



KAIWA

Taylor Scallon
INDD 302, Biomaterials Studio

TABLE OF CONTENTS

The Problem	03	Design With Memory	20
Opportunity Statement	05	Target Audience	21
Inspiration	06	Exploration	22
Existing Market	07	1/4 Scale Models	23
Material Development	08	Coffee Seat	24
Material Exploration Recipes	09	Metal Structure	25
Successful Recipes	13	Orange Coating	26
Ingredient Exploration	14	Challenges	27
Material Data Testing	15	About the Chair	28
Utilizing Artificial Intelligence	16	Future Steps	29
Concept Development	17	Final Model Photos	30
Introducing Kaiva	19		

THE PROBLEM

Most furniture produced today is made of wood, metal, or chemically treated textiles.

In regard to manufacturing, these materials are not infinitely renewable, and other realms of materials need to eventually be explored.

Each year, Americans throw out more than 12 million tons of furniture.*

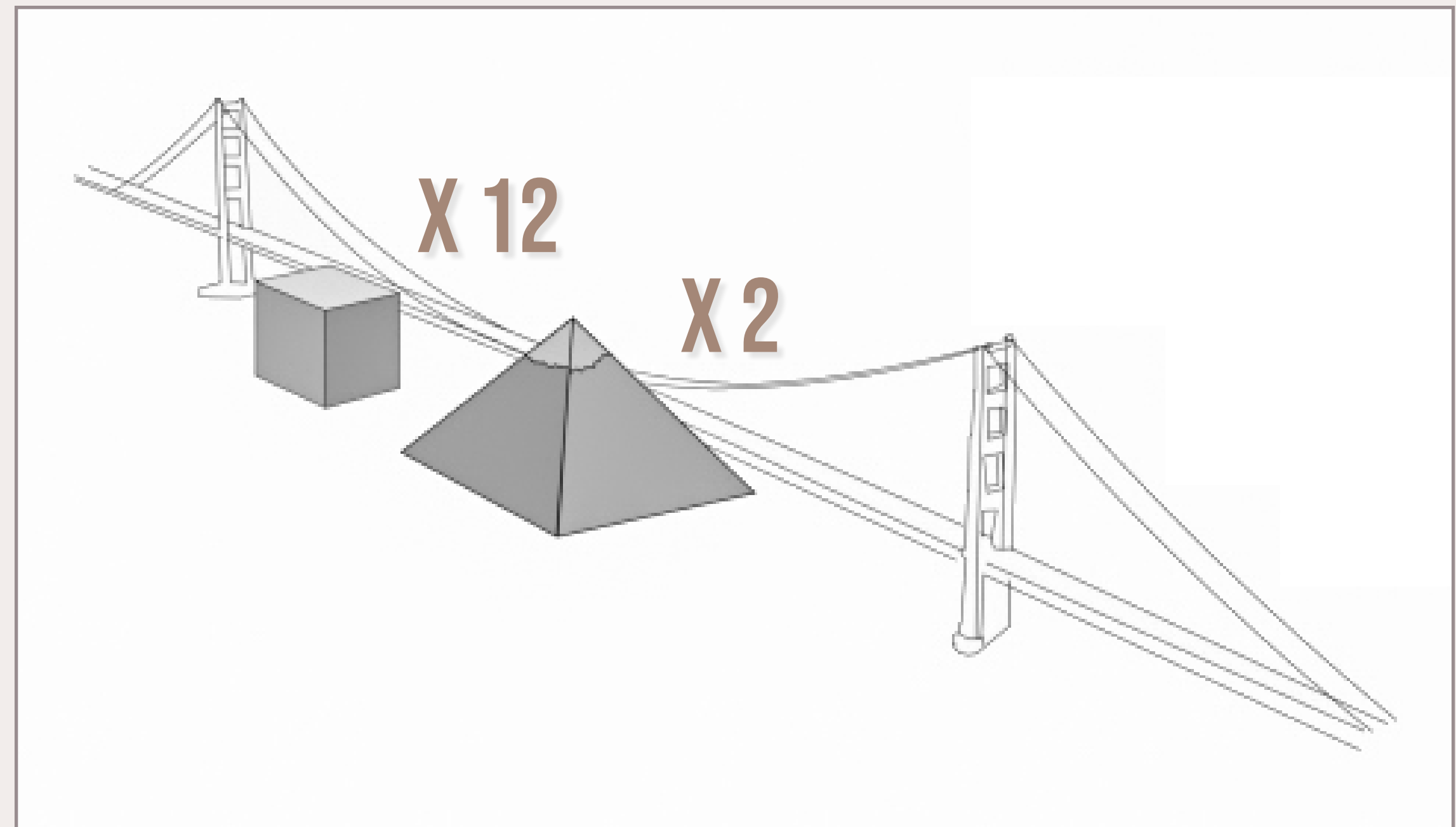


THE FURNITURE WASTE ISSUE IS MUCH LARGER THAN ONE MAY SUSPECT.

Visualizing what 12 million tons looks like:

For reference, a million-ton cube shown in relation to the Golden Gate bridge which measures eight-tenths of a mile between the two towers.

The Great Pyramid, weighing about 6 million tons, is also shown here for scale.



Graphic: ESVA.net

The background of the slide features a close-up, artistic photograph of orange peels and coffee grounds. The peels are bright orange with visible white pith and are scattered across the frame. The coffee grounds are a light brown color and are also scattered, some appearing to be on top of the peels. The overall lighting is soft and warm, creating a natural and organic feel.

THERE IS AN OPPORTUNITY TO...
CREATE SUSTAINABLE FURNITURE SOLUTIONS BY PRIMARILY
USING NATURAL BYPRODUCTS FROM FOOD INDUSTRIES, SUCH AS
USED COFFEE GROUNDS AND ORANGE PEELS.

INSPIRATION



Nontalo Kids Chair
By Eneris Collective

Olive Pits



Decafé Koji S
By Raúl Laurí

Coffee Grounds



Organico

By Philipp Crass

Hemp-Based Materials

EXISTING MARKET

The use of biomaterials in general is on the rise, but especially in the world of design. Designers also have been creating furniture from biomaterials made of plastic alternatives, fruit leather, upcycled materials, food waste, etc. Although the existing market is full of unique products made from organic materials, it is still a very niche market.

Furniture styles are always changing with a new trend constantly right around the corner. Because Kaiva is not a piece that will last forever, it will purposefully breakdown over time, leaving room for new trends to be incorporated into the use of biomaterials.



Sources: Material Source, Wired, Frame, The Index Project

MATERIAL DEVELOPMENT

MATERIALS

Orange peels, saw dust, eggshells, coffee grounds, and cork.



SUCCESSSES

- Solidified samples
- Strong & durable
- Added burlap



FAILURES

- Lots of warping
- Left = too brittle
- Right = too flexible



MATERIAL EXPLORATION RECIPES

COMPOSITE #1: ORANGE PEELS

WATER	.24 CUPS
PROPYLENE GLYCOL	5 GRAMS
CORNSTARCH	10.5 GRAMS
ORANGE PEELS (DICED)	2 TABLESPOONS

Notes:

Jelly consistency. Does not hold together; needs a stronger bond.

Put in the dehydrator; solidified quickly, but was too brittle.

Suggestions:

Cut oranges into smaller pieces. Replace glycol with glycerin.

Leave on stove for longer. Use a fan to dehydrate at a slower rate.



COMPOSITE #2: SAW DUST

ORANGE PEELS (DICED)	1/8 CUP
SAW DUST (MISC WOODS)	1/8 CUP
CORNSTARCH	1/4 CUP
WATER	1/4 CUP

Notes:

Very thick consistency. Solidified quickly on the stove. Very brittle after drying.

Dehydrating make the mixture more solidified.

Suggestions:

Try dehydrating next time. The orange peels did not feel purposeful. Add agar agar once more after heating. Add beef gelatin to the mixture to extra strength.



MATERIAL EXPLORATION RECIPES

COMPOSITE #3: COFFEE GROUNDS

COFFEE GROUNDS	.25 CUP
CORNSTARCH	2 TABLESPOONS
AGAR AGAR	1.2 TABLESPOONS
PROPYLENE GLYCOL	2.2 TEASPOONS
WHITE VINEGAR	2.2 TEASPOONS
WATER	6.75 TABLESPOONS

Notes:

Solidifies quickly. Put in the dehydrator; the thin piece was brittle and the thick piece was solid.

Suggestions:

Add agar agar once more after heating on the stove. Add beef gelatin to the mixture.



COMPOSITE #4: COFFEE GROUNDS

COFFEE GROUNDS	1/4 CUP
SODIUM ALGINATE	1/2 TEASPOON
AGAR AGAR	1/2 TABLESPOON
VEGETABLE GLYCERIN	1/2 TEASPOON
WATER	1/2 CUP

Notes:

Three samples: (1) Recipe mixture (2) Added beef gelatin (3) Dehydrated.

A jelly-like paste at first. After air-drying for three days, the samples hardened and warped.

Added 1 TBSP of beef gelatin and 2 TBSP of water to 1/4 of the mixture.



MATERIAL EXPLORATION RECIPES

COMPOSITE #5: EGGSHELLS

WATER	3.4 TABLESPOONS
EGGSHELLS	1/3 CUP
BEEF GELATIN	1.6 TABLESPOONS
VEGETABLE GLYCERIN	1 TABLESPOON

Notes:

Smells terrible. No major differences between the air-dried and dehydrated samples. They are still slightly malleable after drying.



COMPOSITE #6: ORANGE PEELS

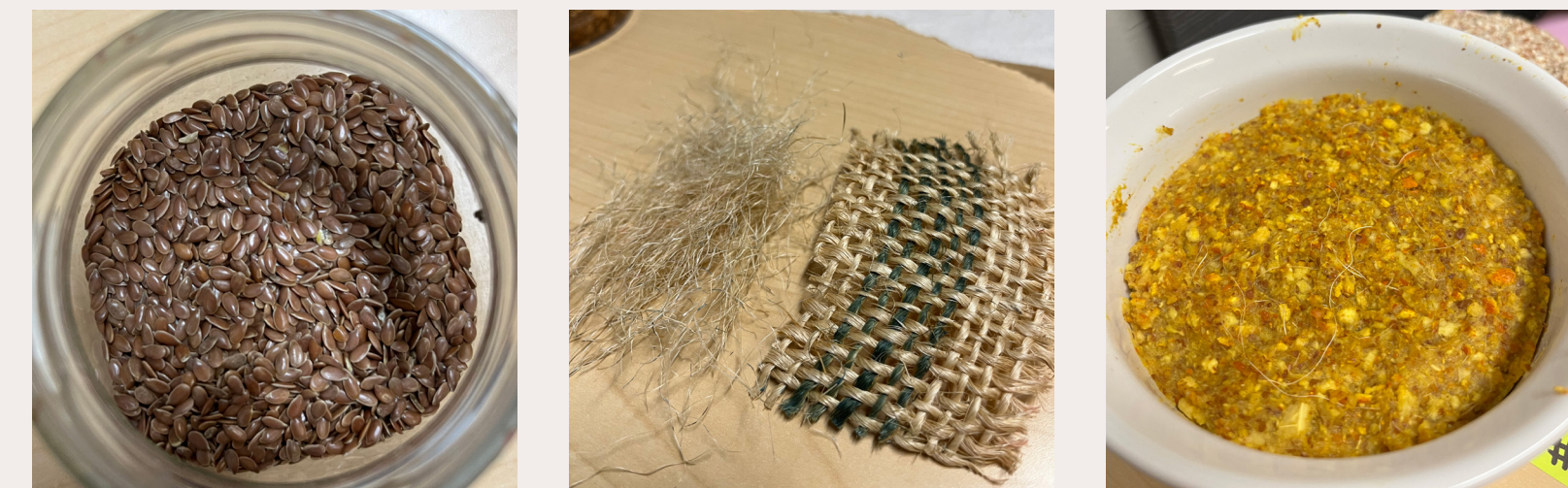
GROUND FLAXSEEDS	1/8 CUP
CORNSTARCH	1/8 CUP
VINEGAR	0.75 TABLESPOON
BURLAP FIBERS	AS NEEDED
ORANGE PEELS	1 CUP
WATER	3/4 CUP

Notes:

After creating this composite, I added 1 TBSP of agar agar and 1/4 cup of water to half of the remaining mixture, which created the thickest sample yet.

Suggestion:

Add more burlap fibers.



MATERIAL EXPLORATION RECIPES

COMPOSITE #7: CORK

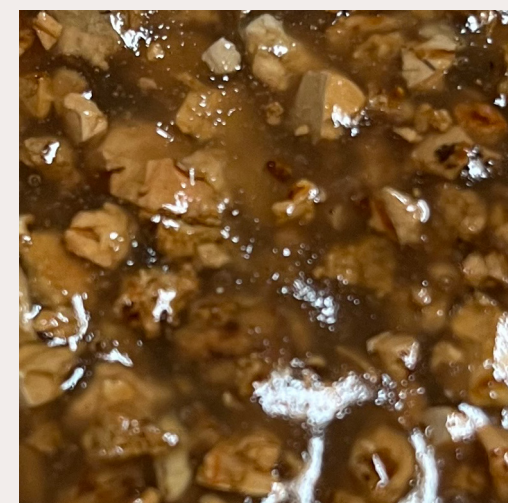
AGAR AGAR	1/2 TABLESPOON
VEGETABLE GLYCERIN	1/2 TEASPOON
WATER	1/2 CUP
CORNSTARCH	1/2 TABLESPOON
CORK	1/4 CUP

Notes: Transformed from a liquid consistency to a jelly material very quickly.

The most visually appealing sample.

Suggestions:

Add more cork to the mixture.



Although these seven material exploration recipes may not have worked out as desired, creating these composites taught me more about the ingredients being used, how they act under specific circumstances, what works well, what does not work well, and what kind of techniques work better than others.

SUCCESSFUL RECIPES

ORANGE PEEL COMPOSITE

ORANGE PEELS	5 TABLESPOONS
AGAR AGAR	2 TABLESPOONS
VEGETABLE GLYCERIN	1 TEASPOON
CORNSTARCH	2 TABLESPOONS
WATER	1/2 CUP + 1 TABLESPOON
BEEF GELATIN	1.5 TABLESPOONS
TURMERIC POWDER	AS NEEDED



Notes:

The oranges were collected from Hy-Vee Market Grille. The orange peels are cut into small pieces and dehydrated for two to three hours. Once dried, this composite can be sanded and sealed.

Mix ingredients. Heat on the stove. Air dry.

COFFEE GROUNDS COMPOSITE

COFFEE GROUNDS	1/4 CUP
SODIUM ALGINATE	1/2 TEASPOON
AGAR AGAR	1/2 TABLESPOON
VEGETABLE GLYCERIN	1/2 TEASPOON
WATER	1 CUP
BEEF GELATIN	4 TABLESPOONS



Notes:

The used coffee grounds were collected from Bookends Café. They were dehydrated for three to four hours. Once dried, this composite can be lightly sanded and sealed.

Mix ingredients. Heat on the stove. Air dry.

INGREDIENT EXPLORATION

Coffee Grounds & Beef Gelatin



Xanthan Gum



Kappa Carrageenan



COMPOSITE DATA

Coffee & Orange Composites:

- Little to no odor
- Expands in water, does not dissolve
- Not electrically conductive
- Self-extinguishing and nonflammable

VEGAN INGREDIENTS

Although creating a 100% vegan product would have been favorable, after testing four different vegan alternatives, beef gelatin was still the best ingredient to use for the final product.



Orange Peels & Beef Gelatin



Unflavored Gelatin



Guar Gum

MATERIAL DATA TESTING

ORANGE PEEL COMPOSITE

Sample Dimensions: 2.25in x 2.4in x 0.25in (16 grams)

Mohs Hardness Scale: 3.5 Mohs

Shore Value (strength/hardness): 80 HD

Flammable: self-extinguishing, nonflammable

Electrical Conductivity: no

Transparency: no

Odor: none

Water Solubility: Does not dissolve, but rather expands and weakens.

Sustainability Tags: biodegradable, made from food waste

COFFEE GROUNDS COMPOSITE

Sample Dimensions: 2.1in x 0.75in x 0.2in (11 grams)

Mohs Hardness Scale: 6.5 Mohs

Shore Value (strength/hardness): 75 HD

Flammable: self-extinguishing, nonflammable

Electrical Conductivity: no

Transparency: no

Odor: faint coffee smell

Water Solubility: Does not dissolve, but rather expands and weakens.

Sustainability Tags: biodegradable, made from food waste

UTILIZING ARTIFICIAL INTELLIGENCE

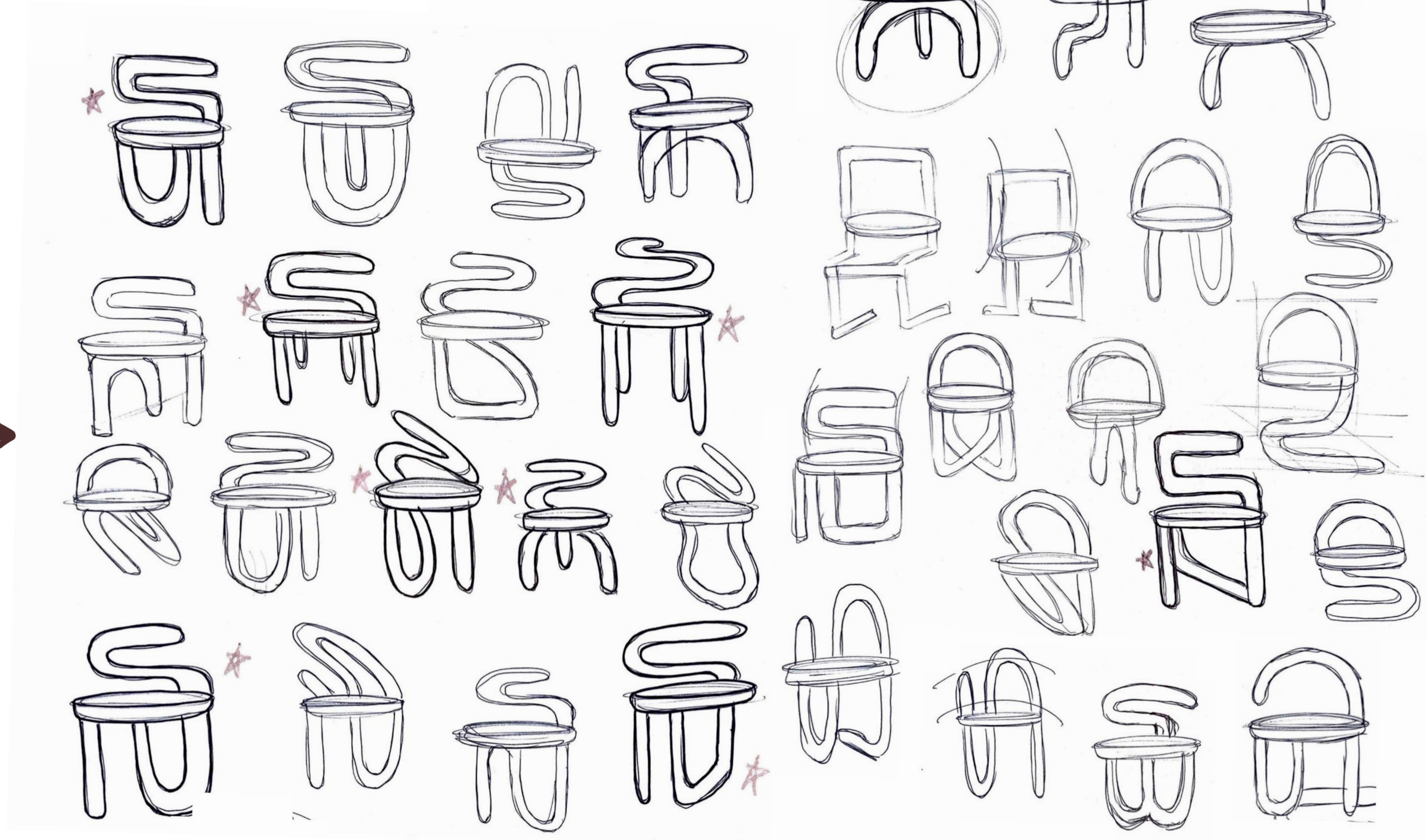
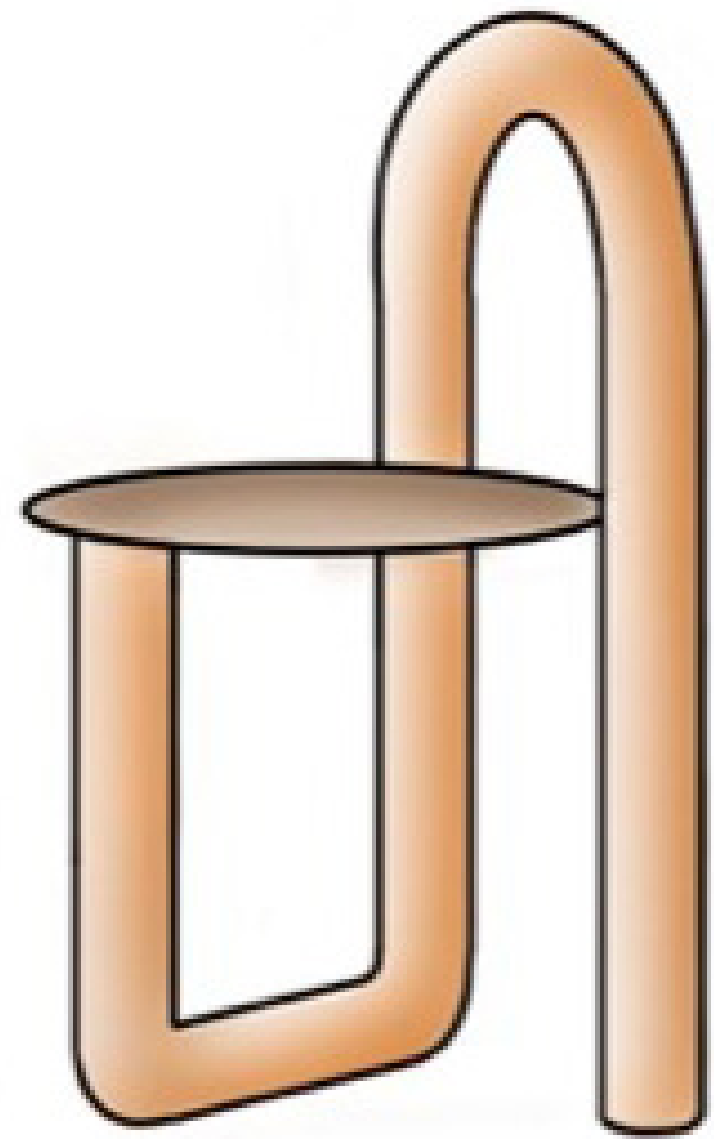
Consulting
Midjourney
for concept
inspiration about
modern furniture
design.



CONCEPT DEVELOPMENT



CONCEPT DEVELOPMENT



KAIIVA.

Kaiva is a unique furniture solution that utilizes coffee grounds and orange peels to create durable biocomposites.

Rather than these byproducts getting discarded after consumption, I see them as a valuable resource, if used properly.

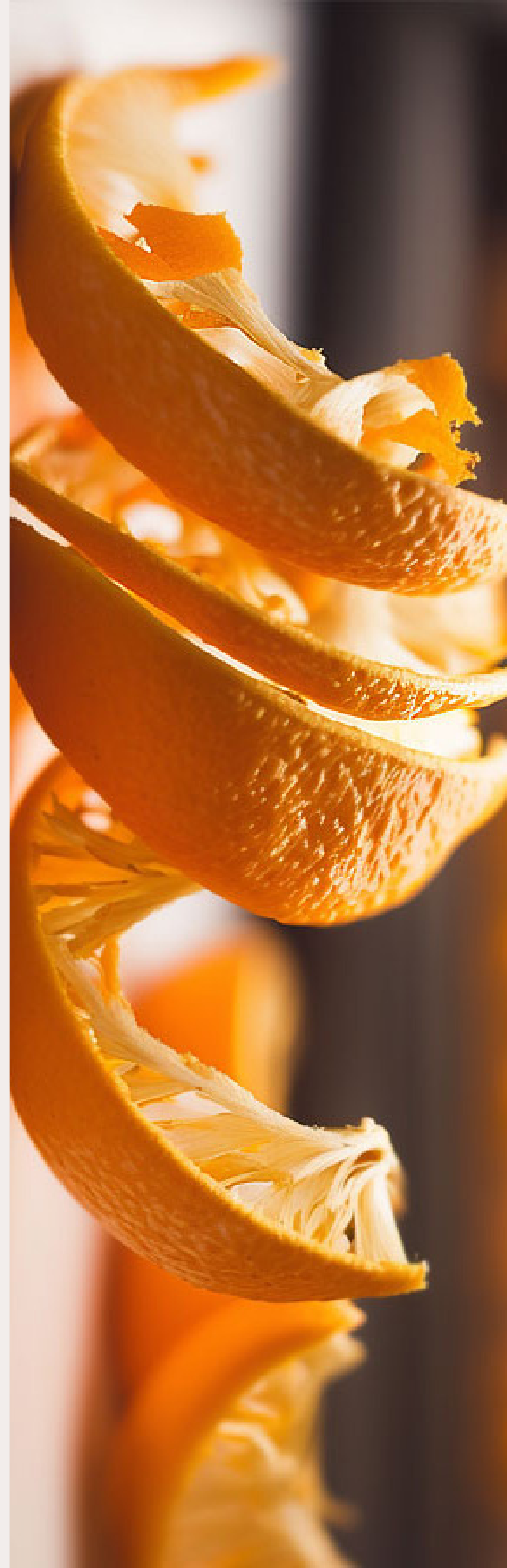
Kahvi = Finnish. Kiva = Turkish.



DESIGN WITH MEMORY

Kaiva embodies the concept of design with memory in an unpredictable way:

Consumers use their experiences and memory to recognize that food waste belongs in the trash. Kaiva reverses this preconceived notion and creates value out of something that is initially deemed to have lower value.





TARGET AUDIENCE

Kaiva was designed with both commercial and residential users and environments in mind.

This product is not limited to one specific audience, but rather is meant for someone who prioritizes limiting their waste and carbon footprint, values sustainability, and has an eclectic style.

Kaiva is a partially-biodegradable product, which means the entire seat and orange coating will eventually break down. At this point, the internal metal structure will remain and can be recycled.

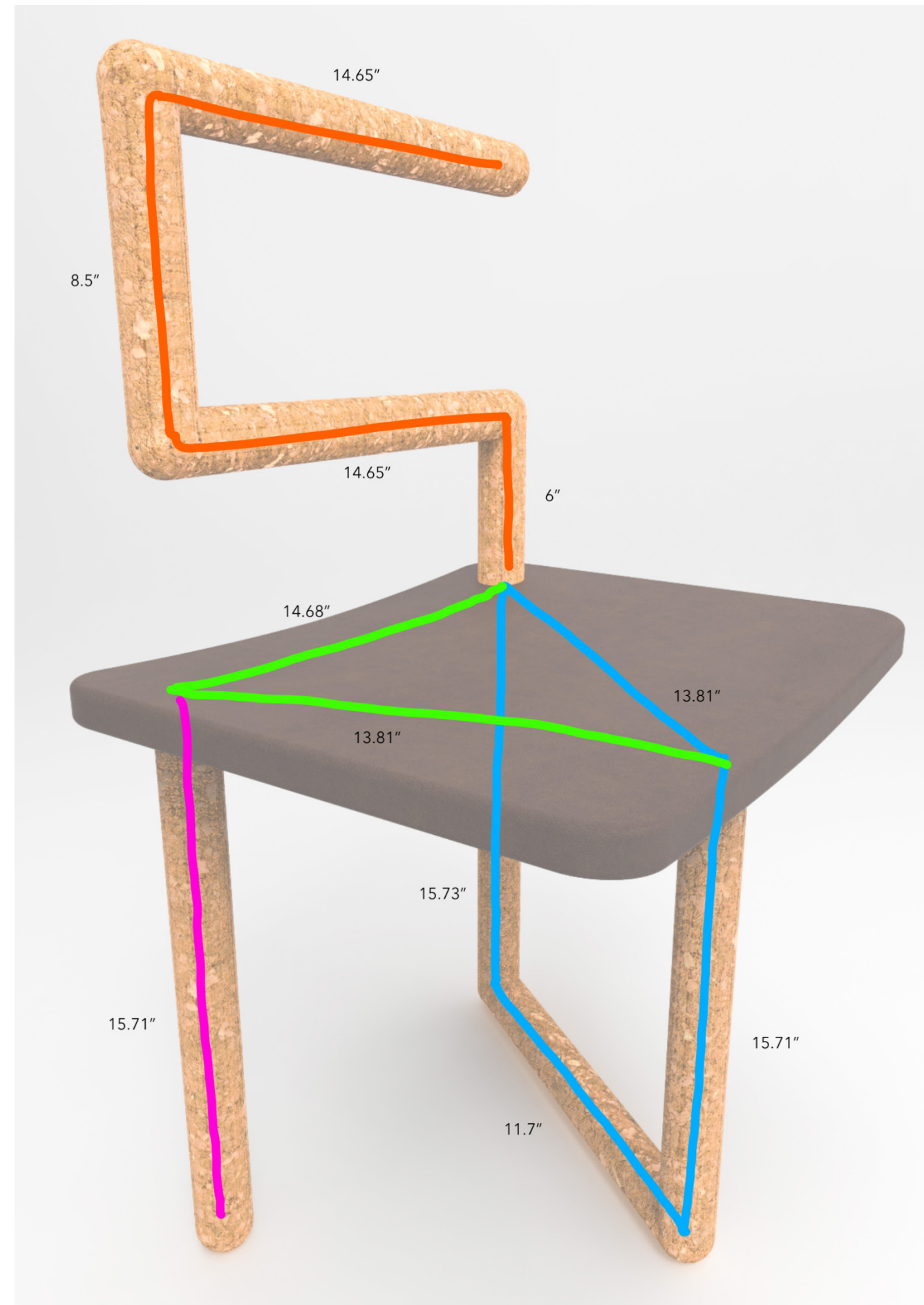
EXPLORATION



The original process of prepping the orange peels was to dehydrate the peels first, then chop, and blend them together to make a powder. This process was not ideal because the peels were hard to chop after dehydration and a less powdery mixture was preferred.



The final design included cylindrical elements, so a PVC pipe was cut in half to act as a mold. This method did not work well because the mixture did not dry to fit the exterior shape.



These measurements drawn over the concept were to show the original lengths of the piece. I originally planned for four different pieces (represented as a different colors) to be bent, then welded together.



I originally wanted to make a seat that had an element of detail or a detailed pattern. I 3D printed a pattern, created a mold box around it, and poured the mixture. Some detail was reflected in the mixture, but I ended up wanting to just make a smooth seat.



I 3D printed the chair to gain a better sense of how the pieces connected.

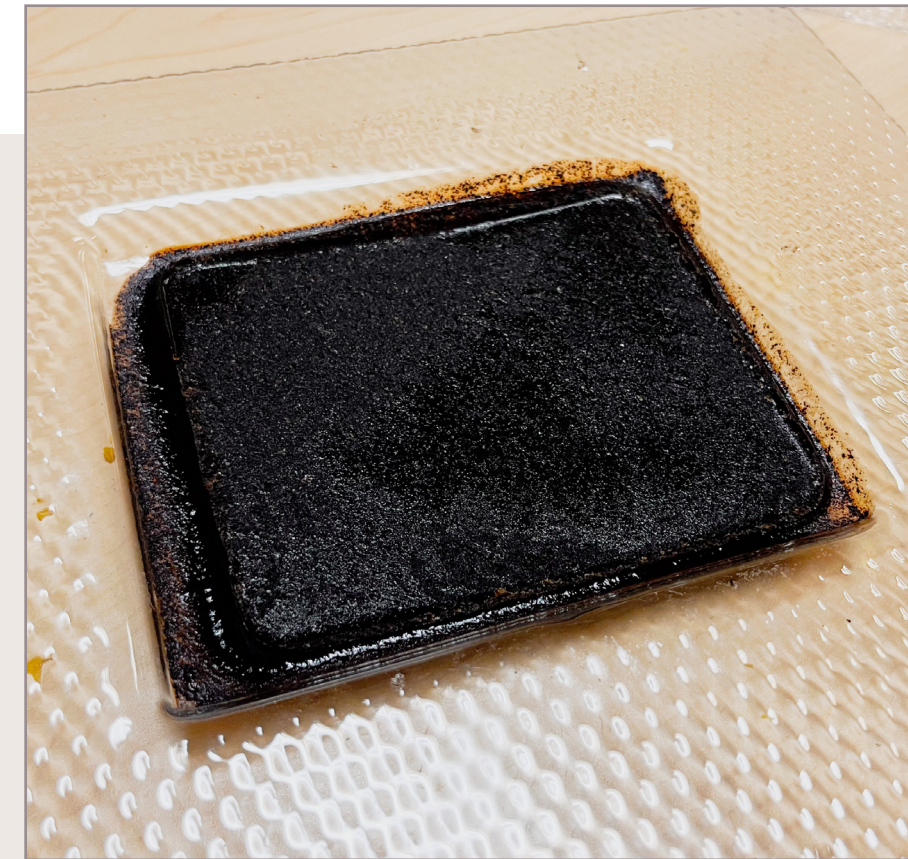


Testing how the orange composite would form on the metal conduit was an essential step.



After welding, the final chair was proven to hold human weight.

1/4 SCALE MODELS THE FABRICATION PROCESS

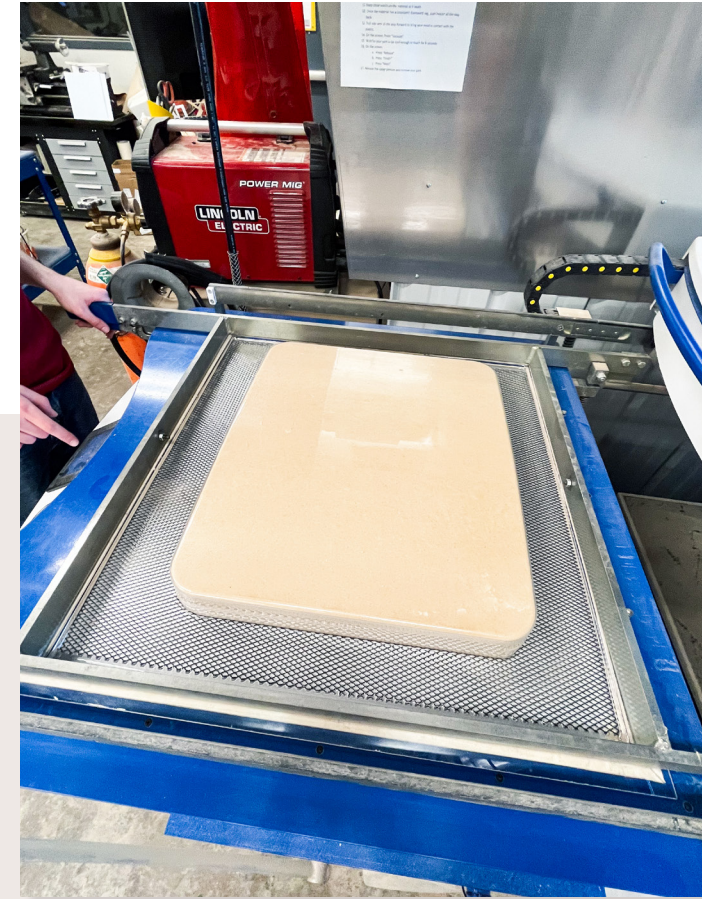


- (1) Bend the wire frame by hand
- (2) Sand the frame where welding is needed
- (3) Weld the joints together
- (4) Shape orange composite around the frame
- (5) Once dried, sand the composite
- (6) CNC the seat mold
- (7) Vacuum form the seat mold
- (8) Pour the coffee composite in the mold
- (9) Once solidified, dehydrate the coffee composite around the seat mold
- (10) Attach all pieces together
- (11) Apply beeswax to the materials

COFFEE SEAT THE FABRICATION PROCESS



CNC Seat Mold



Vacuum Form Top/Bottom



Dehydrate Coffee Grounds



Mix Composite Ingredients



Pour Coffee in Mold Tray



Continue Layering & Let Dry



Cut Seat with Handsaw



Apply Beeswax Coating

METAL STRUCTURE THE FABRICATION PROCESS



Weld 1st Prototype Pieces



Assemble 1st Prototype



Measure the Dimensions



Cut with Miter Saw



Use Drill Press for Joints



Sand Down the Joints



Bend Back Legs to 95 °



Weld the Pieces Together

ORANGE COATING THE FABRICATION PROCESS



Remove Orange Remains



Cut Orange Peels



Dehydrate Orange Peels



Mix Composite Ingredients



Shape Around Metal



Apply More Layers



Sand the Coating



Apply Beeswax Coating



CHALLENGES

- (1) Any size of coffee sample that I made warped in some way.
Small model: wrapped in a mesh screen while in the dehydrator.
Large model: used more weight and used the fan to dry.
- (2) The internal metal structure was difficult to connect with screws.
I learned to weld, which increased the strength of this structure.
- (3) Not only did the coffee warp, it also shrunk when drying.
I made the final CNC mold larger to account for this shrinkage.
- (4) A thicker seat with higher durability was desired.
Stands of burlap and bamboo dowels were used on the inside.

ABOUT THE CHAIR

The orange composite uses turmeric powder to brighten the orange pigment, but other natural dyes that could be used include powders from madder, marigolds, lac, pomegranates, chestnuts, walnuts, safflower, etc.

Approximately seven batches of the orange composite and fourteen batches of the coffee composite were used for all three final models.

Dehydrating the orange peels and coffee grounds prevents mold from forming on the composite.



FUTURE STEPS

The future steps to elevate this product will focus on revising specific problem areas and refining the processes that are used to create it.

(1) The warping of the coffee seat is the largest issue that needs to be addressed further and the composite needs to be refined in order to prevent this.

(2) The chair back needs to be refined more to be comfortable to lean back in.

(3) The branding and marketing of this project need to be developed further.

(4) I would like to expand this project to be part of a larger collection of other furniture pieces such as a side table, a coffee table, and other iterations of similar chairs.





THANK YOU!