigger conversations about how to meet the rising demand for food by growing it in our cities."

https://space10.com/project/the-growroom/



"The entire Gardyn system- the yPods, the aluminum columns, and the water reservoir- are made of high- quality, FDA-compliant, 100% recyclable materials to ensure that your garden is growing as naturally as possible."



Gardyn Tech

Growframe

THIS SMART FRAME IS A FULL SPECTRUM GROW LIGHT THAT HELPS YOU ACHIEVE ALL YOUR INDOOR GARDENING ASPIRATIONS!

"Using LEDs with a long lifespan, the Growframe produces a natural white light, that supports the healthy growth of a variety of plants, such as jade, types of ferns, crotons, alocasia to even flavorful herbs and leafy greens."

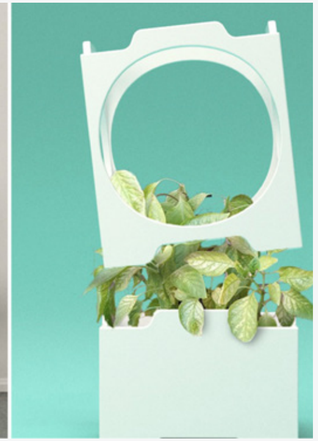
Designer: Modern Sprout

LeGrow

"This state of the art system foregoes traditional flower pots for sleek, cubic planter boxes. Each block-like container is spill-proof and stackable, allowing aspiring gardeners to pick and choose the arrangement of their nursery. In addition to its contemporary and customizable aesthetic, LeGrow is also equipped with helpful aids that ensure a thriving garden. An internal reservoir and a 360° humidifier work together to keep the plants happy and hydrated, while an LED lamp provides 6 hours of daily sunlight anytime of year. Additionally, LeGrow's unique “Power Pot” features 4 USB ports so you can charge your devices as you watch your flora flourish!"

https://legrow.co/

THIS LEGO-INSPIRED MODULAR PLANTER UPGRADES VERTICAL FARMING FOR GARDENING IN TINY LIVING SPACES



Designer: Lorenzo Vega

https://www.yankodesign.com/2021/05/28/this-lego-inspired-modular-planter-upgrades-vertical-farming-for-gardening-in-tiny-living-spaces/

Designer: Loop Design Studio

THIS CONCRETE RESTAURANT MERGES BRUTALIST ARCHITECTURE WITH A VERTICAL GARDEN DESIGN FOR AN INVITING GREEN VIBE

https://www.yankodesign.com/2021/07/30/this-concrete-restaurant-merges-brutalist-architecture-with-a-vertical-garden-design-for-an-inviting-green-vibe/

Designer: After Architecture

Tables introduce interaction with plants outside of their usual place on the shelf or windowsil.

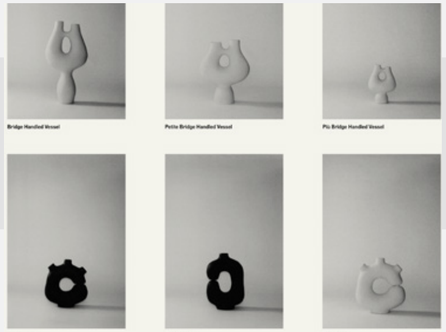
Designer: Dustin Anthony (BloomingTables)

Considering the Structure of Terraces

- Modular aspects
- "Stacking" structure
- Water usage/recycling
- Variety of plants

Commercially Available Stacking Planters

Ceramic Vessels



NESTING, STACKABLE & MULTI-SIZE ORGANIC SHAPES

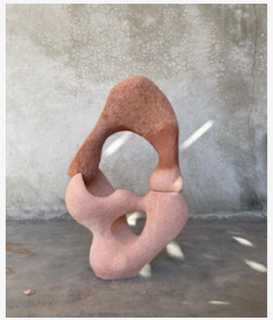
Simone Bodmer-Turner

Arc Objects

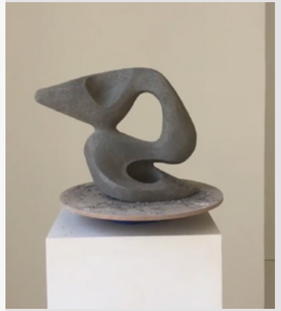
Eny-Lee Parker

Abstracted Organic Shapes

I was inspired by the organic and unusual shapes of Simone Bodmer-Turner, Jan De Swart and others' scupltures and ceramic objects as multi-purpose vessels.



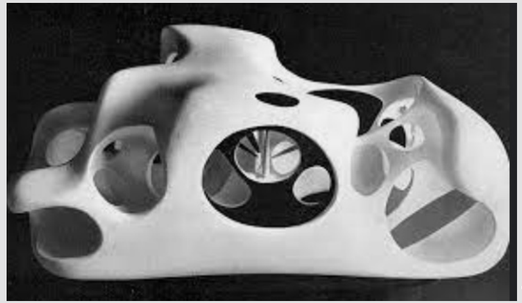




Simone Bodmer-Turner



KEY MUSHROOM SHELF

Designed By: Wang & Soderstrom



Jan De Swart

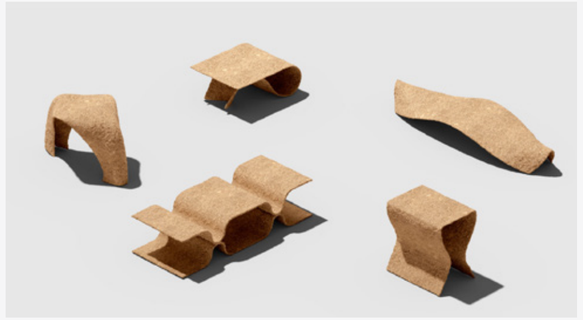
Sonja Ida Ferlov-Mancoba

Materials Research

Nike.com: How to Grow Your Own Bio-Material Using Agar

https://www.nike.com/a/hands-on-how-to-make-bio-materials

BIO-FOLD: A CIRCULAR DESIGN EXPLORATION WITH THE FRAKTA BAG



"Biocomposites are formed by mixing vegetal fibres with a natural binder — such as plant-based resin or bicarbonates — and compressing the material into a solid form."

https://space10.com/project/bio-fold/

COCOA BEAN SHELLS

"Materials used to craft the packaging meet a range of criteria too, being heatproof, lightweight, recyclable, and insulating. The bio- composite polymer used to mold the containers themselves is made from cocoa-bean shells (a by-product of the cacao industry) by designer Paula Nerlich."

Yankodesign.com

EGGSHELL PASTE 3D PRINT

OYSTER SHELL | ALGINATE COMPOSITE 3D PRINT

www.materiom.org

I researched many different Bio-Materials that could lend to ceramic-like structures for my modular indoor garden system.

Focusing on the accessibility angle, Eggshells seemed to be the most readily available for most households and the least complicated mixutre to make.

Bioplastic from Agar (Seaweed)

Graduate shows 2016: Vilnius Academy of Arts graduate Austeja Platukyte has designed a range of packaging using a material made from algae, which could replace non-biodegradable forms of plastic (+ slideshow).

Platukyte used only two ingredients to make the material: agar, which is derived from algae, and calcium carbonate, which has been impregnated with emulsifying wax.

The material is strong enough to protect products but remains lightweight and is also waterproof. After its use it can be composted, or used as a fertiliser to help retain soil moisture.

The packaging can also be discarded and left to naturally decay, forming new layers of chalk as it does so. To prove the material's biodegradability, the designer buried packaging earlier in the year and has been regularly monitoring its gradual decomposition.

Orange peel | Chitosan | Hemp

Created By: Jil A Berenblum Phoenix Lai Esther Chang Anna Lu

Eggshell Composite 'Ceramic' Eg02
Created By: Midushi Kochhar

Eggshells collected from local delis and food trucks.

Coffee | agar - alginate Co01
Created By: Antonia Bañados Maquinario Fab Lab Santiago

Eggshell Biocomposite Recipe 1- Sodium Alginate

Fig 2: Irregular edges achieved by pouring more vinegar in the mold at first. Cool to experiment too :)

Scientist Janine Benyus, in her 1997 work Biomimicry: Innovation Inspired by Nature, invites us to reimagine material research and production methods by taking nature as a model. The natural world manufactures, calculates, performs chemistry experiments, builds structures, and designs high-performance systems and tools. Benyus encourages interdisciplinary collaborations between design and science so that we might mimic these incredible feats. Cradle to Cradle: Remaking the Way We Make Things, published five years later by designer and chemist duo William McDonough and Michael Braungart, highlights the importance of planning for the end of a product's life from the moment it is designed in order to eliminate the need for waste.

Inspired by the ecological thinking of these visionaries, today we will look at how to make an eggshell biocomposite.

Before COVID-19, we planned to create bio-tableware for Sympoiétiques, helping to re-envision the material needs of a conference. Our contribution was meant to reduce the ecological impact of the event as well as recover and value the waste. Cyclical_Matters came to fruition in the early days of the pandemic when we were forced to shift our research spaces from our labs and studios to our kitchens. This interdisciplinary project is led by three artists and designers with complementary know-how and is supported by the expertise of chemist Yves Gélinas, member of the chemistry and biochemistry department at Concordia University.

A little chemistry to start: eggshells are primarily composed of calcium carbonate (95%) but also contain proteins (3%) and water. For this recipe, powdered eggshells are incorporated into a viscous mixture of water and sodium alginate. Sodium alginate (C6H7NaO6) is a polymer derived from brown seaweed and is composed of carbon, sodium, hydrogen, and oxygen. It is a gelling and emulsifying agent primarily used in cooking and is classified as a food additive (E401). In the presence of calcium it allows for spherification, a chemical reaction that binds molecules, resulting in material agglomeration. Once the eggshells are thoroughly combined with the hydrated sodium alginate solution, pour them into a mould and cover them with vinegar. Adding vinegar to the calcium carbonate and sodium alginate mix is what causes the material to harden. At the molecular level, vinegar—an acid—mixes with the carbonate to form carbonic acid (H2CO3), which quickly decomposes into carbon dioxide and water (H2CO3 à CO2(g) + H2O). During the drying process, the water and carbon dioxide evaporate and the residual calcium, which is not volatile, acts as a binder that allows for the agglomeration of the alginate molecules.

Ingredients:

- 15-45 mL vinegar (or enough to cover your mixture on both side)
- 45 g eggshell powder
- 200 mL water
- 4 g sodium alginate

Preparation:

- Collect eggshells (at home or from a restaurant).
- Clean and boil the shells for 15 minutes to remove bacteria.
- Fully dry them for 15 minutes in the oven at 100°C / 212°F (or lower for longer) to render them more brittle. You don't want them to start browning.
- Grind the shells using a blender (or a mortar and pestle, if that's what you have). *At this stage, wearing a mask is strongly recommended because the powder gives off a fine dust that can be easily inhaled*
- While still wearing the mask, pass the powder through a sieve. You will end up with two types of materials: fine and coarse powders, that will give you two different textures. ich remains.
- Keep your eggshell powders at room temperature in well-labeled jars.
- The day before you plan to make your biocomposite, prepare a 2% alginate solution with 200 mL of water and 4 g of sodium alginate (this is enough for several recipes).

Recipe:

1. Mix 60 mL of hydrated sodium alginate with 45 g of eggshell powder.
2. Lightly put one spray of vinegar on the bottom of your mould and spread it around with your finger (too much vinegar makes the mixture coagulate on contact and doesn't result in even edges).
3. Pour the mixture into the moulds (we generally use yogurt lids or silicone moulds) and spread it out. Depending on how thick your mixture is, you might be able to tilt your mould in order to fill it or you may need to use a spatula to push the mixture to the edges. Gently spray the top of it with approximately 15-20 mL of vinegar.
4. After 30 mins, gently lift up the biocomposite edges to allow the vinegar to pass underneath and let it rest for an hour. Gently remove the biocomposite from the mould and rinse it under water. Place it in between two plates or the mould of your choice and in the oven at 55°C / 130°F for 30 mins (or the lowest temperature it will go). Remove from the oven, soak up the water that has separated from your composite, and return to the oven for 30 more mins. Finish by air-drying for 2-3 days.

Authors

Vanessa Mardirossian

Alex Bachmayer

Miri Chekhanovich

Eggshell Biocomposite Recipe 2- Calcium Alginate

Recipe

Eggshell Composite 'Ceramic' Eg02

Created By: Midushi Kochhar

Code:

Collection

Calcium carbonate composites

Process

Molded, Mixed, Air Dried,

License

CC BY-SA 4.0

Difficulty

Tools

Microwave, Cooker/stove/hotplate, Teaspoon, Measuring Cup, Cooking pot, Scale, Thermometer, Oven, Grinder, Stirring spoon, Container or bowl, Weight, Mold, Sieve, Flat surface,

Source

Author: Midushi Kochhar

midushikochhar.squarespace.com

Web - Inspired by Eggshell Biocomposite from LABVA - Materiom Recipe 60

Composition

Water	22 ml
Eggshell	20 grams
Calcium Alginate	5 grams

Natural Dye Powder

Using natural dye pigments to test a colorant for the Sodium Alginate + Eggshell mixture.

Turmeric

Indigo

Cutch

Logwood

Eggshell Bio-Composite Testing

Eggshell Powder Recipe:

For this recipe I used approx. 10 dozen chicken and duck eggs.

Collect eggshells by thoroughly rinsing shell after opening. Let air dry. Store in Ziploc bags in freezer until you have collected at least 3-5 dozen.

Place shells in large pot of boiling water. Boil for 15 minutes to kill bacteria. Stir often, it is ok if shells start to break more.

After boiling, remove from water and strain excess water off. Spread shells on a baking sheet, make sure they are not piled ontop of eachother, spread out.

Heat oven to 175 degrees. Place baking sheets with shells into oven for about 1 hour. Check and stir shells frequently to help evaporate the water. You do not want the shells to burn.

After they are dry to the touch, break up the larger shell pieces with your hands. Let cool.

Place egghsells in a blender and blend until they are completely crushed and you have a powder. Store in sealed jar until ready for use.

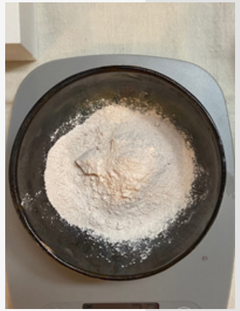
Materials:

- Cutch powder
- Logwood powder
- Indigo powder
- Hibiscus powder
- Sodium Alginate
- Crushed/powdered eggshell
- Water

Tools:

- Kitchen scale
- Small whisks
- Small spatula
- Measuring spoons
- Liquid measuring cup
- Small/Medium mixing bowls
- Tape and marker to label

Composite Recipe

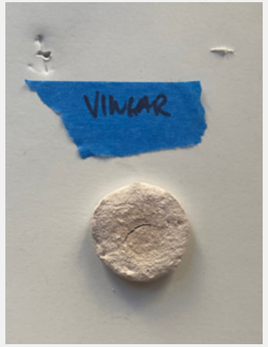


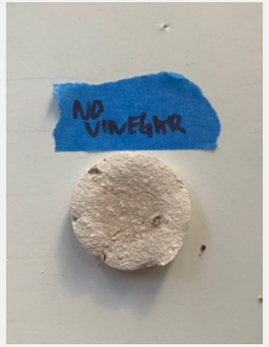
Gently pour Sodium Alginate powder into bowl of water and whisk together. There will be clumping. After initial stirring, let sit for a few minutes until the mixture starts to look cohesive. (Store extra in sealed jar).

Whisk 60 ml Sodium Alginate with 40g Eggshell powder. Do not overstir. Gently fold ingredients together until mixed.

STAGE 1 : EGGSHELL COMPOSITE TESTING

Initial testing was done with 60ml 2% Sodium Alginate mixed with 40g crushed and powedered eggshell. One precedent recipe suggested coating the mold with vinegar to help bond the particles. The composite was tested with both methods in addition to a 1tsp turmeric mixture, and a 1/2 tsp powdered cutch mixture.

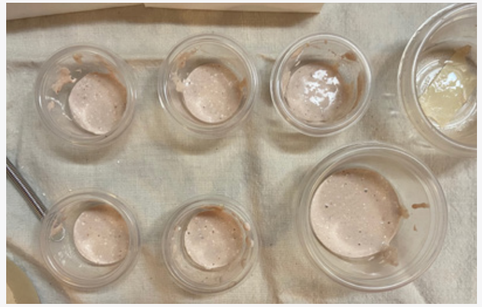


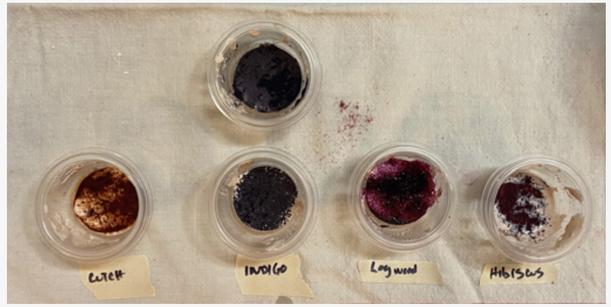


I did not notice much difference with the vinegar vs. no vinegar. Going forward I will omit this step.

The turmeric was added after the sodium alginate and eggshell were already mixed. A chemical reaction with the turmeric caused the composite to congeal and crack. The alginate lost its body. The cutch powder was successful.

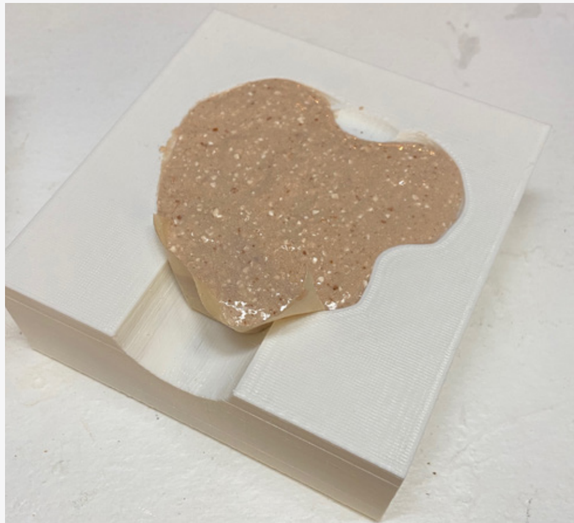
STAGE 2 : EGGSHELL COMPOSITE TESTING





Natural dye powder was added on top of the mixed composite. Almost all dyes changed color after drying for 2 days. For future tests I mix the dye powder with the Sodium Alginate or the eggshell instead of after.

Cutch Dye Powder Test in 3D Printed Mold



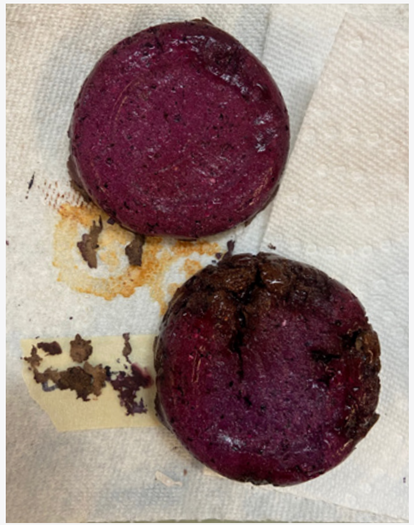
Logwood Dye Powder Test in 3D Printed Mold

24 HOURS AIRDRY

Cutch and Eggshell Composite

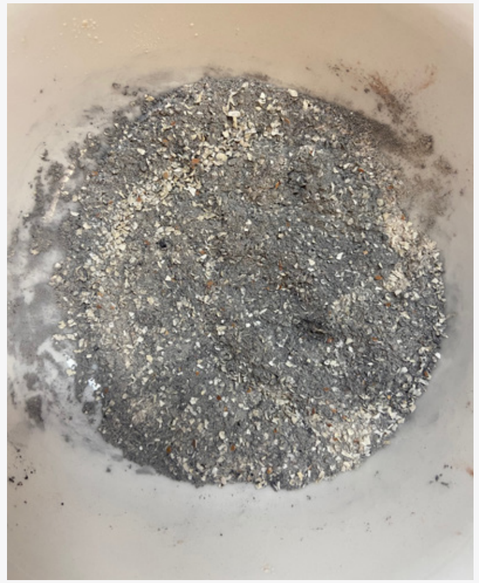
3 DAYS AIRDRY

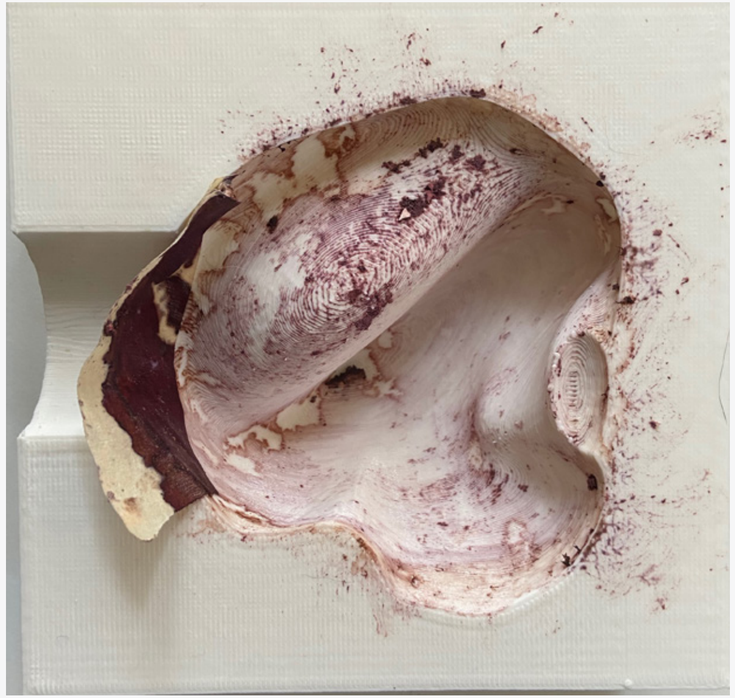
Logwood and Eggshell Composite



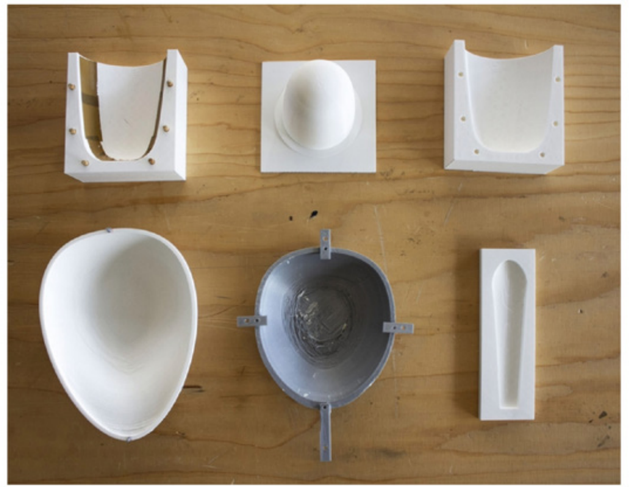
24 HOURS AIRDRY

3 DAYS AIRDRY





Mold-Making and 3D Printing

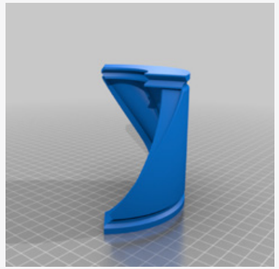


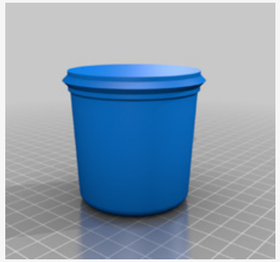
Eggware: single-use biodegradable crockery made from eggshell waste © Midushi Kochhar

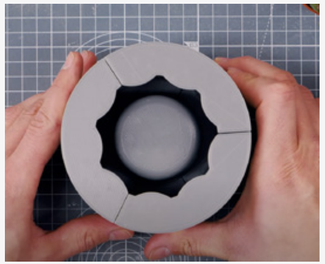
Research of Mold-Making Techniques Using 3D Printing and Plaster Casting

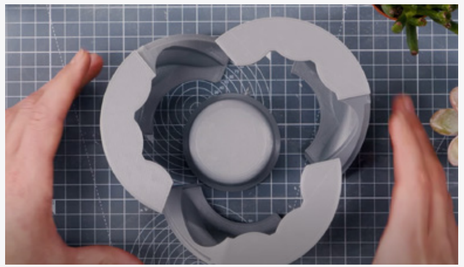
Simone Bodmer-Turner

3D PRINTED MOLDS FOR CONCRETE PLANTERS BY ALEXANDRE CHAPPEL



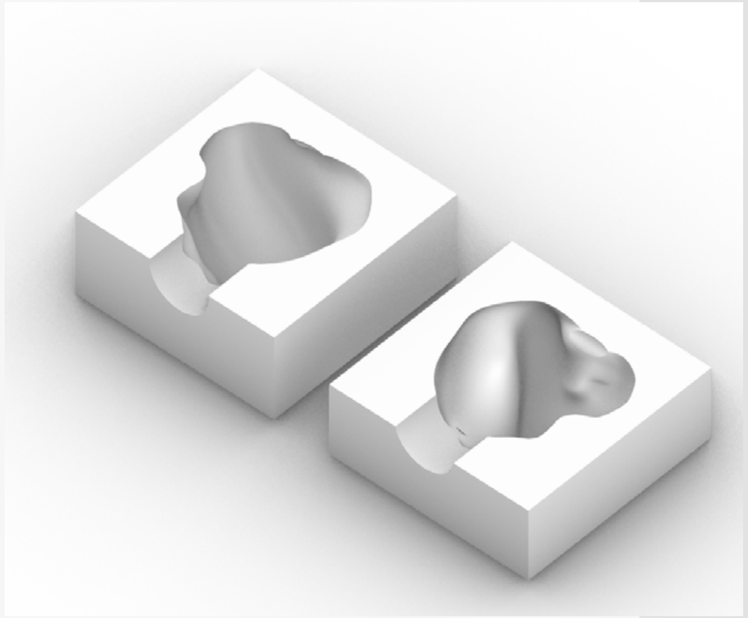


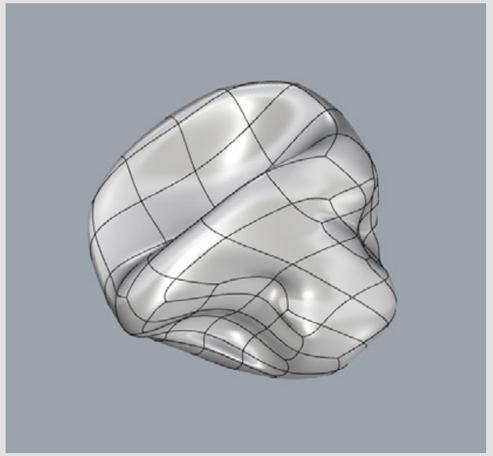


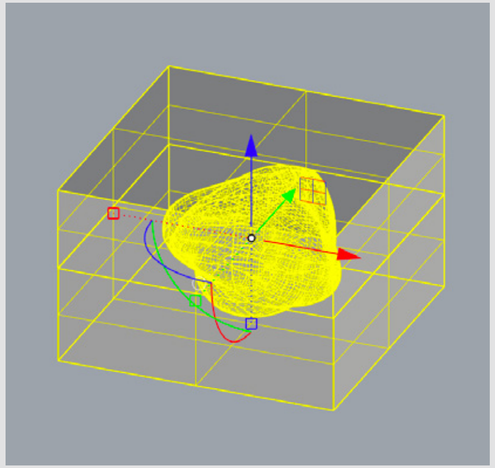


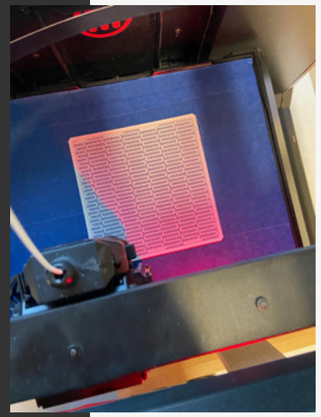
https://www.youtube.com/watch?v=XBX42ZZNQas

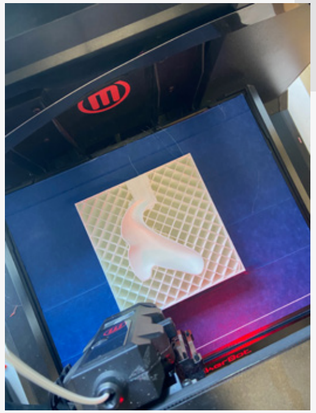
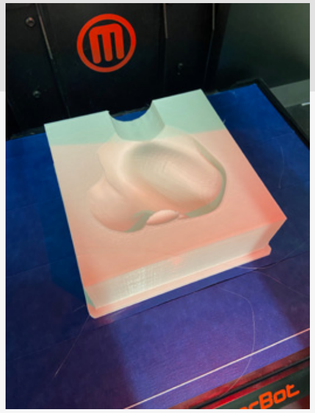
RHINO MODEL FOR 3D PRINTED 2-PART MOLD



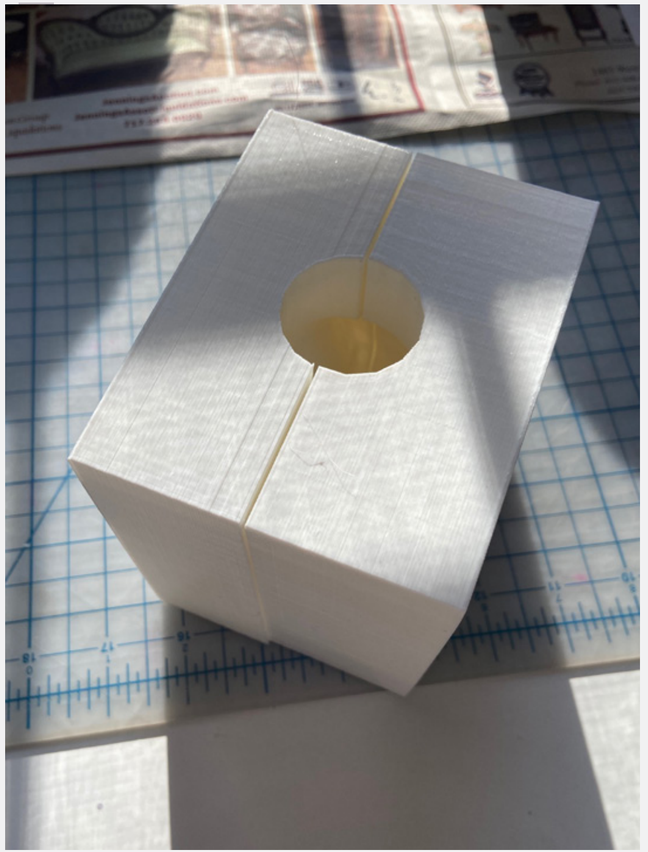
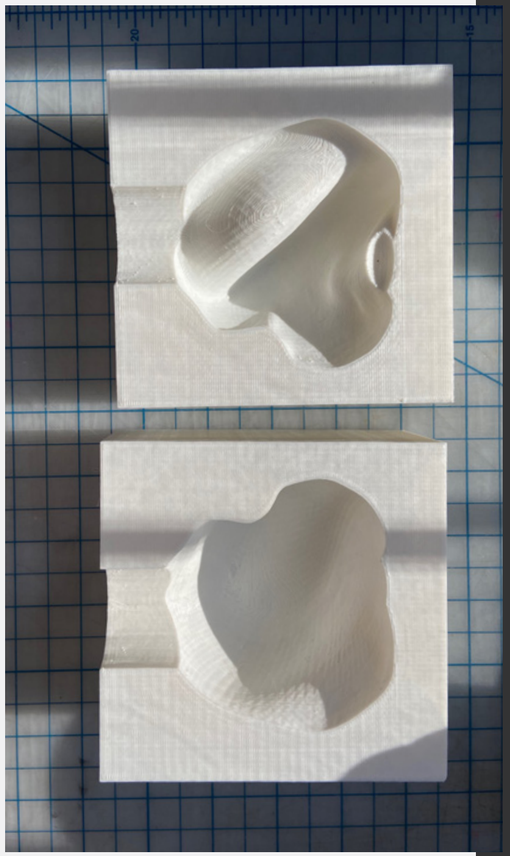




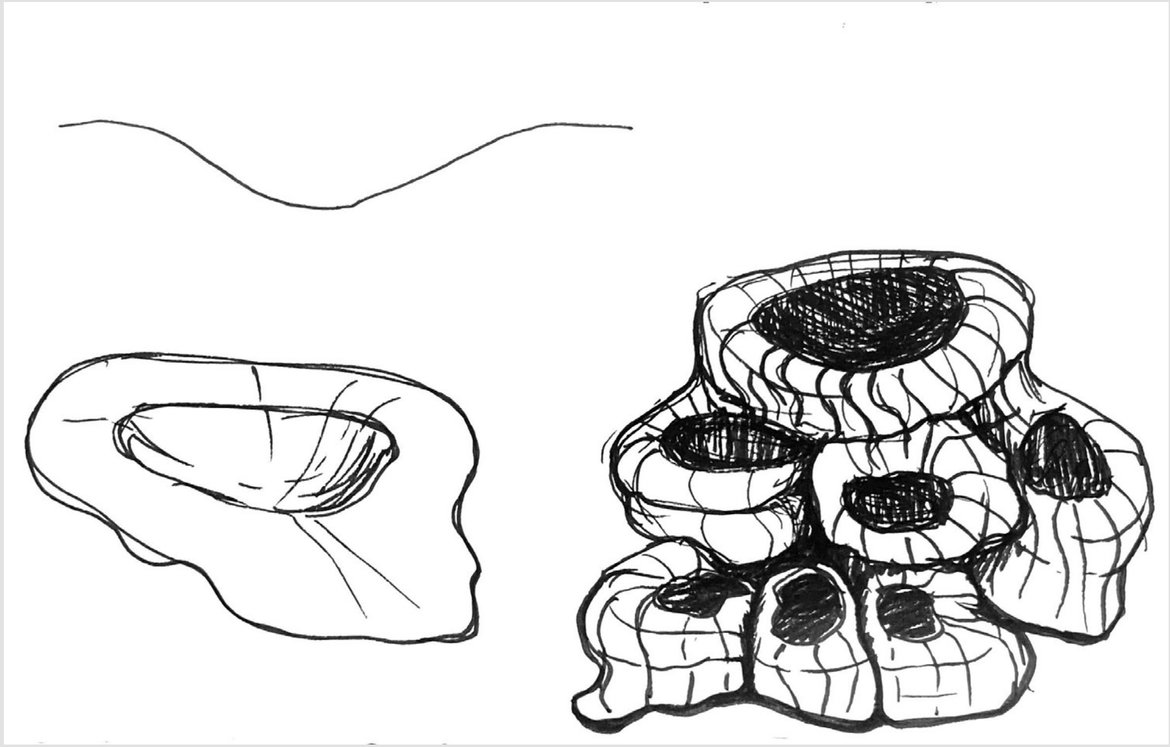


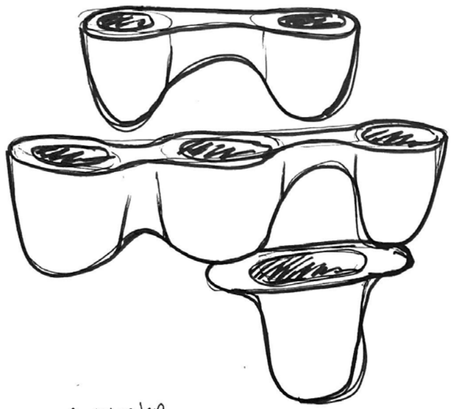



3D PRINTING THE 2 PART MOLD ON MAKERBOT REPLICATOR
USING PLA FILAMENT.

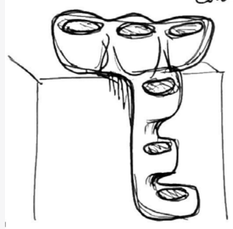



Concept Sketches/ Prototyping

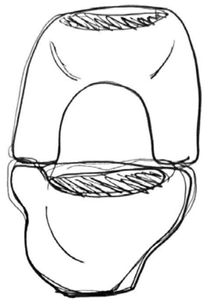


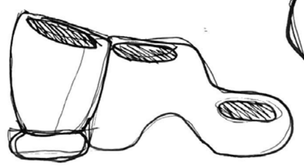


countertop cascade



Stackable

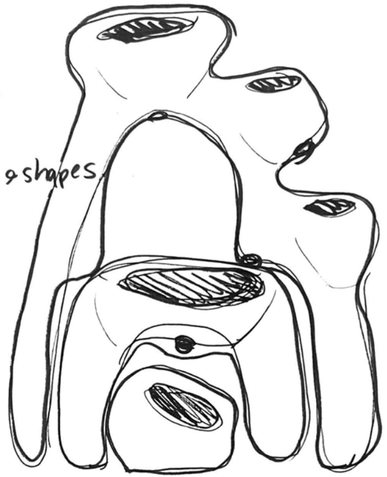




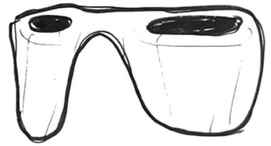
- SENSORY
- LUSH
- OVER FLOWING
- Organic
- modular w/o cooking it.
- STACKING VS. WALL MOUNT

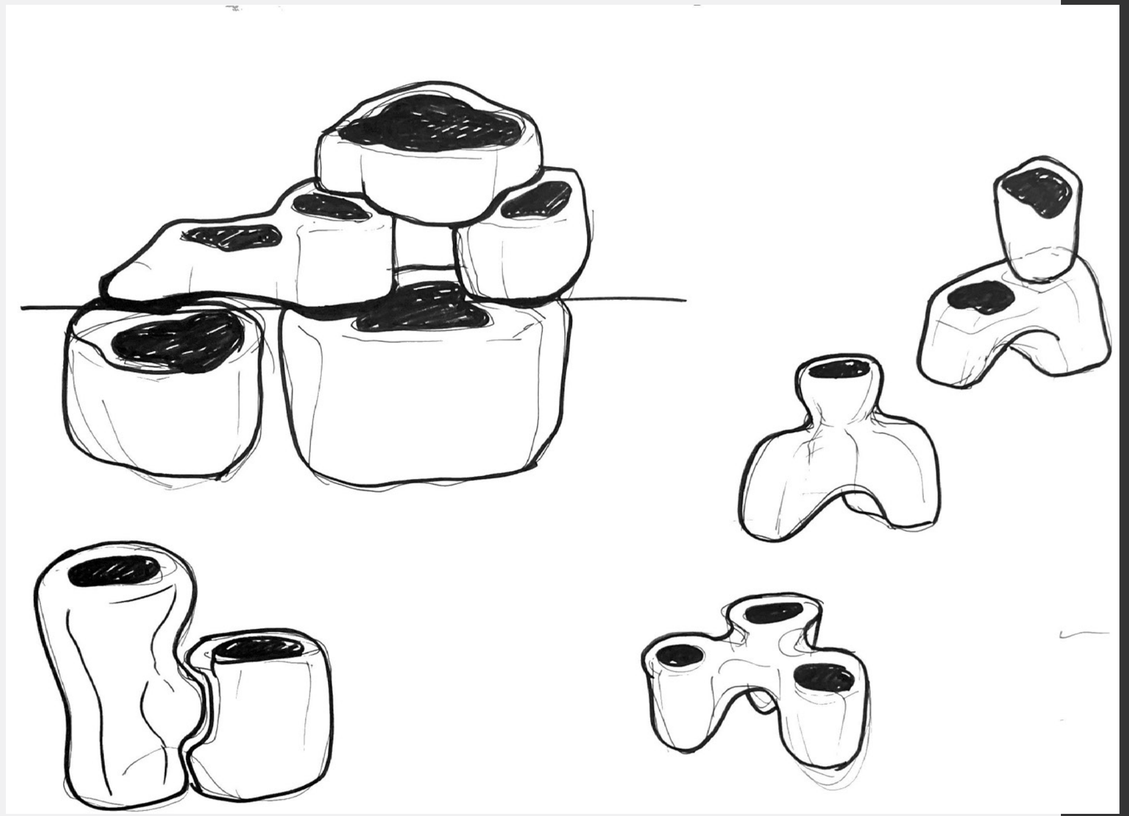
- OPEN SOURCE
- ACCESSIBLE MATERIALS
- Made for small living spaces.
- Abstraction of shapes,
- Modular w/different sizes & shapes.

Focus on Natural Topography

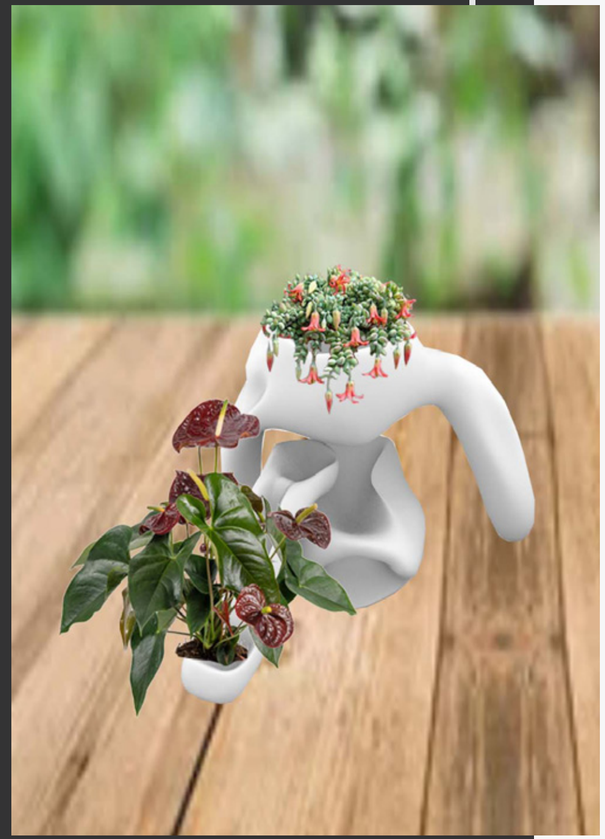


Sonja Ferlov Mancobat
Matisse
Frederick Keisler
Alex Mylona
Moore, Viani, Calder
Jan de Swart

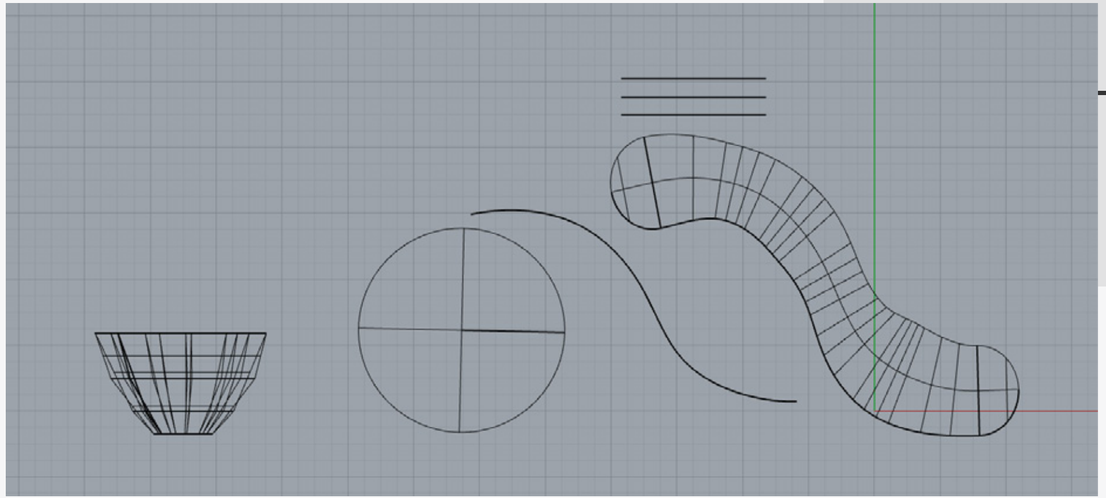




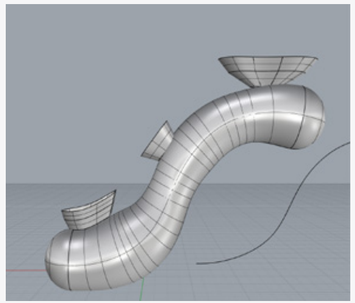
CLAY SKETCHING

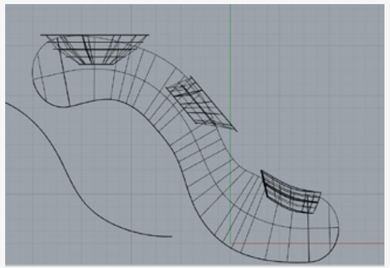


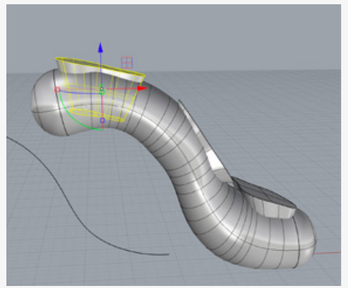
Rhino + Rendering of Prototype

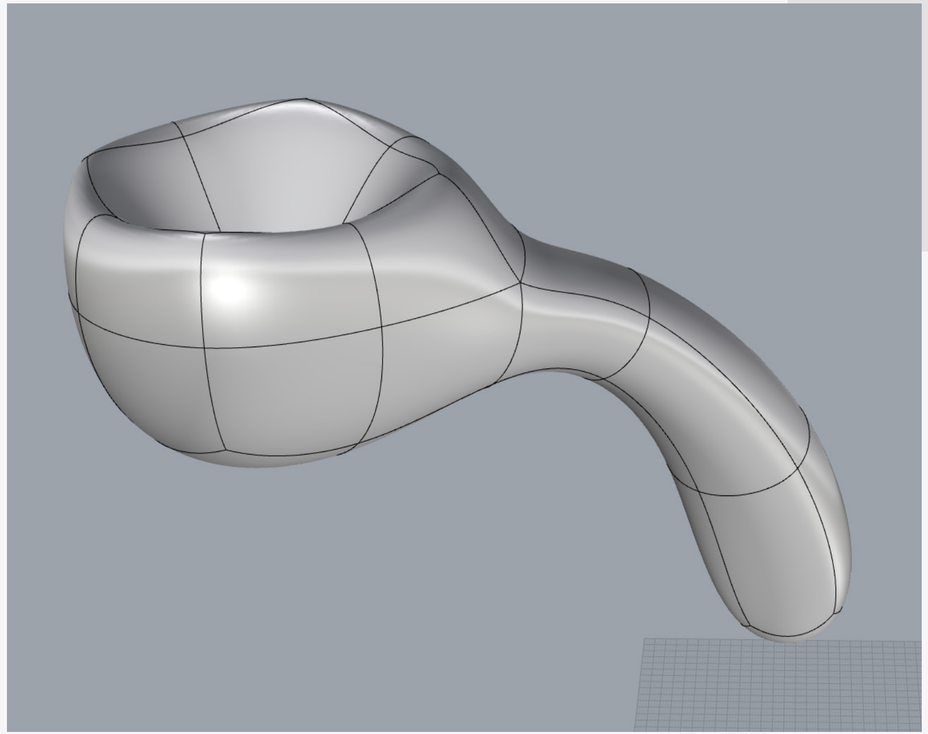


I initially used solids and polysurfaces to attempt to get my shapes, but after facing some issues with the program, I ended up moving into SubD to create all of my shapes and final forms, which you will see on the following page.





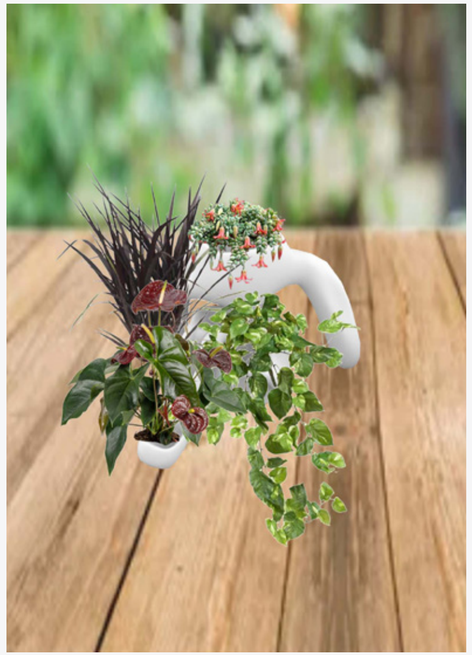




I got so caught up in working in SubD
that I forgot to take process photos...

FINAL
FORMS.

FINAL FORMS CAN BE ARRANGED IN VARIOUS FORMATIONS.



What Could Be Next?

- HANDBOOK WITH RECIPES FOR OPEN SOURCE USE
- FURTHER EXPLORING NESTING/STACKABLE SHAPES IN RHINO
- CONTINUE BIOCOMPOSITE RESEARCH, TESTING NEW RECIPES

THANK YOU.

DSRE625 FINAL PRESENTATION

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