

Sophia G. Cabral

This portfolio is a compilation of my academic and professional work, observations, and explorations.

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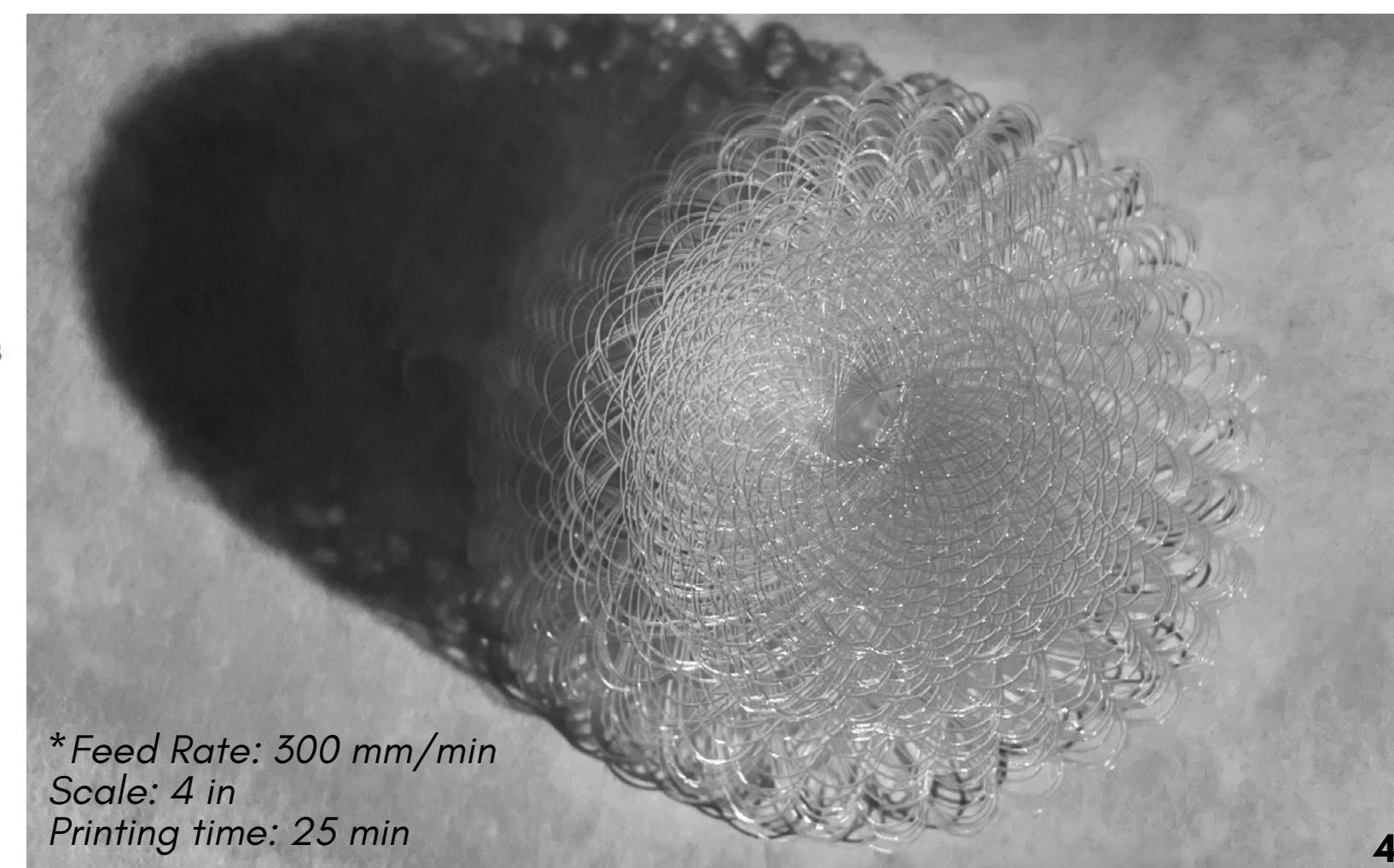
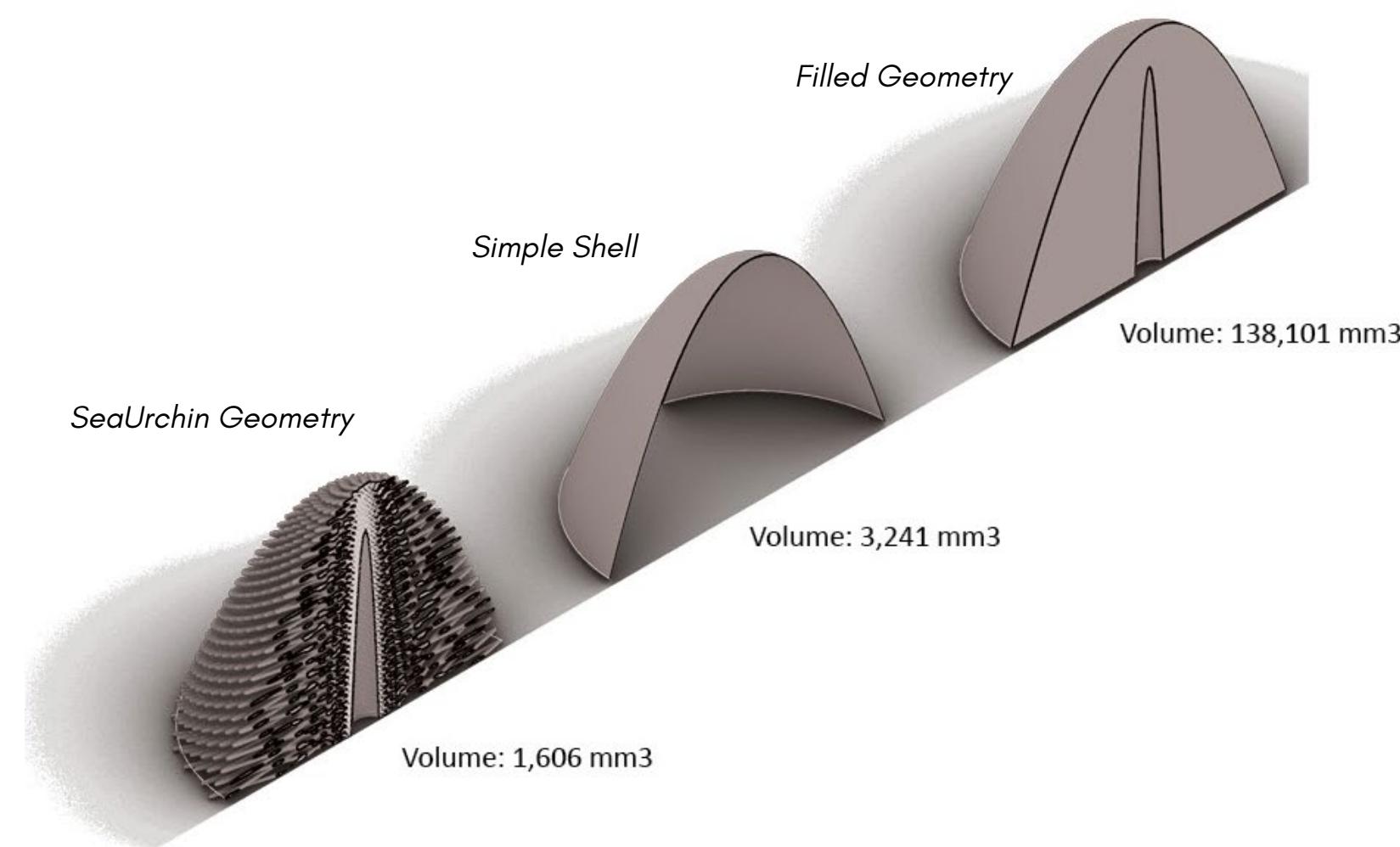
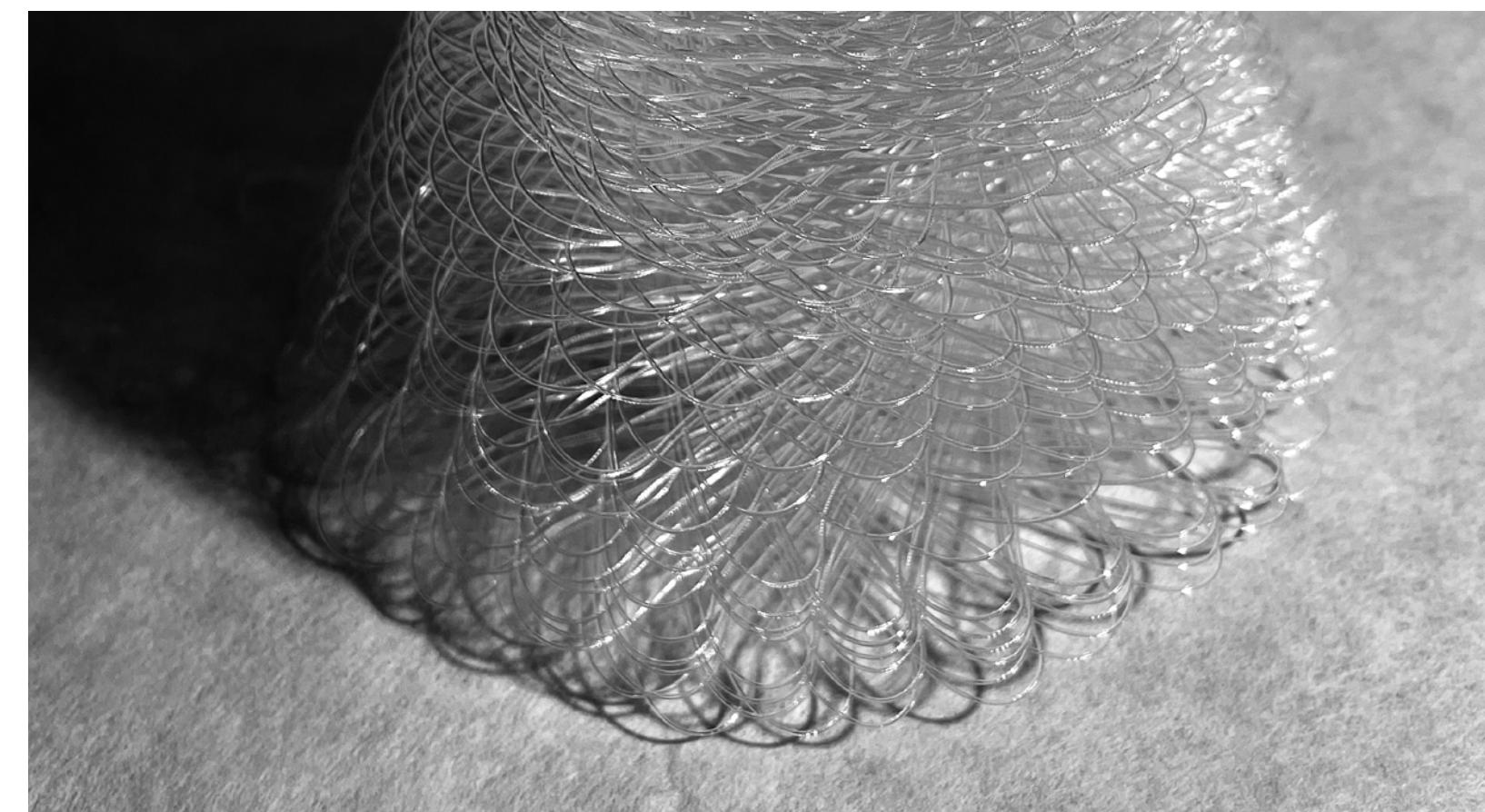
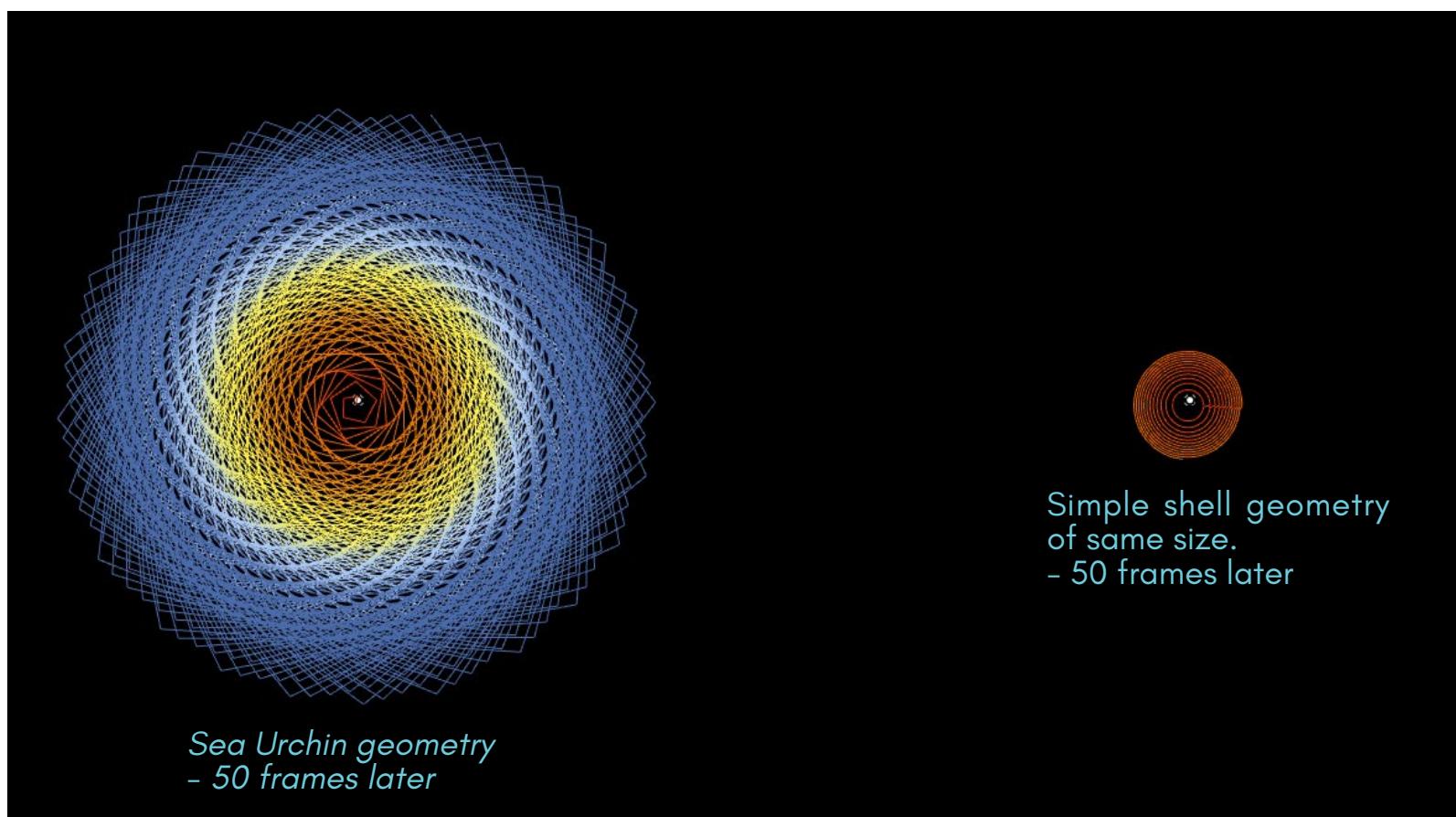
Programming & 3D printing

C# + Grasshopper [Rhino3d] + Custom G-code

The following shows the development and studies that lead to grasshopper plug-in SeaUrchin. Sea Urchin harnesses the power of simple phyllotaxis algorithms to generate a diverse array of forms. SeaUrchin enables the generation of a continuous and complex polyline, simplifying the translation into G-code for 3D printing purposes.

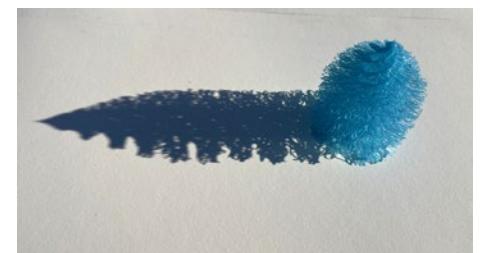
Concept + Introduction:

SeaUrchin explores the numerous possibilities of phyllotaxic algorithms to create intricately detailed forms quickly and with minimal volume. The plug-in ensures proper layer heights for 3D printing purposes, and designers can achieve various shapes depending on how they set their own feed rates and geometry scales.



The many iterations

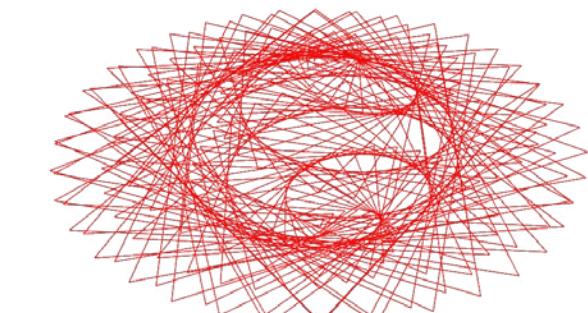
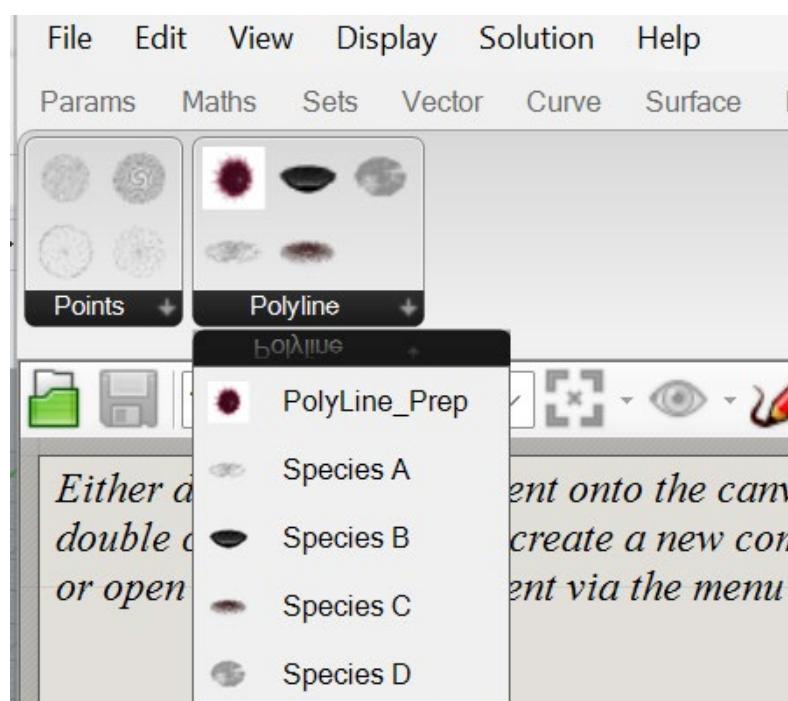
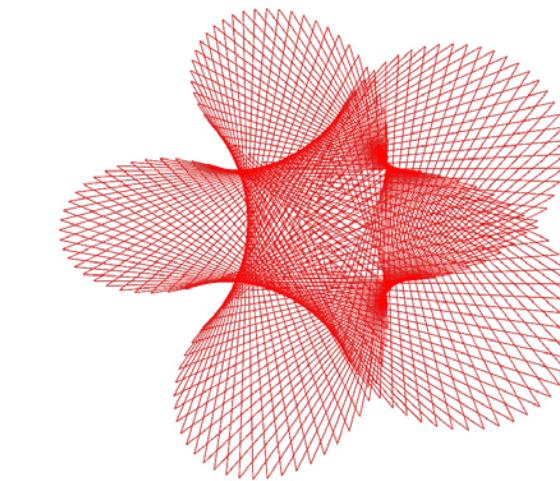
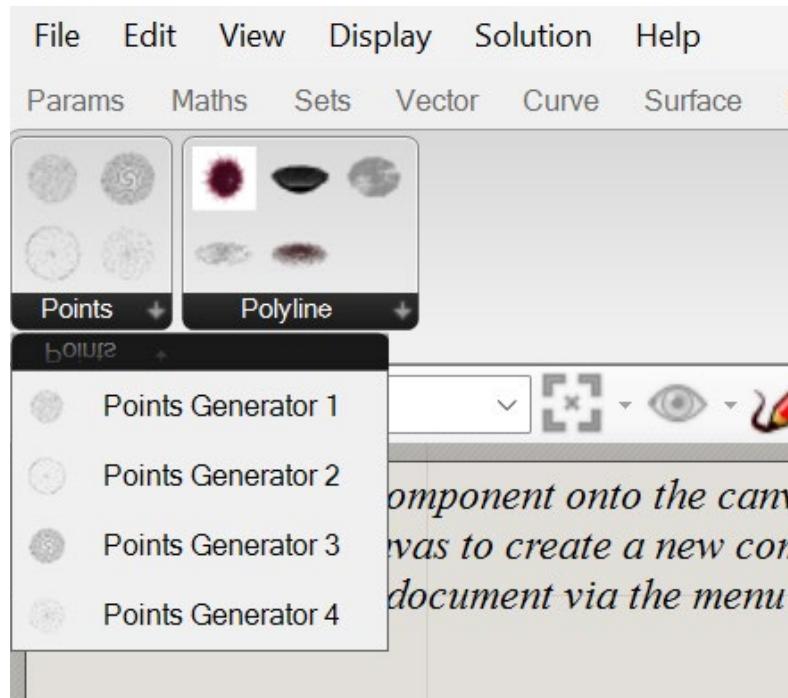
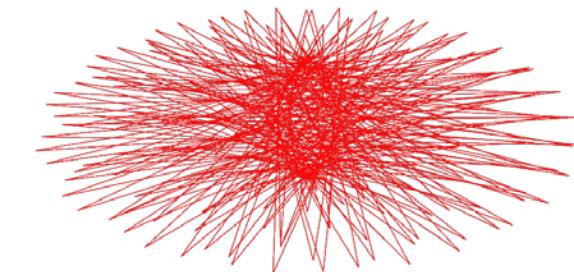
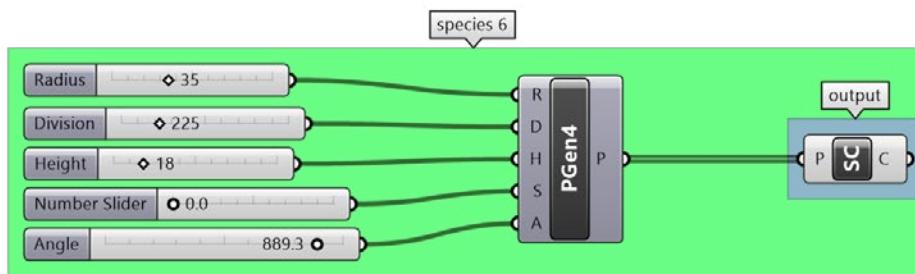
Testing parameters: Angle of divergence, scale, feed rate, and printer.



Model Name	Parameter: angle	Parameter: scale	Parameter: feed rate	Printer	Picture
final shell attempt	90	2	250	dremel	
3rd shell attempt	5	1	200	dremel	
2nd shell attempt	137.3	1	300	prusa	
1st shell attempt	137.3	1	300	dremel	
1st pine cone attempt	135.7	1	200	dremel	
2nd pine cone attempt	135.7	1	120	dremel	
final pine cone attempt	135.7	1	120	prusa	
1st icicle attempt	135.7	0.5	300	dremel	
final icicle attempt	135.7	0.5	250	prusa	
mini pine cones attempts	137.6	0.5	500	prusa	
sunflower center	137.5	1	300	prusa	
1st flower attempt	135.7	1	300	dremel	
transparent flower	135.7	1	120	dremel	
stem	n/a	0.5	300	dremel	

Simple & Beautiful

The plug-in includes four types of point generators, each following different angles of divergence, as well as four different species. The richness of shapes that one can achieve with these two configurations is endless.

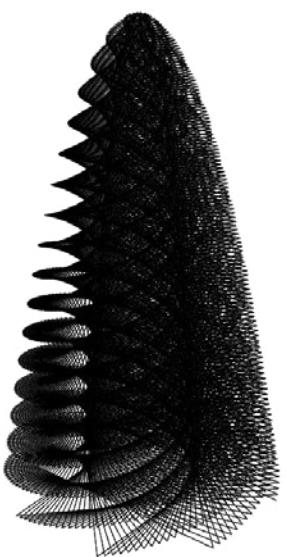
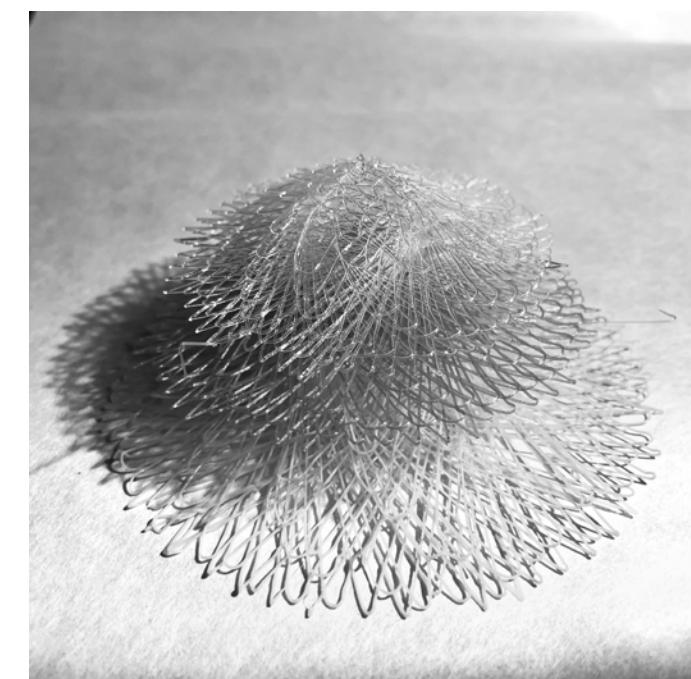
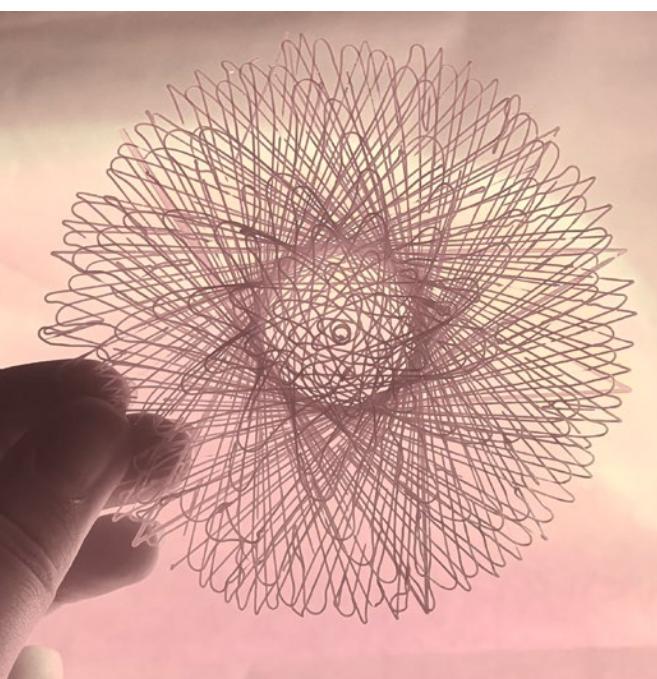
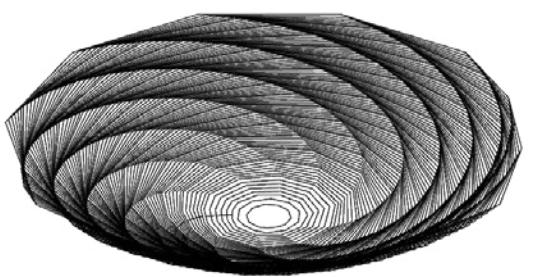
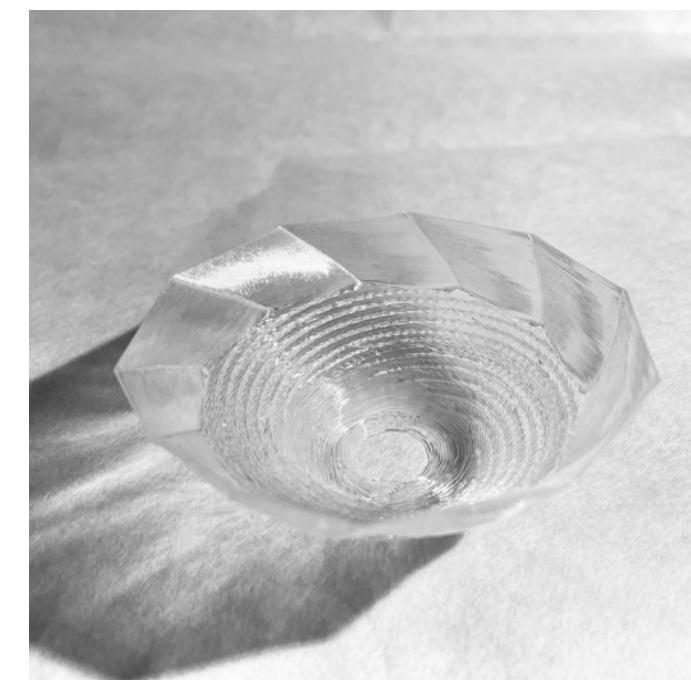
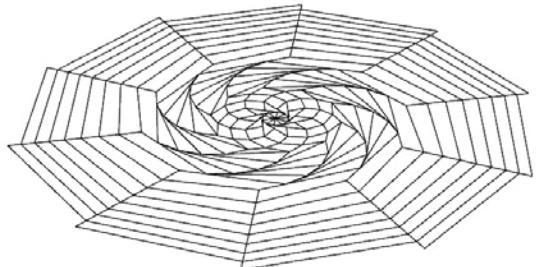
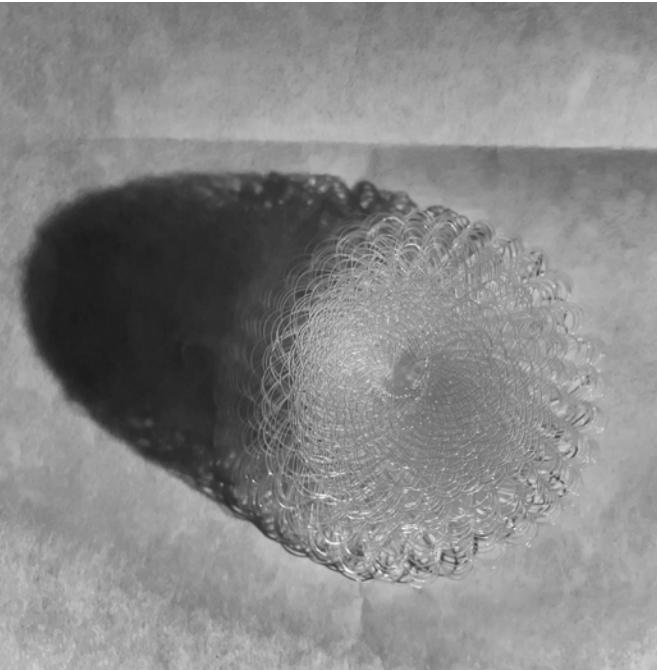


*Possibilities within a single species

Food4Rhino + Harvard GSD Documentation

Visit :
<https://gsd6338.org/fall2023/projects/seaurchin/index.html>
for Harvard GSD documentation

And:
<https://www.food4rhino.com/en/app/seaurchin>
for Food4Rhino download



Product Engineering

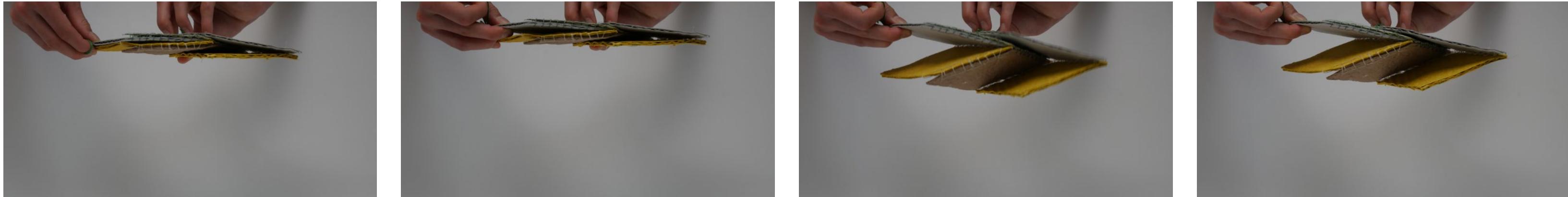
Scientific experimentation + Market studies + Design Development

The following pages showcase a segment of the development process for the product Pulp Panels*. Pulp Panels are easily deployable sound-absorbing panels designed to offer quick, affordable, and aesthetically pleasing solutions for users seeking to privatize their spaces.

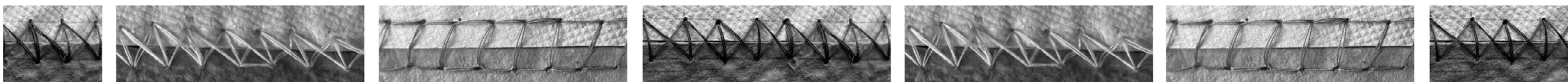
*This product is currently pre-registered and undergoing a copyright process. Please refrain from unauthorized use or reproduction.

Pulp panels are...

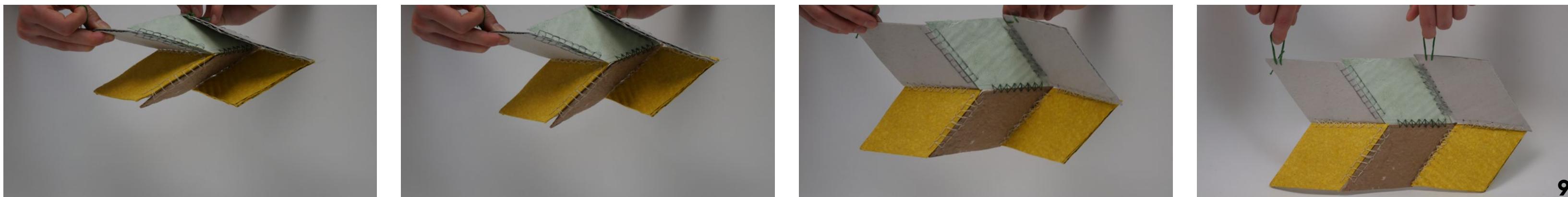
Easily deployable sound-absorbing panels designed for users seeking quick, affordable, and aesthetically pleasing solutions to privatize their spaces.



Highly engineered yet simple, crafted from recycled paper and bound using traditional bookmaking techniques to improve longevity.



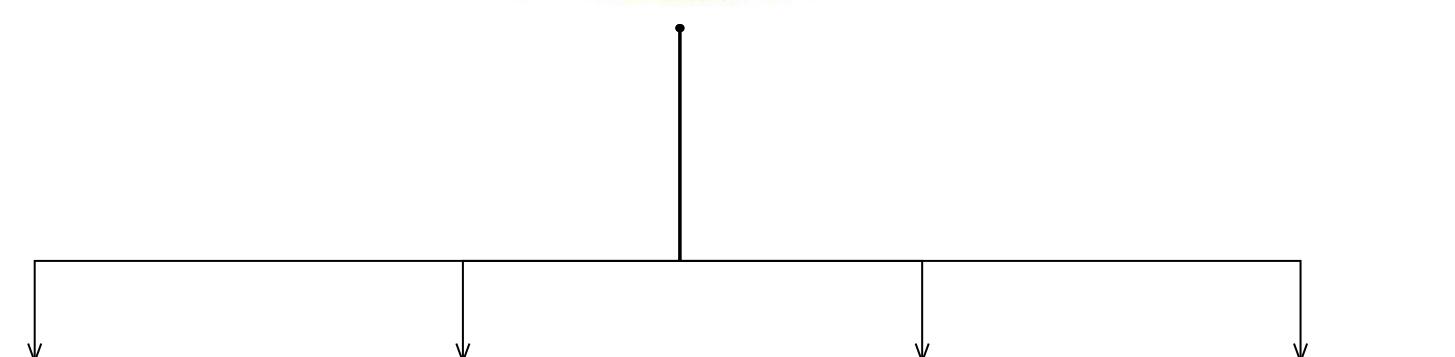
Their origami format enables swift and straightforward deployment, ensuring accessibility for individuals of all skill and income levels—only tools required are two pins or nails.



Reverse Engineering

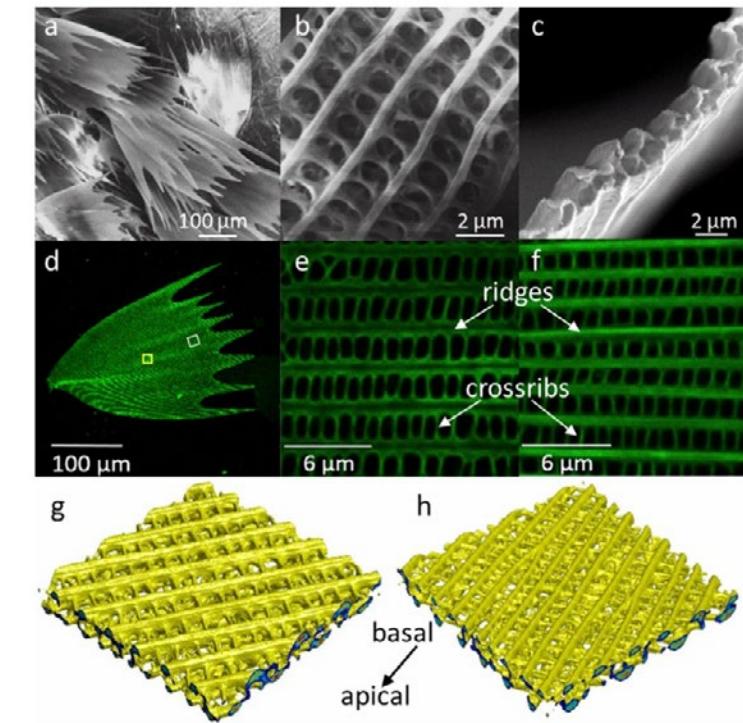
We reverse-engineered the pulp panels, drawing inspiration from the absorbent properties of moth wings, characterized by their porosity and laminations. Our aim was to replicate this natural phenomenon in our design. ---->>

...And we chose paper because:

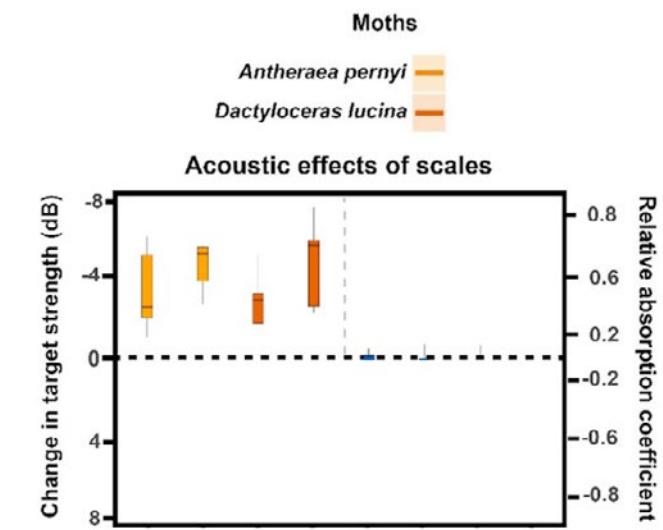


¹<https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/paper-and-paperboard-material-specific-data>

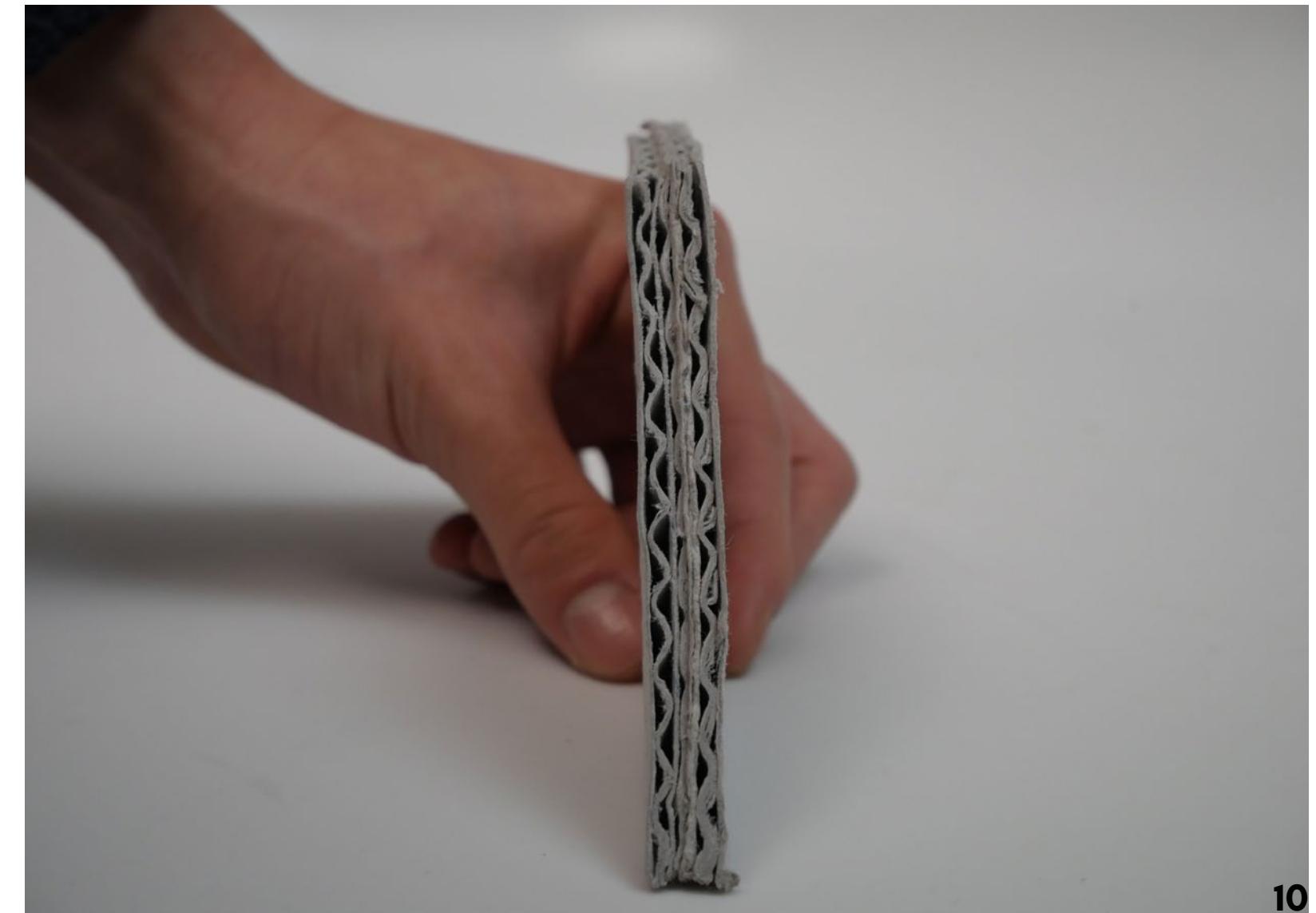
²<https://www.mdpi.com/2071-1050/13/10/5546>



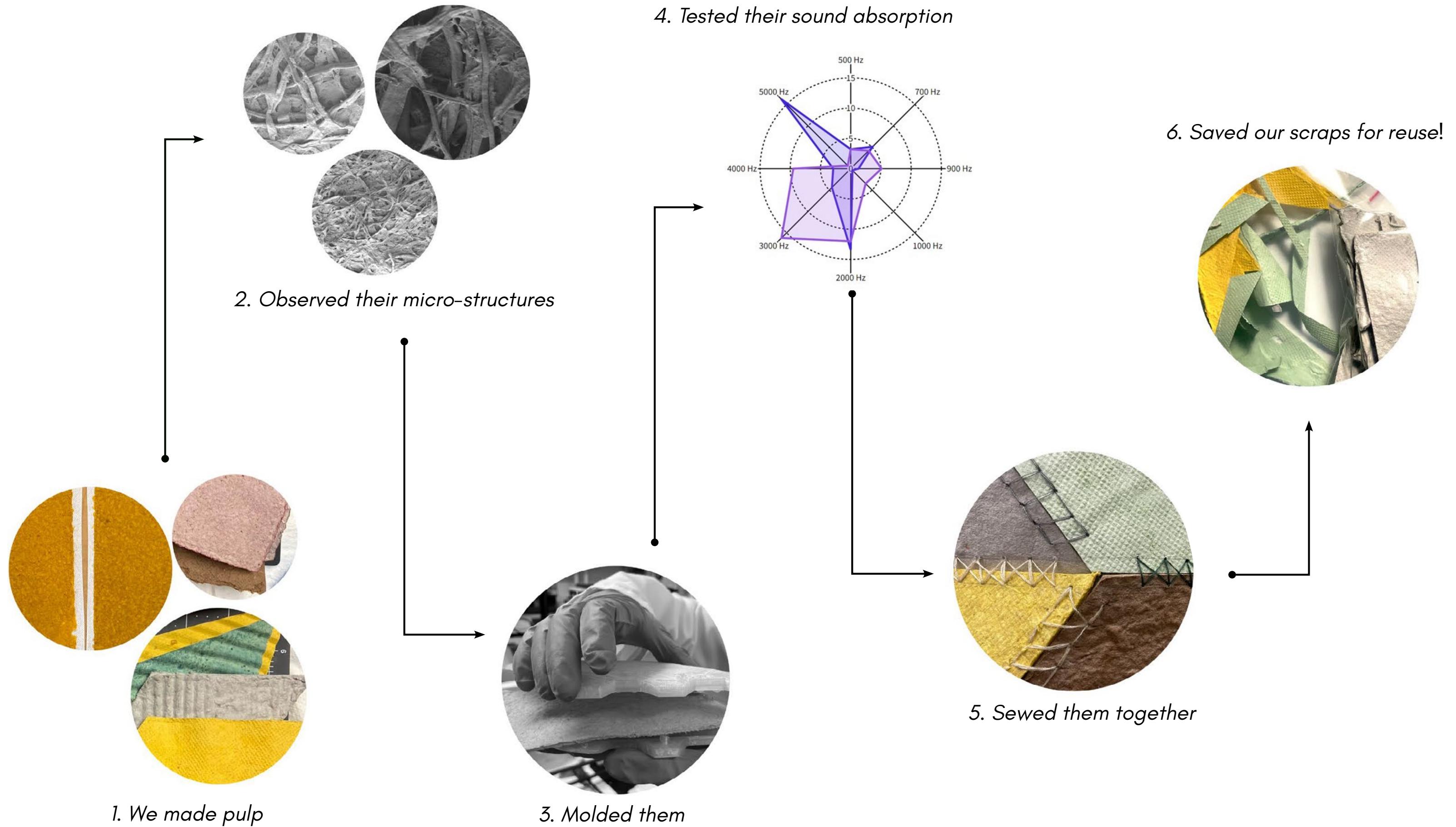
**Porous laminae connect trabecular pillars
**scales layered to create disorder



**Wing scales reduce sound by ~5 dB & function like resonant sound absorbers

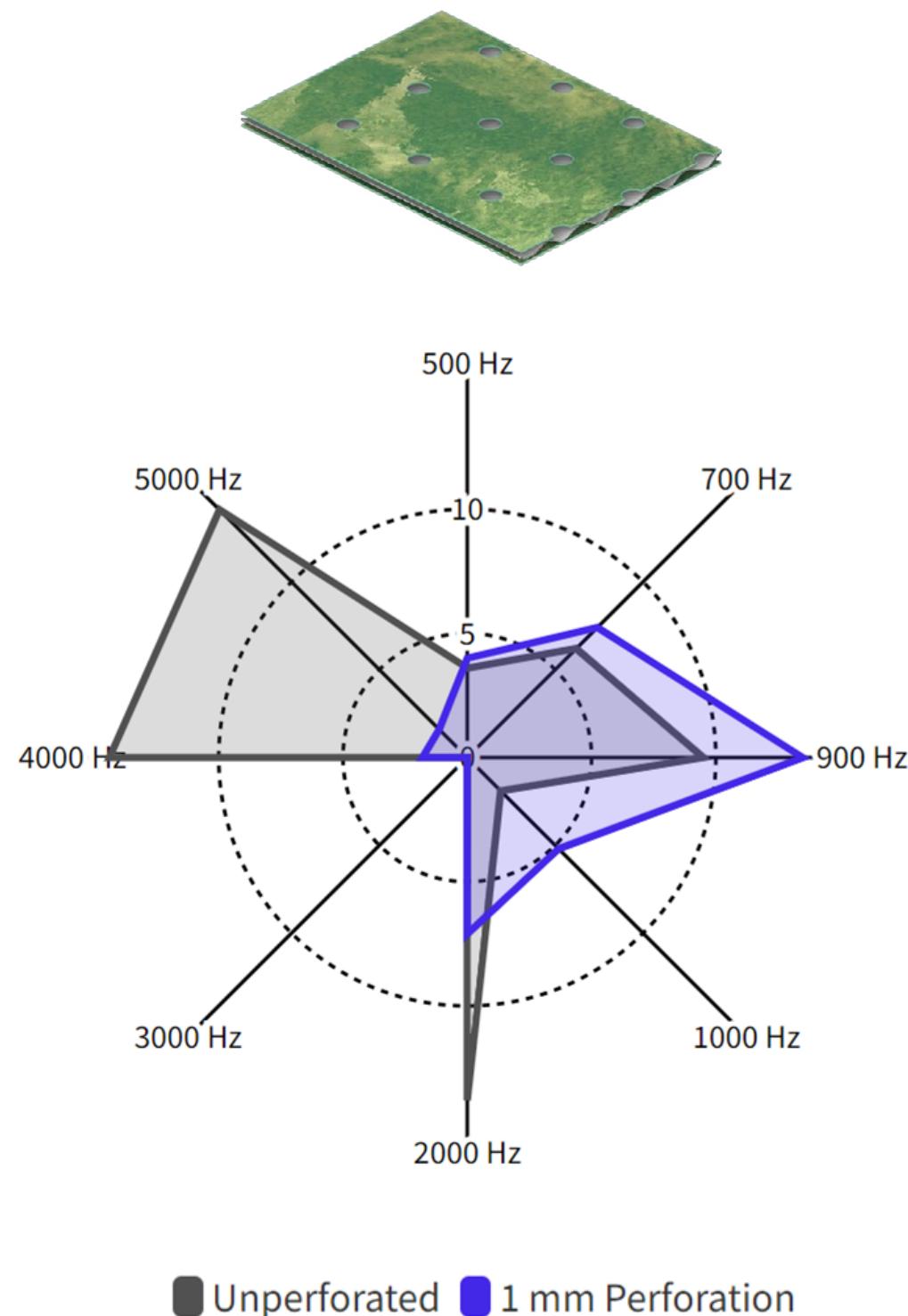


Our process:

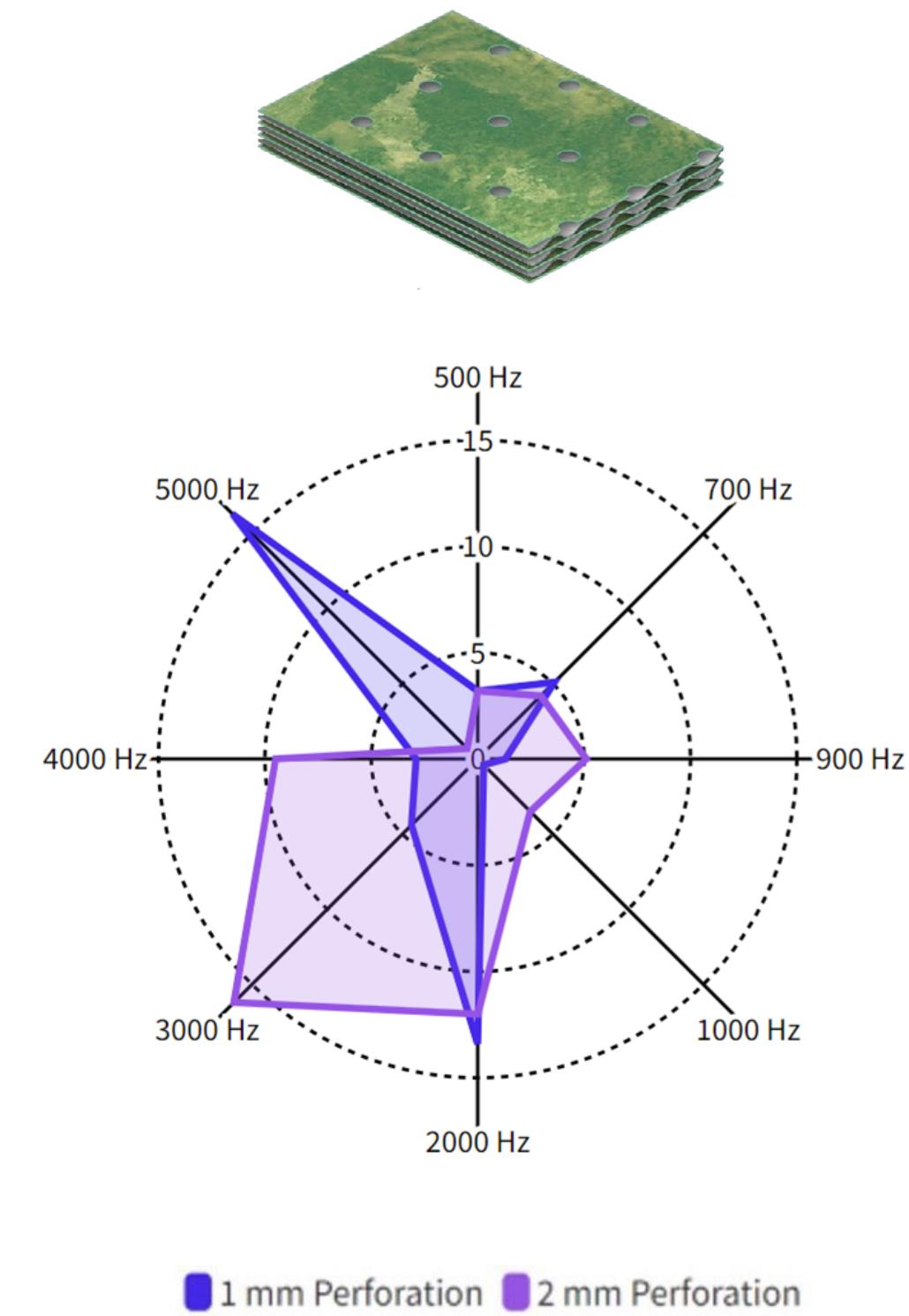


Our findings

Sound insulation of a single newspaper laminate :



Sound Insulation of a Triple Newspaper Laminate:



*Perforations increase resonant absorption in mid-frequency range (500 Hz - 2 KHz)

**Triple layering increases resonant absorption in upper mid-frequency range (2 kHz - 4 kHz)

Our findings

Product	Material	Avg. Insulation	Advantages	Recommendation	
	<u>Single Sheet</u>	Filter paper	- 9.5 dB	Mid frequency (500 Hz to 2kHz) Upper Mid Frequency (2 kHz to 4 kHz)	Base material for insulating instruments, voices
	<u>Single Sheet</u>	Paper bag	-10.7 dB	Upper frequency (> 4kHz)	Base material for insulating bird chirps, cymbals
	<u>Single Sheet</u>	Copy paper	-9.3 dB	Mid frequency (500 Hz to 2 kHz) w/peak insulation at 900 Hz and 2 kHz	Base material for insulating voices (extra insulation at upper & lower range)
	<u>Single Sheet</u>	Newspaper	-8.2 dB	Mid frequency (500 Hz to 2 kHz)	Base material for insulating instruments, voices
	<u>Single Laminate</u>	Newspaper (1mm perforation)	-5.0 dB	Mid frequency (500 Hz to 2 kHz)	Insulator for instruments, voice
	<u>Triple Laminate</u>	Newspaper (2 mm perforation)	-6.8 dB	Upper frequency (> 4kHz) Mid frequency at 2 kHz and 4 kHz	Insulator for instruments, voice

Micro-Studies

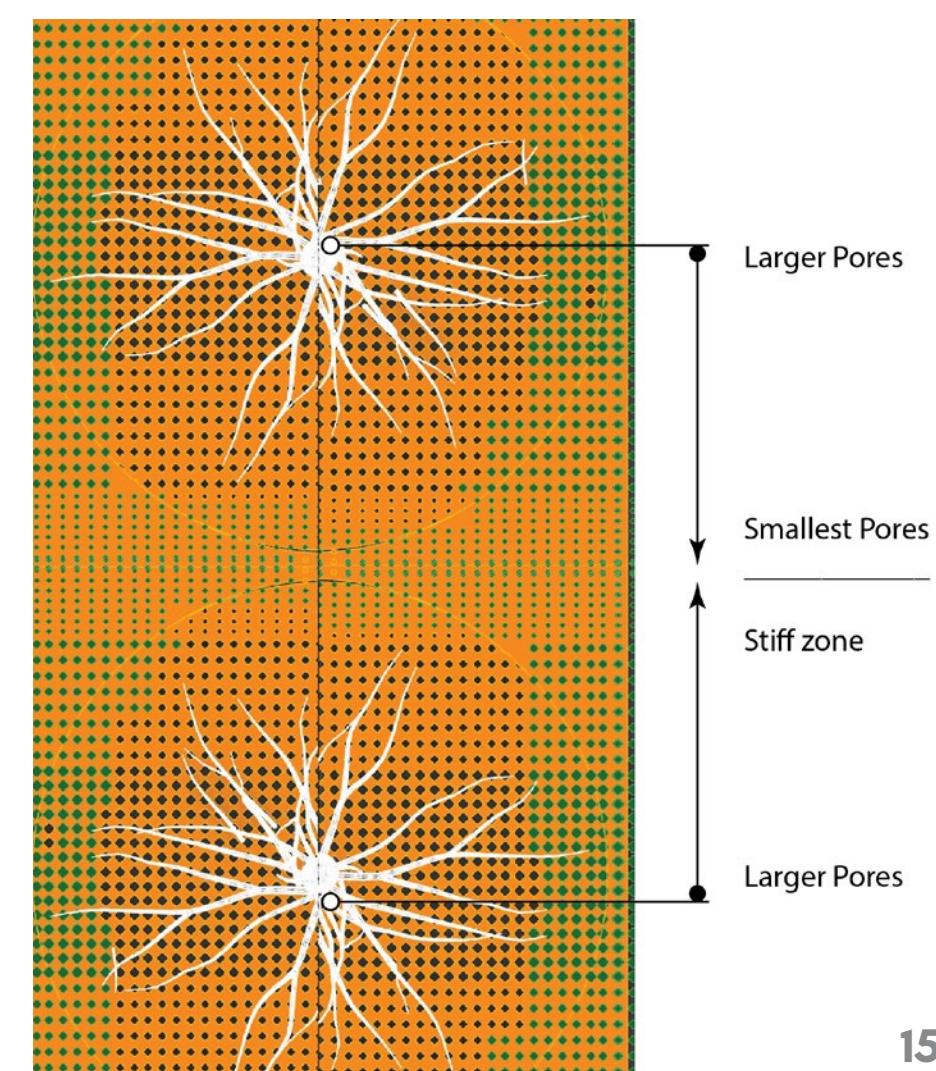
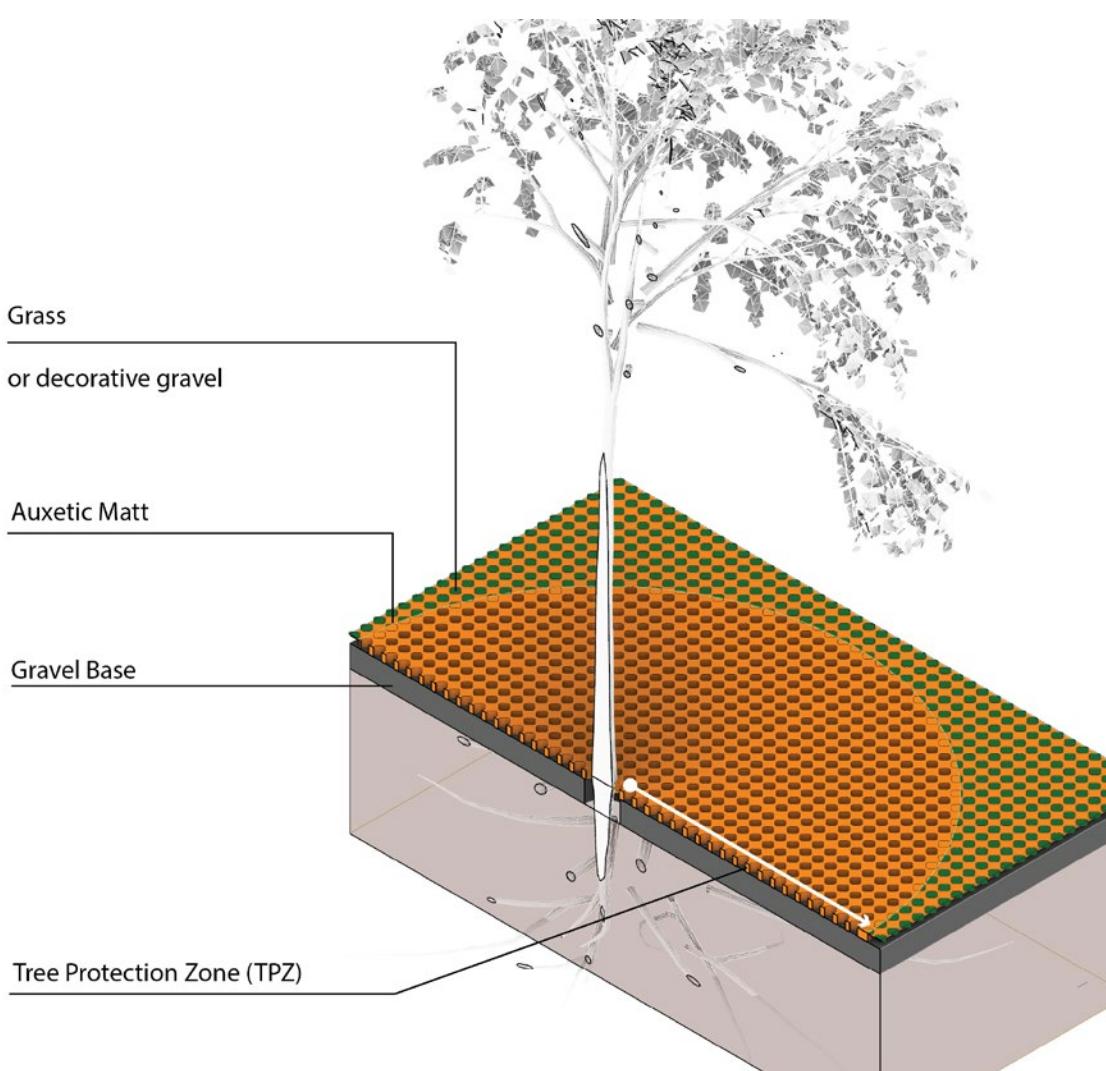
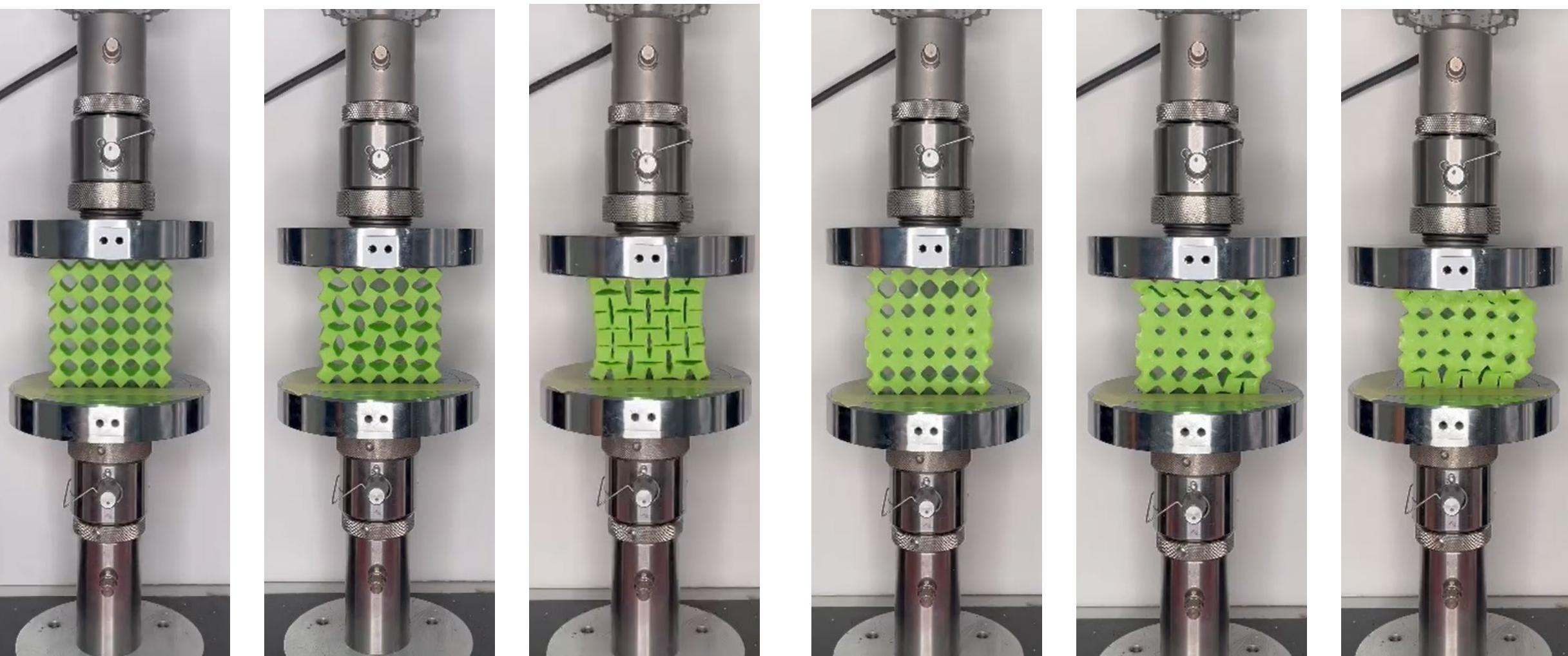
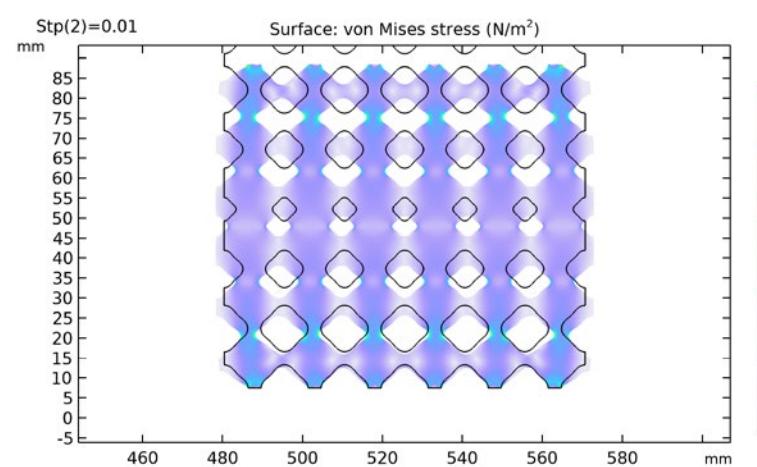
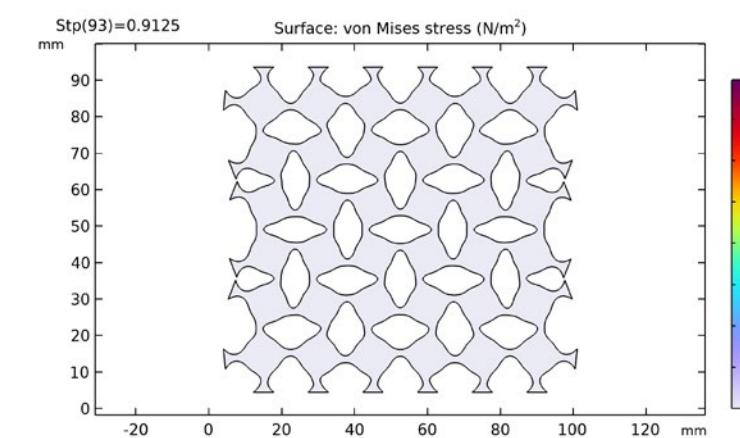
Scientific experimentation + Design Development

3Depot is a platform designed for the efficient and swift visualization and display of one's 3D creations, as well as for the efficient transfer and viewing of 3D objects among various users. It facilitates easy sharing and interactive visualization of 3D models, enabling seamless collaboration and exchange of 3D models between individuals.

Auxetic Sidewalks to Accommodate Urban Tree Root Growth

View paper:

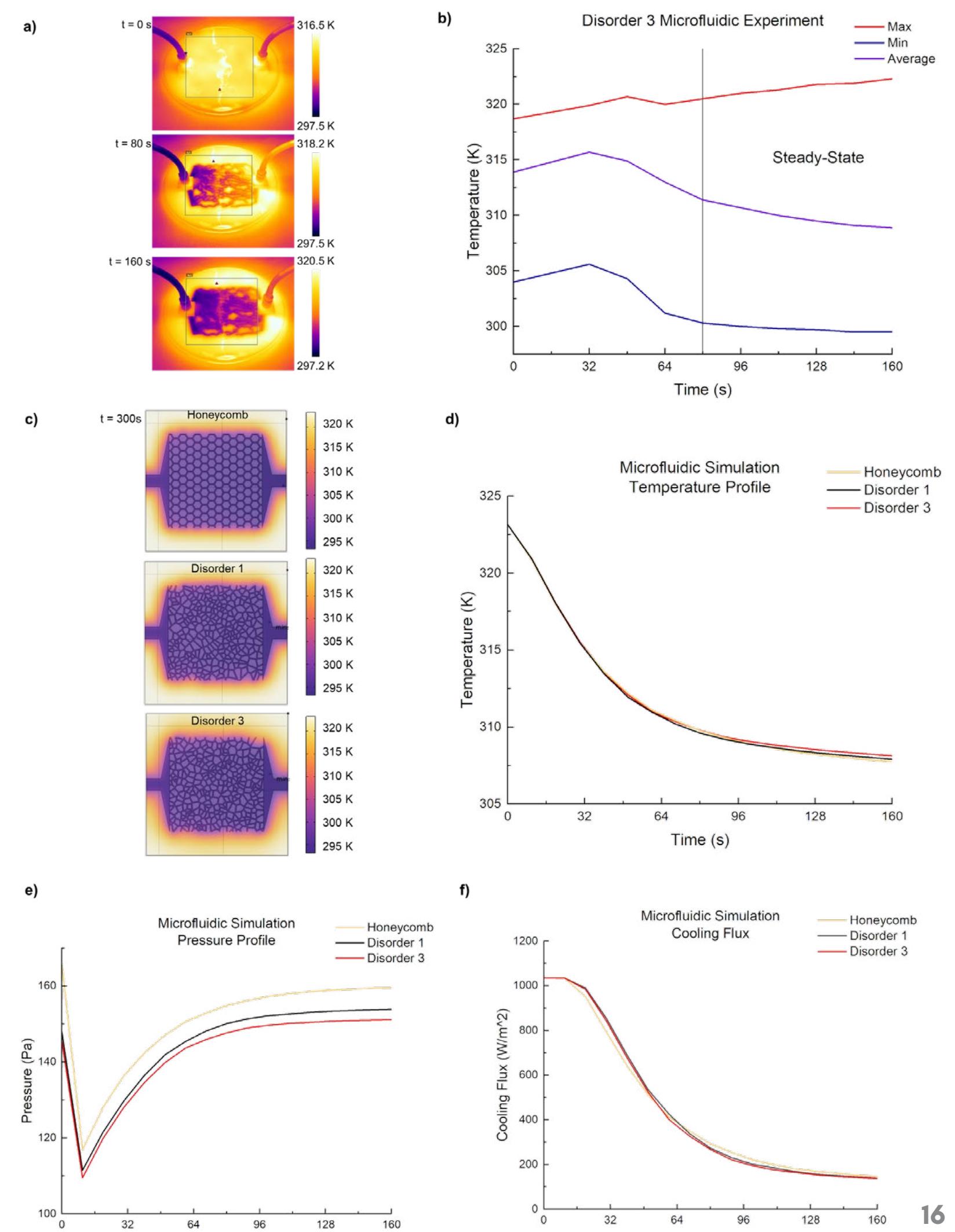
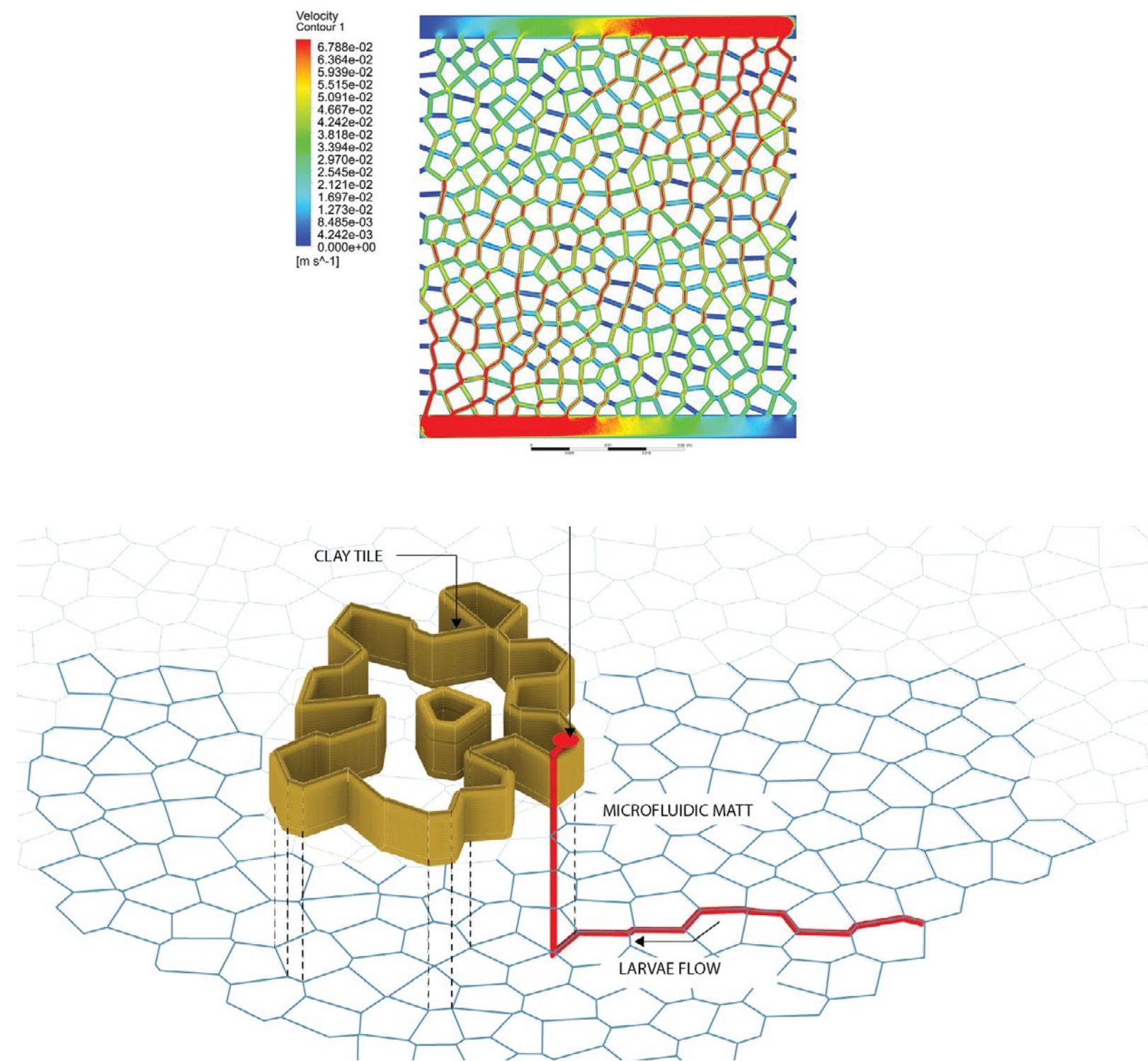
https://www.researchgate.net/publication/378100904_Auxetic_Sidewalks_to_Accommodate_Urban_Tree_Root_Growth



Microfluidics for coral larvae propagation

Porposal for a composite device, made of microfluidic PDMS channels for the flow of larvae over large expanses of the ocean floor, and clay tiles following the blueprint of the mat and acting as a substrate for larvae to grow when released from the channels. Coral larvae can be as small as 1mm, making microfluidic channels good vessels of transportation.

View citation: https://www.researchgate.net/publication/378102189_Microfluidics_for_coral_larvae_propagation



Application Development

Dynamic web-development [Python + Flask + Jinja + HTML + CSS]

3Depot is a platform designed for the efficient and swift visualization and display of one's 3D creations, as well as for the efficient transfer and viewing of 3D objects among various users. It facilitates easy sharing and interactive visualization of 3D models, enabling seamless collaboration and exchange of 3D models between individuals.

A screenshot of a web browser window displaying the 3Depot app. The address bar shows '3depot.app'. The header features the '3Depot' logo on the left and 'Register Log In' links on the right. The main content area has a large, bold '3Depot' title. Below it is the tagline 'Your 3D models at your fingertip'. A central feature is a large, shiny, metallic sphere. At the bottom, there is a 'Register' button.

3Depot

Your 3D models at your fingertip

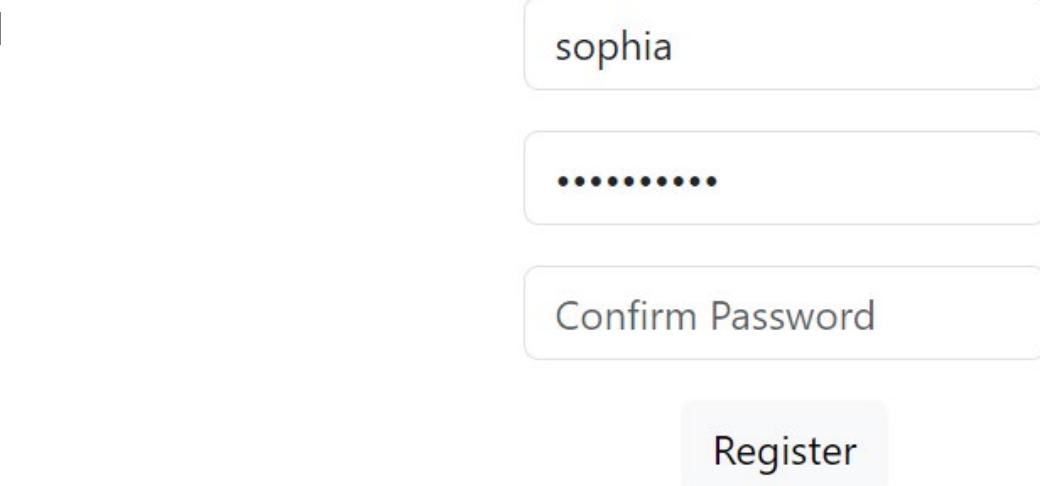
Upload, show, share, explore. 



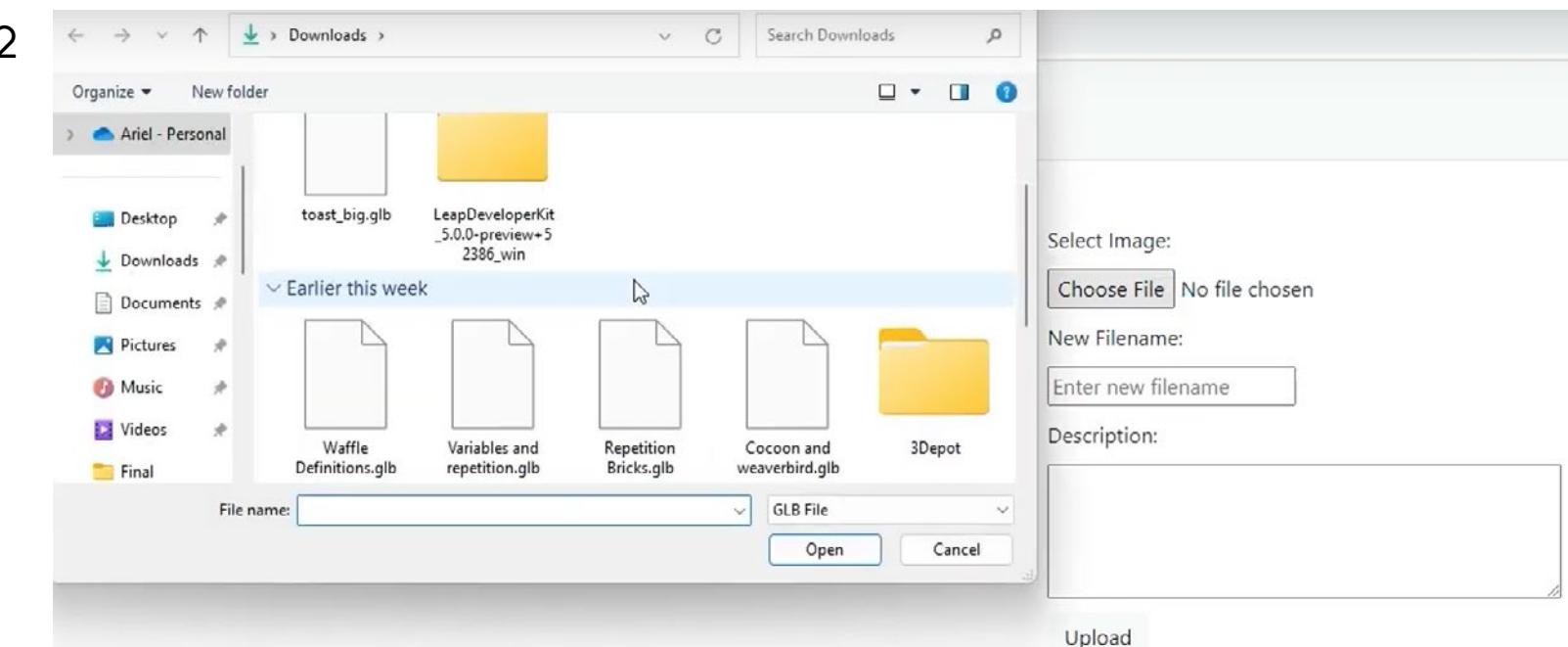
Register

Backend development

1. Set up the website's backend to store user information.



2. Develop a storage system so people can upload their 3D models and access it later.*



3. Explore Javascript features to interact with the models + 3D Model Converter Integration.



*The project employed Flask, Jinja, Python, HTML, CSS, and JavaScript, harnessing Python's capabilities to handle user data storage efficiently.

Waffle_Definitions
Description: Hello World!
Owner: Ariel
File Size: 2.9 MB

Repetition_Bricks
Description: Hello Harvard!
Owner: Sophia
File Size: 6.3 MB

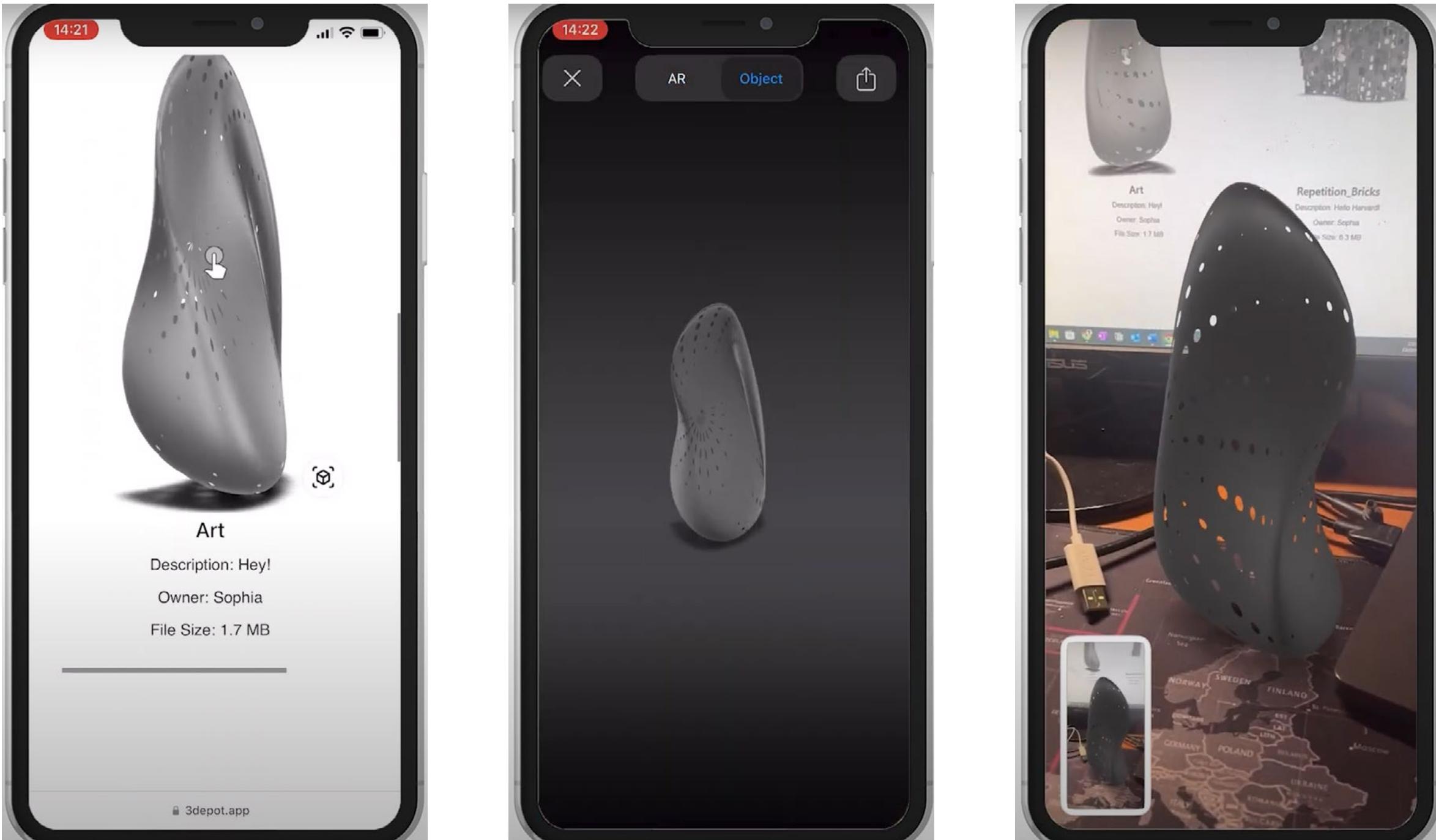
Phone App + AR integration

To see how our application works, visit:

<https://www.youtube.com/watch?v=67LJnXjonX8> Of 2021

To see my GitHub repository:

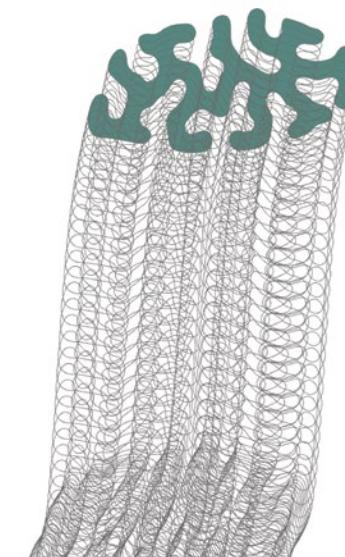
<https://github.com/soph-cabral/3depot/>



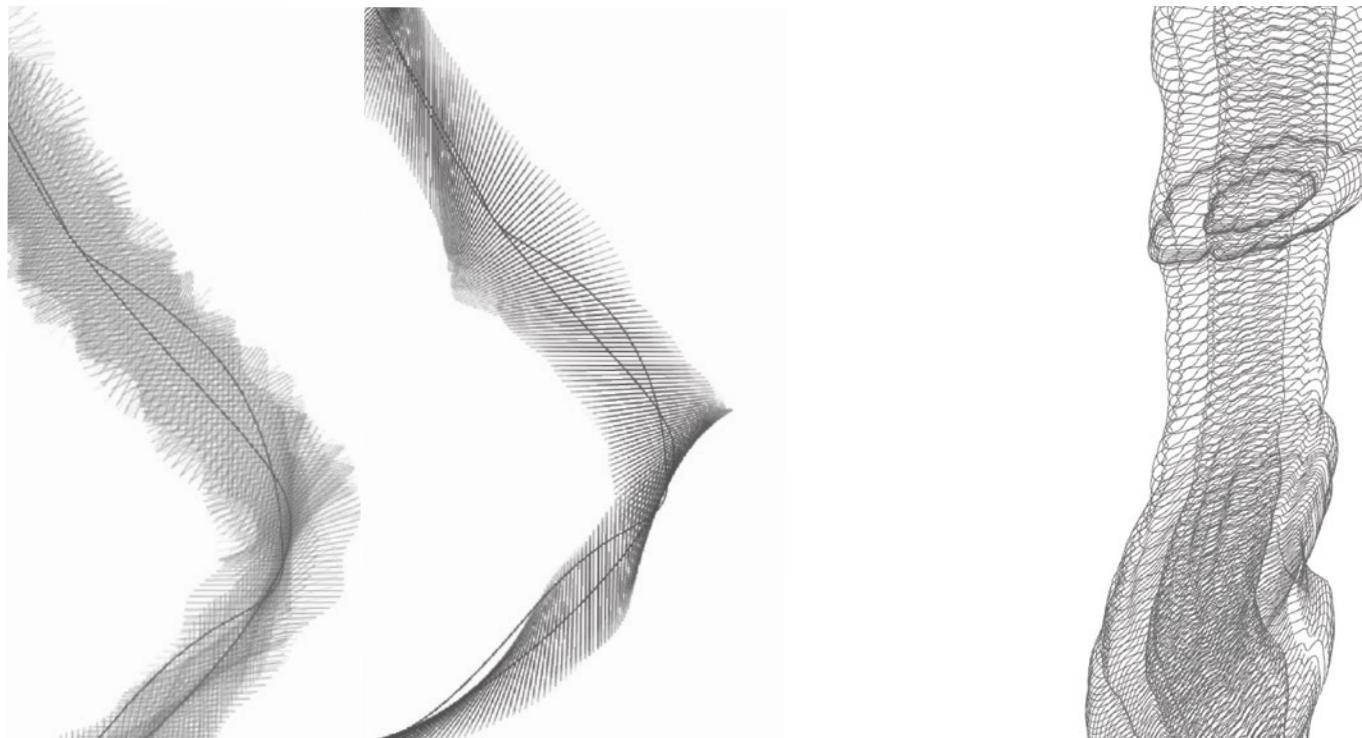
Fun things:

Clay Extrusion: Coral Cross-Sections

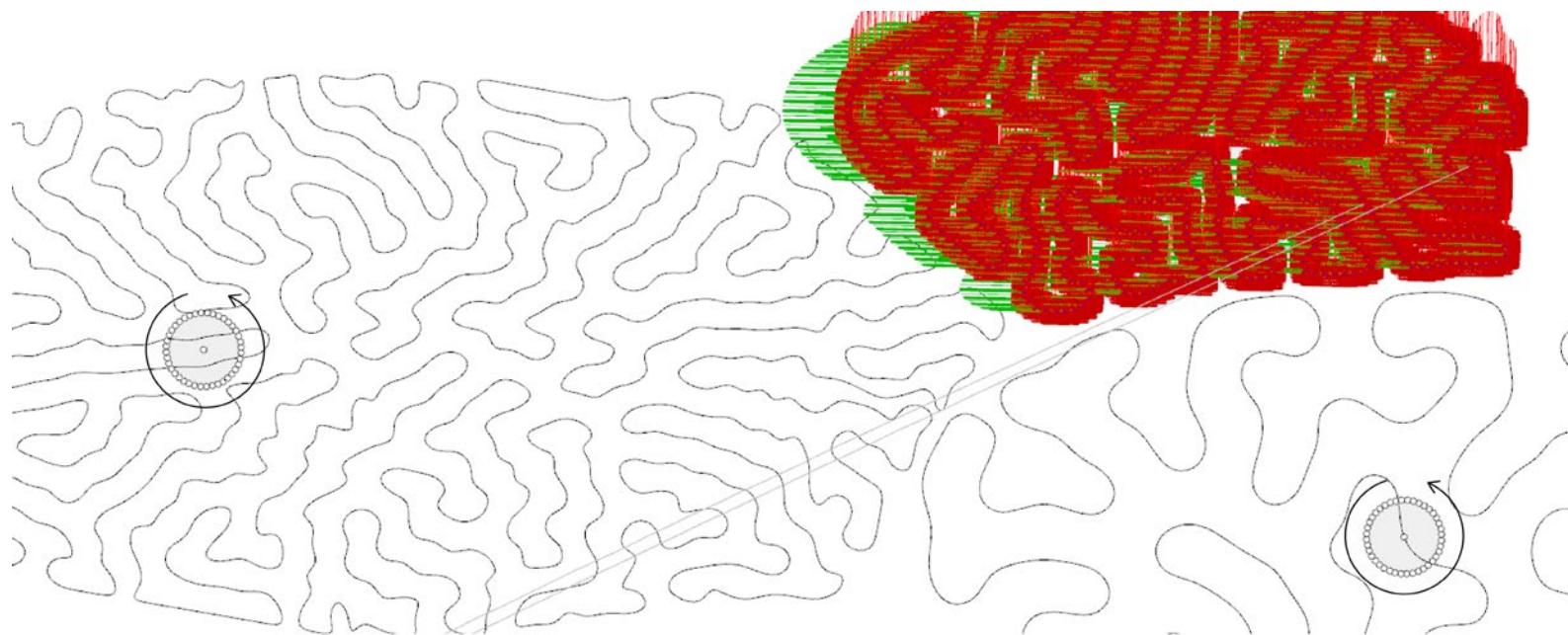
Because clay printing works with continuous motions and reaction-diffusion algorithms develop a continuous line, a clay extruder is used to test the production of the cross-sections.



< One cross-section repeated 464 times to create a continuous geometry.

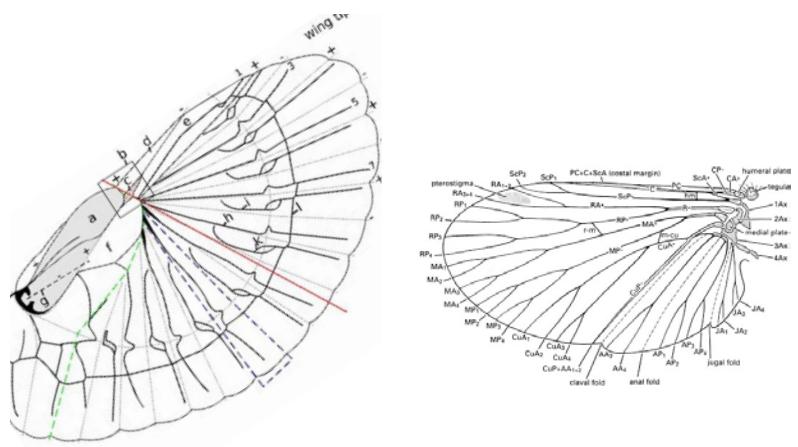


<Create 464 unique cross-sections for a dynamic geometry.



<Testing different grains to print using a reaction diffusion algorithm

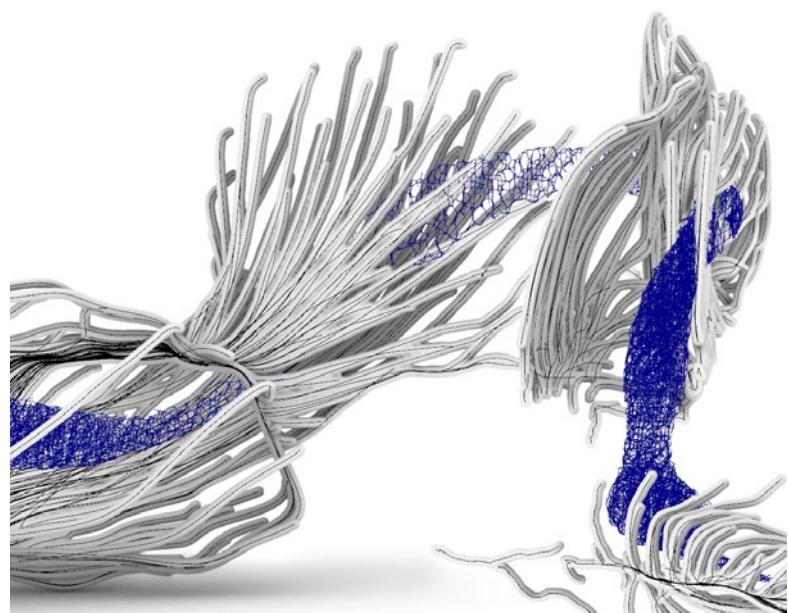
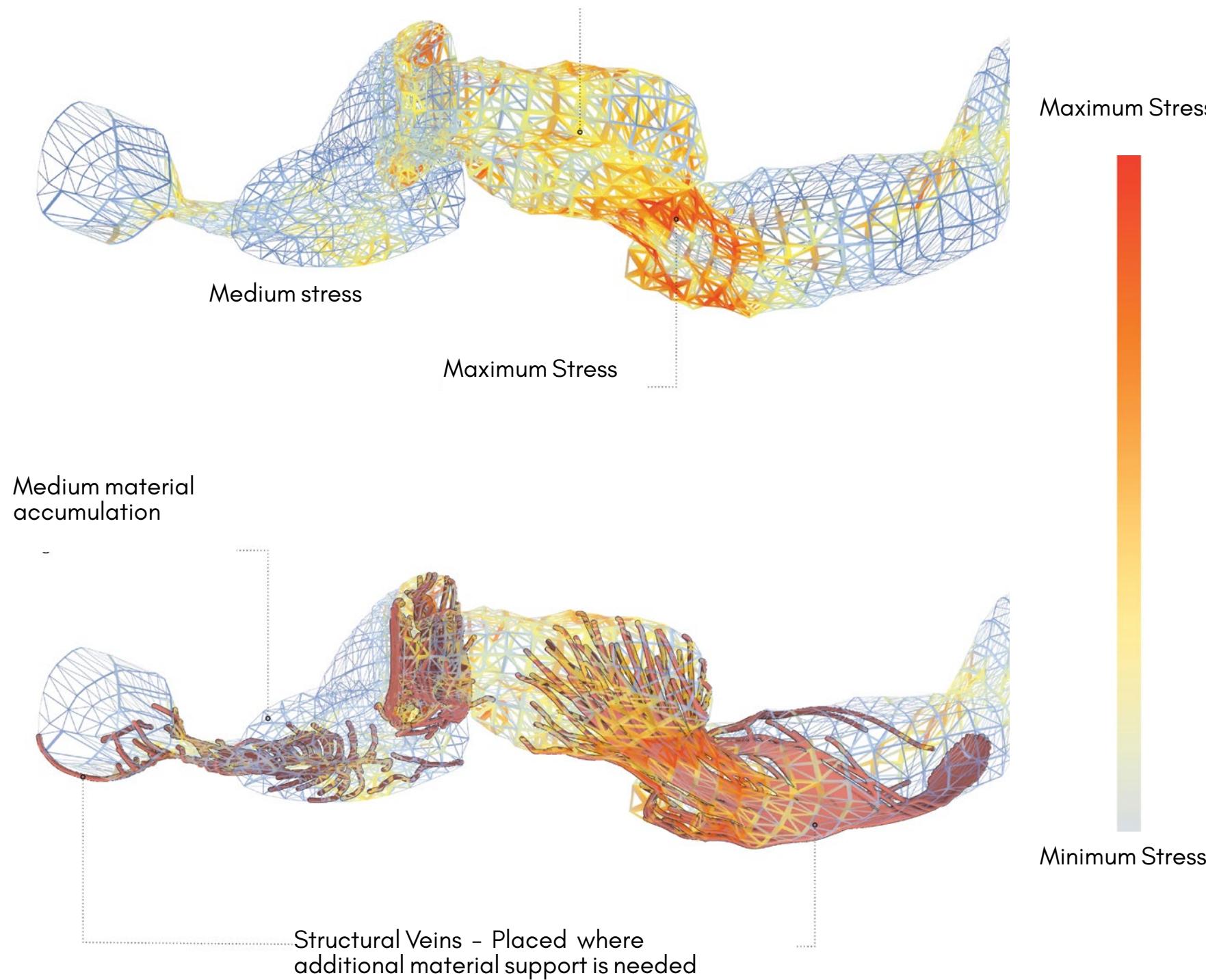




Ref Image - Earwig *Labia Minora* Wing Venation used as an inspiration for the design of the structure

Growth of Structure on Areas of Stress

Using Karamba (grasshopper plugin) to identify stress areas and using those areas as start points for a swarm simulation. The swarm simulation allows for the flow of those points to other parts of a geometry's body; the initial agglomeration diffuses as it moves further away from its start. As a result, support diminishes as it gets closer to stronger areas.



d

Images a-d:
Shows the growth of structural veins required to support compromised areas.

Responsive Surfaces: The New Public Space (Part 1)

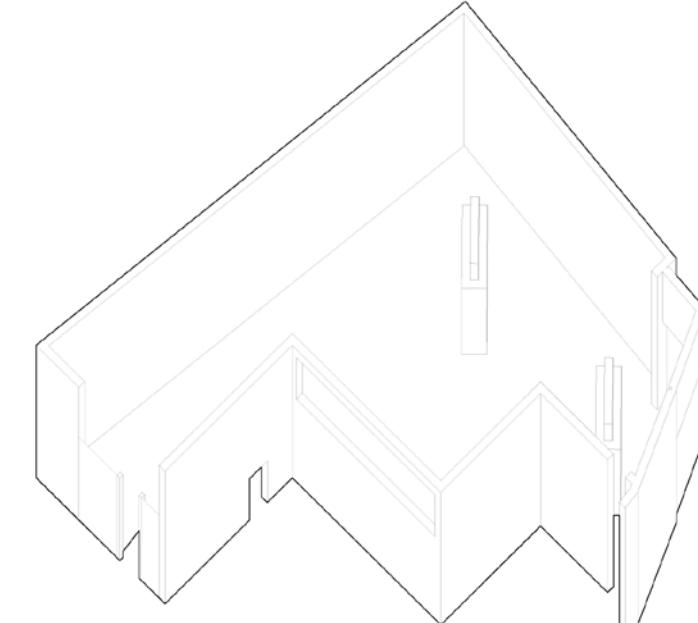
This exploration led to a one-day event at the BEA Gallery at Florida International University. The project studies the possibility of embedding responsive surfaces, either digital or non-digital, or small-scale urban interventions to improve people's engagement with each other and their environment. The additions, or interventions, were designed to stimulate the senses and increase one's awareness of what surrounds them.

Data was recorded through surveys and recording to discover what surfaces people interacted most with.



<https://www.youtube.com/watch?v=67hdZrt7G9E>

BEA GALLERY | FIU SCHOOL OF ARCHITECTURE →



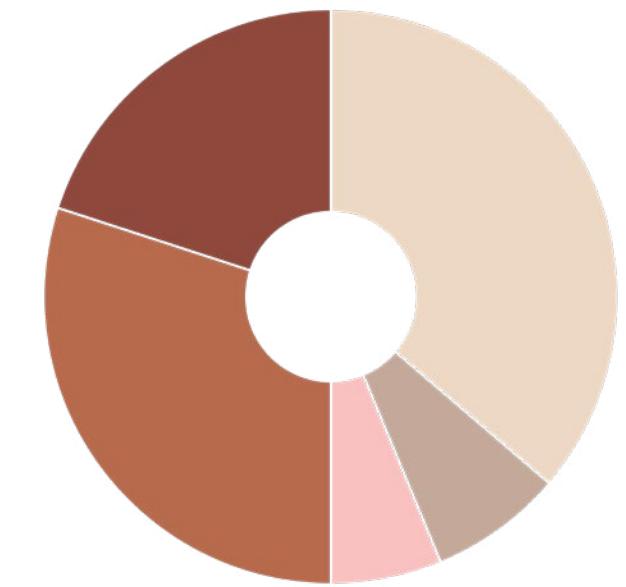
Preliminary Studies: Testing Responsive surfaces.



These photos show a projection that mirrors you and transforms your image into a digitalized self. It responds to your motions as a mirror would, but a lag allows you to view the sequence of your actions.

The New Public Space Event: (Part 2)

According to surveys, the most popular areas of the event were:



- Delayed Action on Digital Wall (DS2)
- Wooden Bench & Soft Carpets (S1+S2)
- Sound Wall (A1 + A2 + A3)
- Yarn Walls (PS1+PS2)
- Motion Detection Digital Wall (DS1)

Curated, designed and built by myself, Daniela Perez, Elmer Garcia and Hadi Alhaffar

Bench: Fabricated by Elmer Garcia for the event.

Carpets Designed and made by artist Karla Caprali for the event

● DIGITAL SCREEN
● PHYSICAL SCREEN
● SEATING
● AUDIO



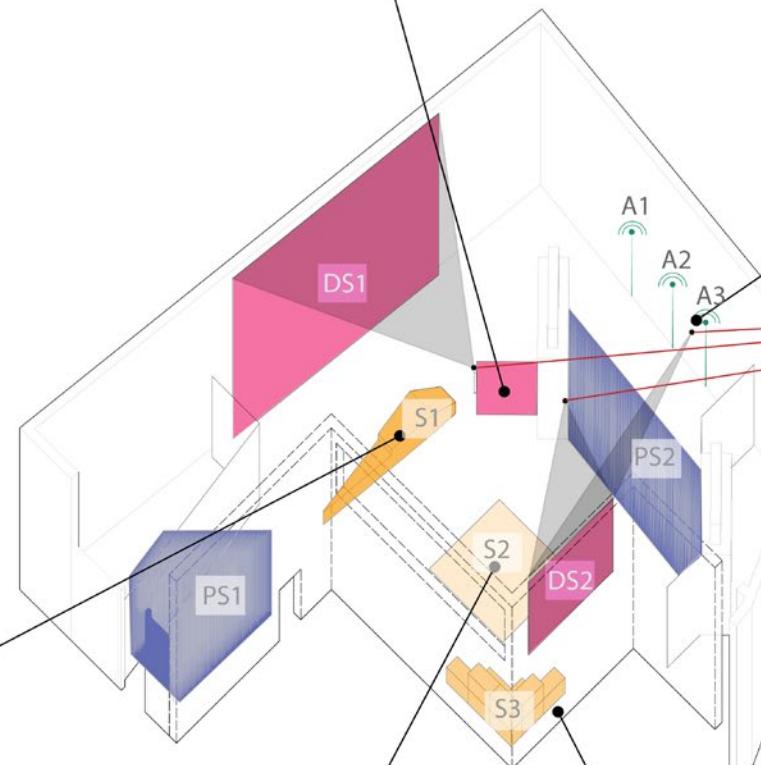
Digital Motion Responsive Wall



Height Changing Bench



Soft floor:
Textured
Carpets



Sound Wall:



Inhabitable Yarn Walls:



Carving Ceramic Tiles

Parametrically designed clay bricks carved with the aid of a 6-axis robotic arm. The bricks acquire rich textures and vary according to the end-effector/ carving tool.

Openings in the center of each brick vary to monitor the amount of light coming in. The bricks are arranged in rows [image 1] to create a dynamic light and shadow effect on the surrounding context [Image 2].

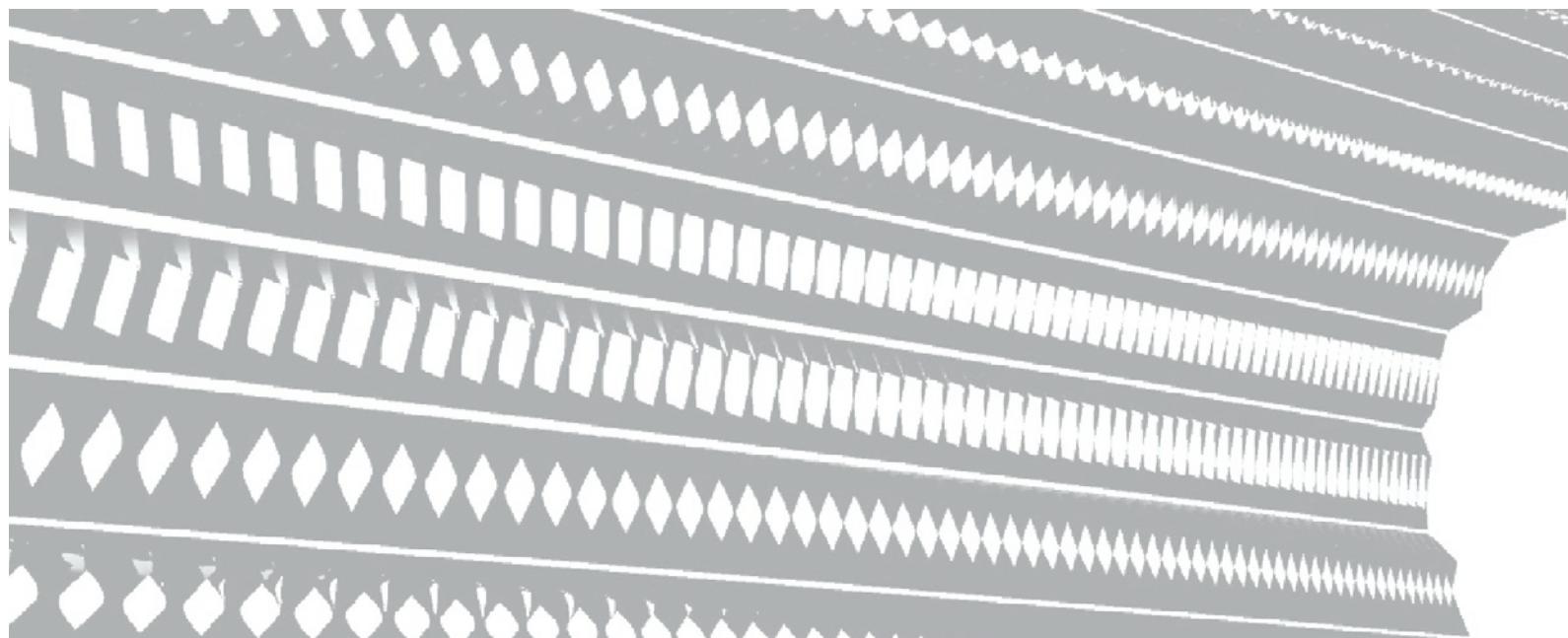


Image 1

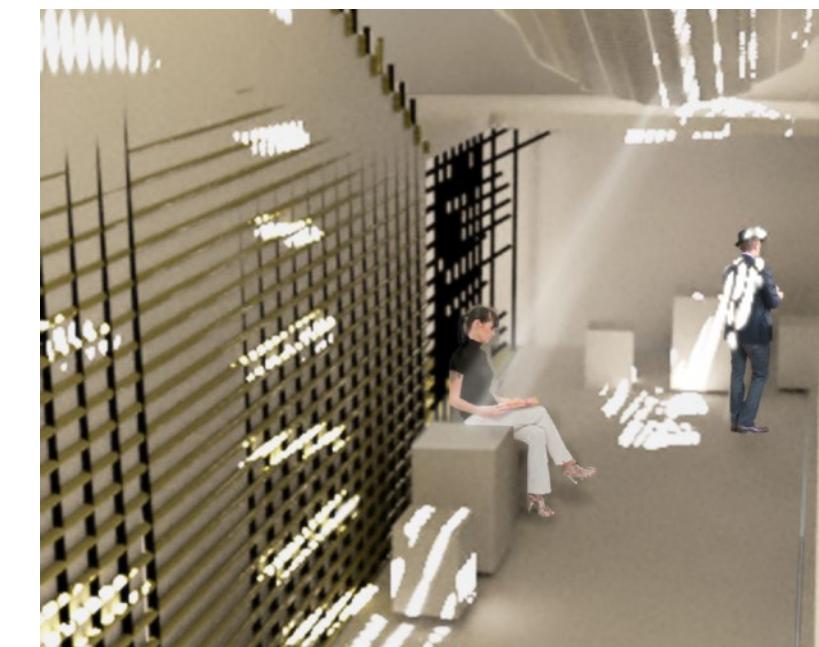
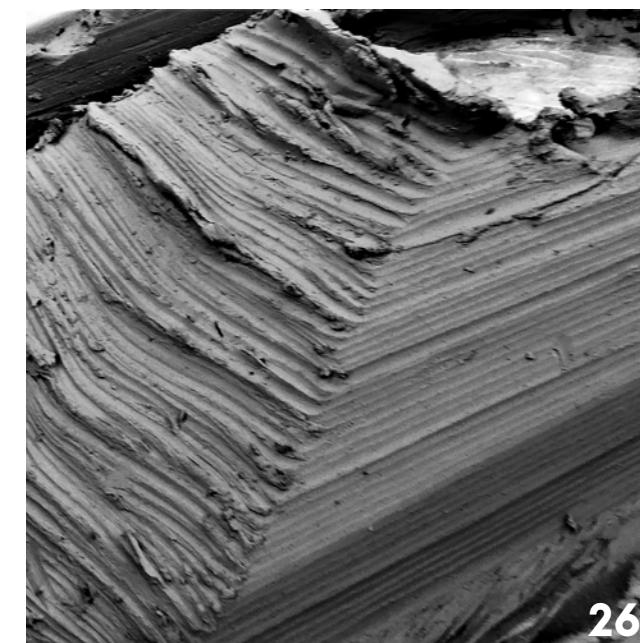
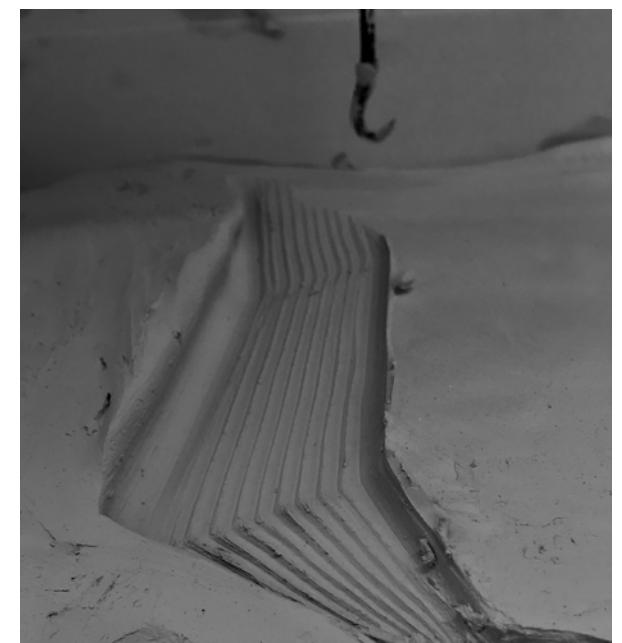
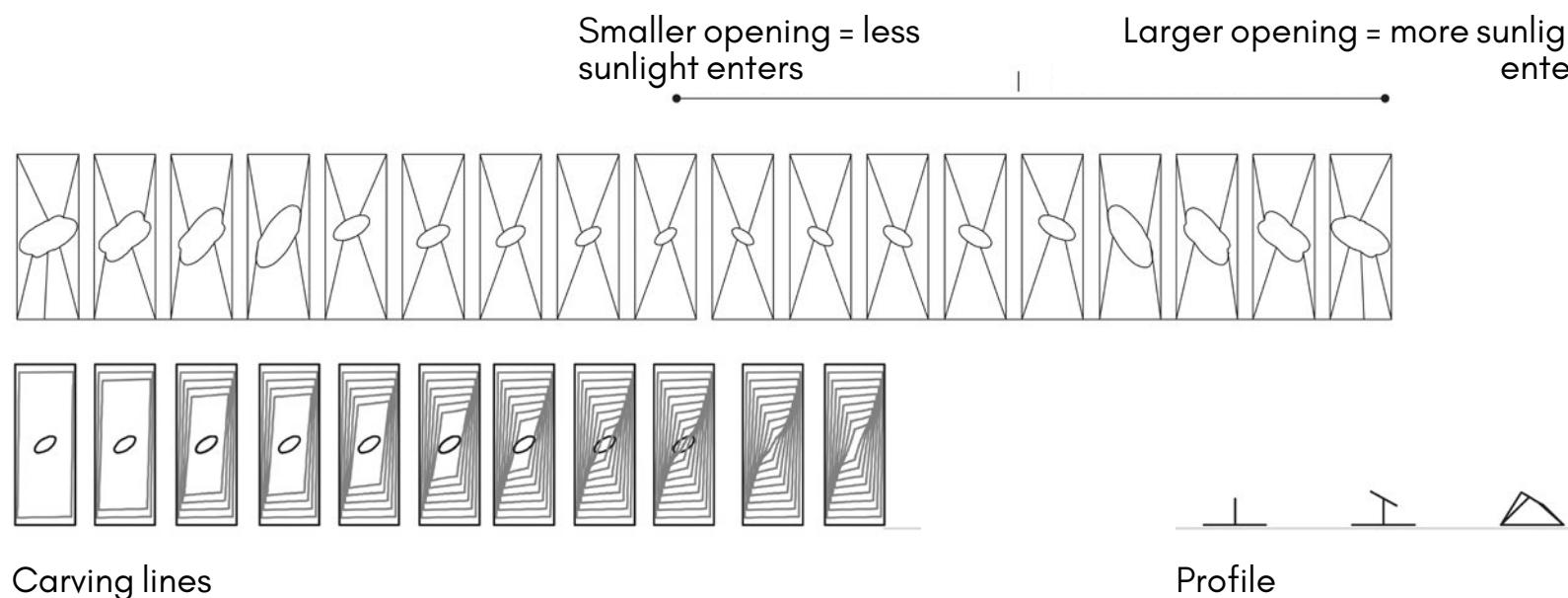


Image 2



Biophilic Household Objects



Ref Image - Precedent from my own explorations shown in previous section.

Teaching 3D printing techniques to Architecture Graduate students at Florida International University. Two the right, the student's creation are shown.

The Phases where as follow:

1. Analysis of everyday household objects such as kettles, cups, etc.
2. Learning to use Modo and Grasshopper to design objects.
3. Analysis of plants and their needs and application of this analysis into the design of household objects that sustain them.
4. Making of household objects that sustain plant life.



Lemon Balm Infuser



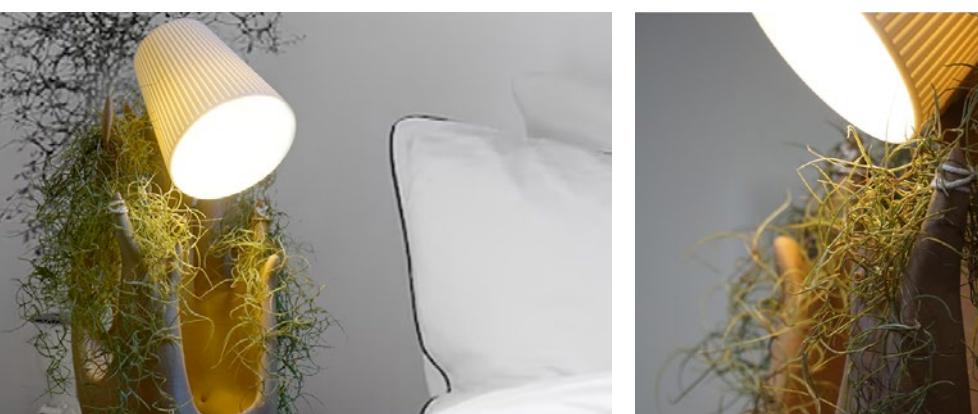
by: Natalia Castillo



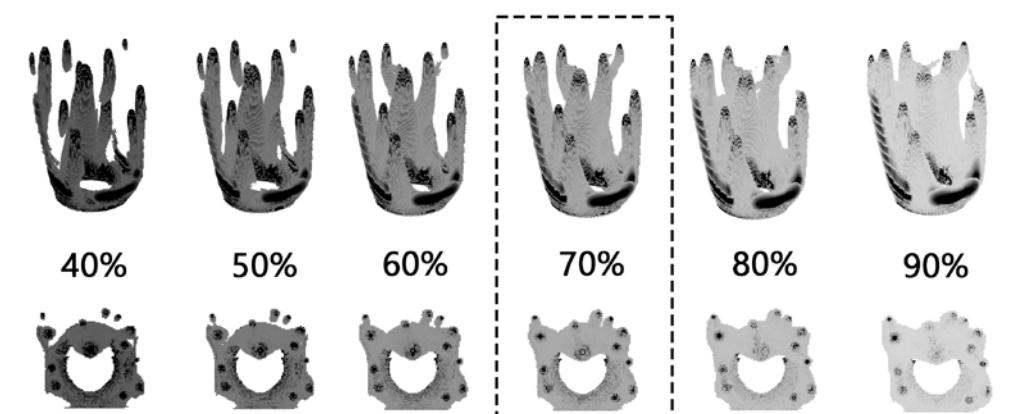
Succulent Teapot



by: Colin Mele



Spanish Moss IKEA Lamp



by: Rafael Cardero



Other Prototypes

End.