Nature Nova

Designed by Faith Arnett and
Olivia Bates

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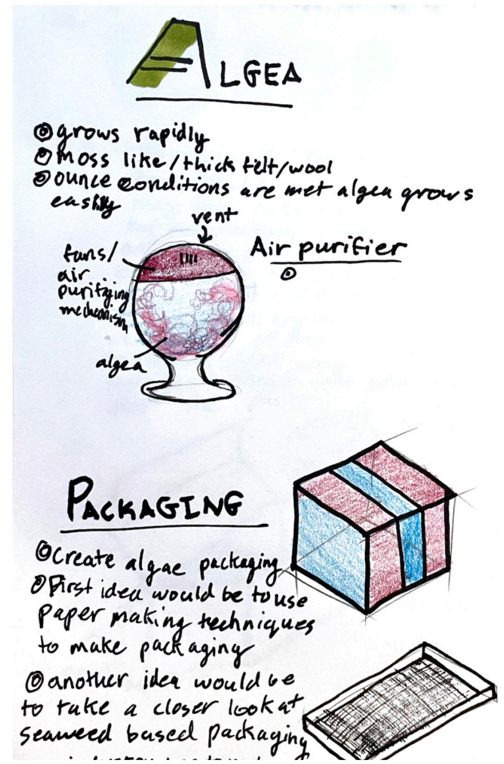
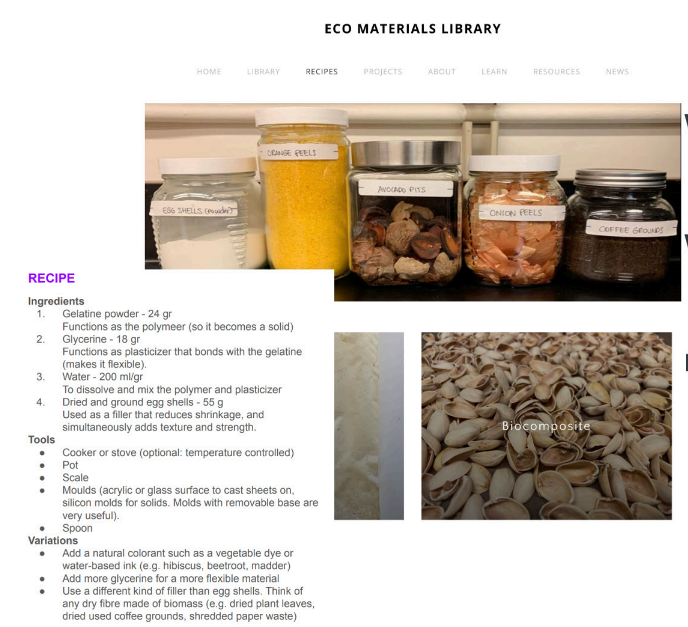


UC Davis Eco Material Library


ECO MATERIALS LIBRARY

RECIPE

Ingredients
1. Gelatine powder - 24 gr
   Functions as the polymeer (so it becomes a solid)
2. Glycerine - 18 gr
   Functions as plasticizer that bonds with the gelatine (makes it flexible).
3. Water - 200 ml/gr
   To dissolve and mix the polymer and plasticizer
4. Dried and ground egg shells - 55 g
   Used as a filler that reduces shrinkage, and simultaneously adds texture and strength.

Tools
- Cooker or stove (optional: temperature controlled)
- Pot
- Scale
- Moulds (acrylic or glass surface to cast sheets on, silicon molds for solids. Molds with removable base are very useful).
- Spoon

Variations
- Add a natural colorant such as a vegetable dye or water-based ink (e.g. hibiscus, beetroot, madder)
- Add more glycerine for a more flexible material
- Use a different kind of filler than egg shells. Think of any dry fibre made of biomass (e.g. dried plant leaves, dried used coffee grounds, shredded paper waste)

DES 127B SQ2021 | Eco-materials | Eldy S. Lazaro Vasquez

Where/What?
- Eco Friendly Materials that can be used to make alternatives of plastic bags, leather, etc.

Who?
- Anyone can make it using the right measurements (might take a little bit of experimenting)

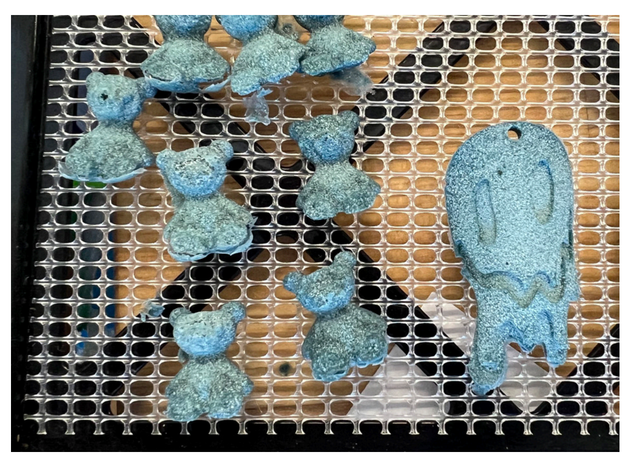
Materials
- Kitchen food items, clothing, etc.
- Coffee grounds
- Tea Leaves

Initial Sketches and Research

In our brainstorming phase, we came up with a number of iterations and ideas for our project. We especially liked the idea of using recipes from the UC Davis Design Department;s Eco Material Library since we were interested in working with biodegradable materials. Initially, we were aiming to create biodegradable jewelry, but as we experimented more with the material we decided to think of a more climate-change focused idea.

Materials and Tools

Then we gathered materials and tools that were available to us and made a list of what we had. We primarily used the following materials: Calcium Carbonate, Titanium Dioxide, Blue Butterfly Pea supercolor powder, Spirulina Powder, Agar Agar Powder, Gelatin Powder, Vegetable Glycerin, Coffee Grounds, and Turmeric. As for tools, we primarily used a tabletop stove, pots, measuring cups, trays, and silicon molds.



BioComposite with Eggshells

For our first recipe, we followed the BioComposite Recipe from the Eco Library website by using Gelatine, Glycerin, water, ground-up eggshells, and blue butterfly pea powder. We first boiled water, added the powder, added the gelatine and glycerin, stirred slowly for 20-30 min. at under 80 degrees Celsius, added egg shells, poured them into silicon molds, and let sit more about 1-2 days.

The results were extremely successful, the only notable changes being the color lightening a shade and the flexibility of the material being stiffer where there were more concentrated areas of eggshell residue. The areas with more eggshells in them were much whiter by comparison.

BioFoam

For our second recipe, we followed the BioFoam recipe from the Eco Library Website using Gelatine powder, Glycerine, Water, Blue Butterfly Pea powder, and organic Dishwashing soap. We boiled water, added the powder, added gelatine and glycerin, and stirred slowly for 20-30 min. at under 80 degrees Celsius, then added in the soap, poured it into the silicon mold, and let sit for about 1-2 days.

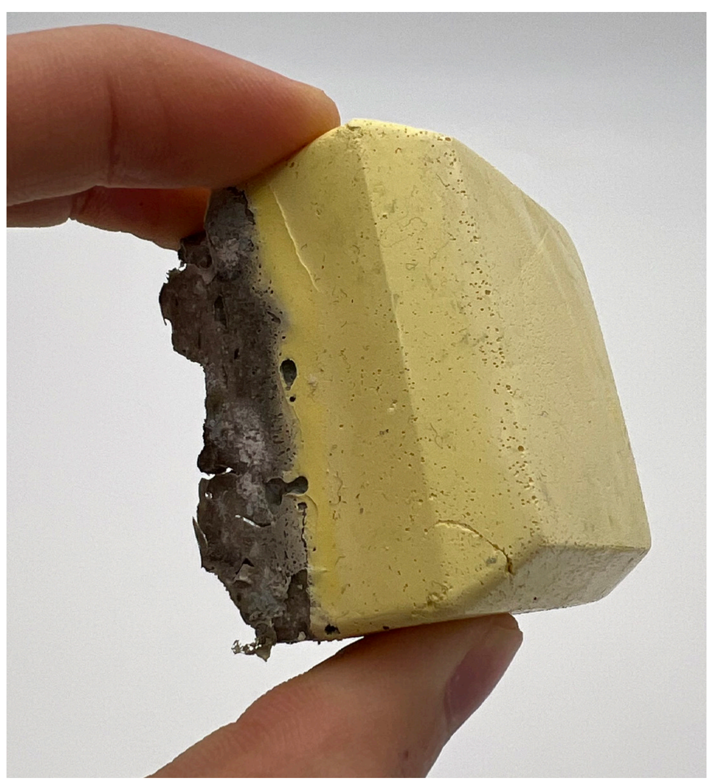
The recipe was also extremely successful with the material coming out a shade darker compared to the BioComposite. It was a very fun material to play with as it was squishy and soft to the touch. As it dried for more days, it became stiffer, but it still retained its squishiness.

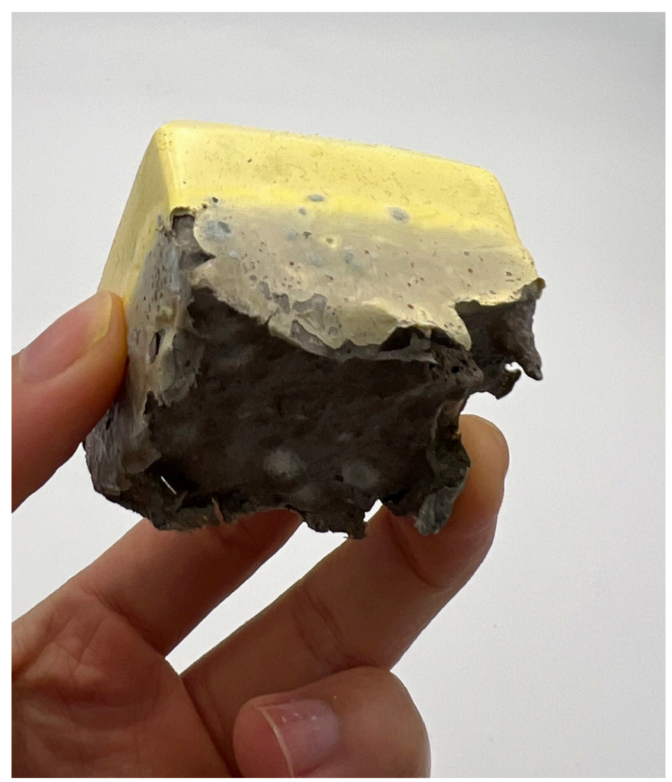
BioComposite Vegan with Calcium Carbonate

After making the original BioComposite and BioFoam recipes, we decided to experiment with different variations of the "control" recipes.

One iteration was using the same BioComposite recipe but instead of gelatine powder we used Agar Agar, replaced the Butterfly Pea Powder with Hibiscus, and we added calcium carbonate to help agar agar, the polymer, bind better with the Glycerine.

We followed the instructions as normal, but we may have stirred a little hard and quickly which could have messed with the final product. Large bubbles kept appearing in the mixture as we stirred and became extremely thick even before we put the calcium. Was it because of Agar? The Hibiscus? We were not certain so we decided to keep sticking with Gelatine powder.





BioFoam with Titanium Dioxide

We also made the same BioFoam recipe but with Titanium Dioxide and Tumeric to create a yellow color. This recipe turned out extremely well and dried quickly thanks to us using a dehydrator. We hoped the Titanium Dioxide would help prevent the BioFoam from shrinking and also strengthen the BioFoam so it wouldn't fall apart too quickly. The Dioxide did both things and lightened the turmeric to create a bright yellow.

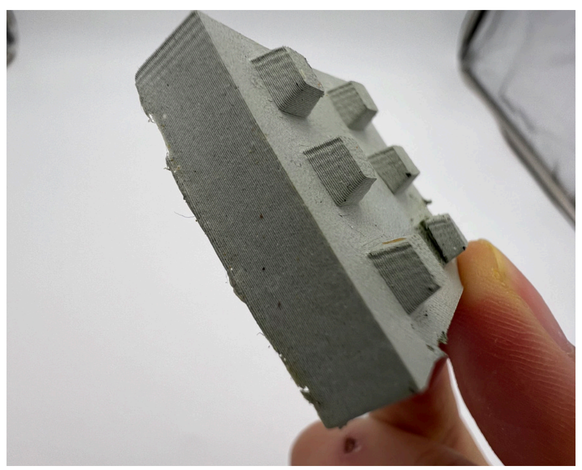
Just because we were curious, we also combined the BioFoam with the Vegan BioComposite to see how they would or wouldn't mix, and it created an interesting double-sided shape with a stiff bottom and a squishy top. Unfortunately, the BioComposite molded so we had to throw it out, but it was interesting to see how they separated into their respective textures.

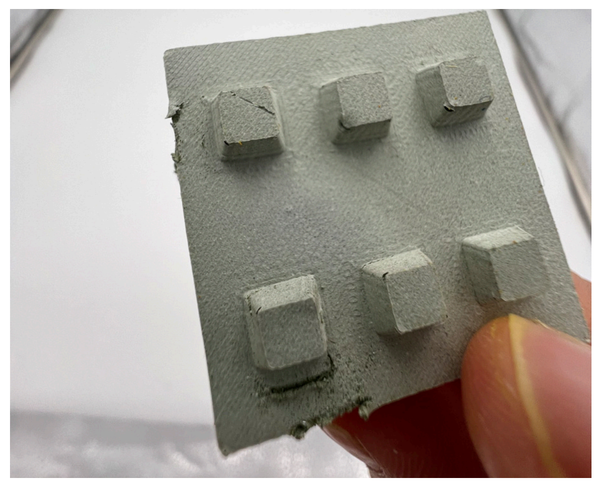
BioComposite with Coffee Grounds and BioPlastic with Tea Leaves

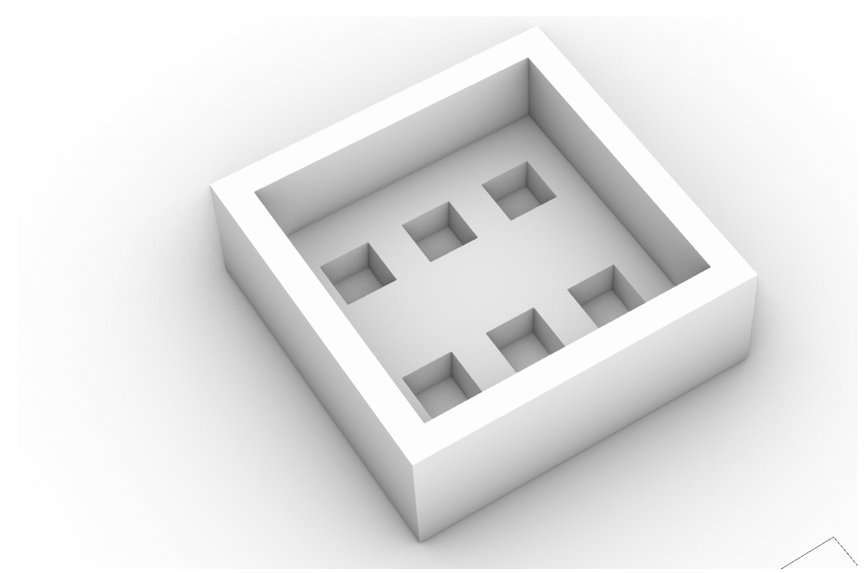
The last two recpies we were able to test were with the BioComposite and BioPlastic. Since we were unsatisfied with the Vegan BioComposite, we decided to continue using gelatine powder. We also wanted to try using coffee grounds and tea leaves since we had access to so much excess material from a coffee shop.

The BioComposite with coffee grounds iteration turned out well, making a slick, smooth material that was jet black. However, this material also ended up molding which we surmised was because of not letting it air properly.

For the BioPlastic Tea Leaves, we used Water Gelatin, Glycerol, and dried and crushed Tea Grounds from green and black tea leaves. This material also turned out well and did not mold due to proper airing.



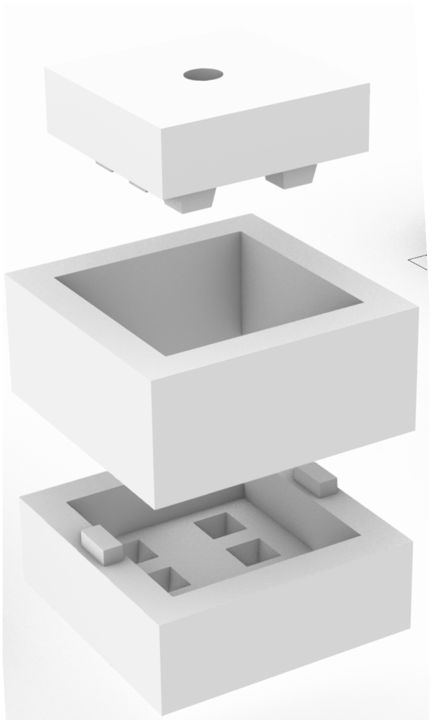


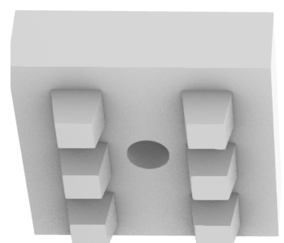


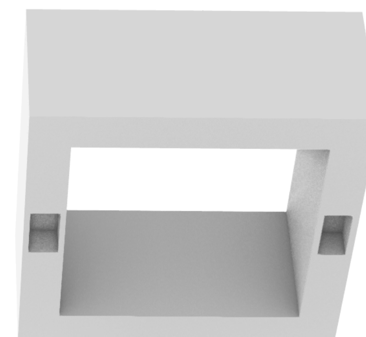
First Mold Design

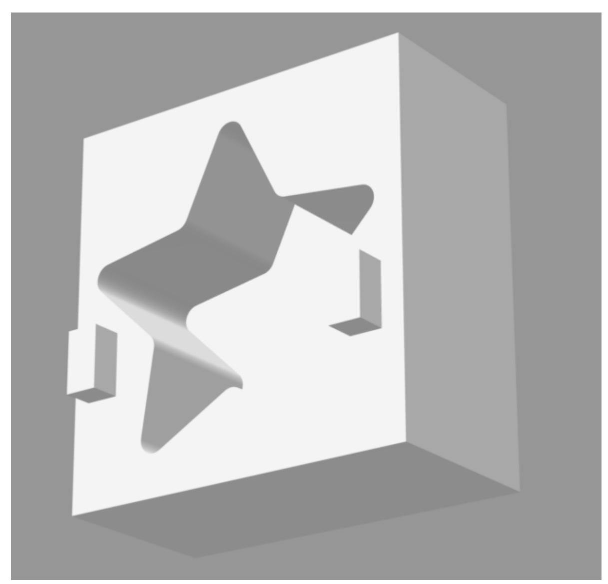
Up until this point, we had been using silicon molds since we already had some on hand and they were easy to remove the final molds from. However, we decided to make our own design of star-shaped BioFoam toys that could be used as stacking toys. Since the material was biodegradable, safe to eat in small amounts, and dissolved easily in water (as pictured at the top), it would be perfect for children's toys. Oftentimes toys are lost and discarded, ending up in natural spaces like the ocean, so we came up with Nature Nova as a fun, biodegradable toy safe for children.

Now we had to learn the skill of mold making. Initially, we tested out Lego-like shapes as a possible second toy. The mold was simple, but it wasn't detachable so it was hard to get the mold out so we decided to try different techniques.







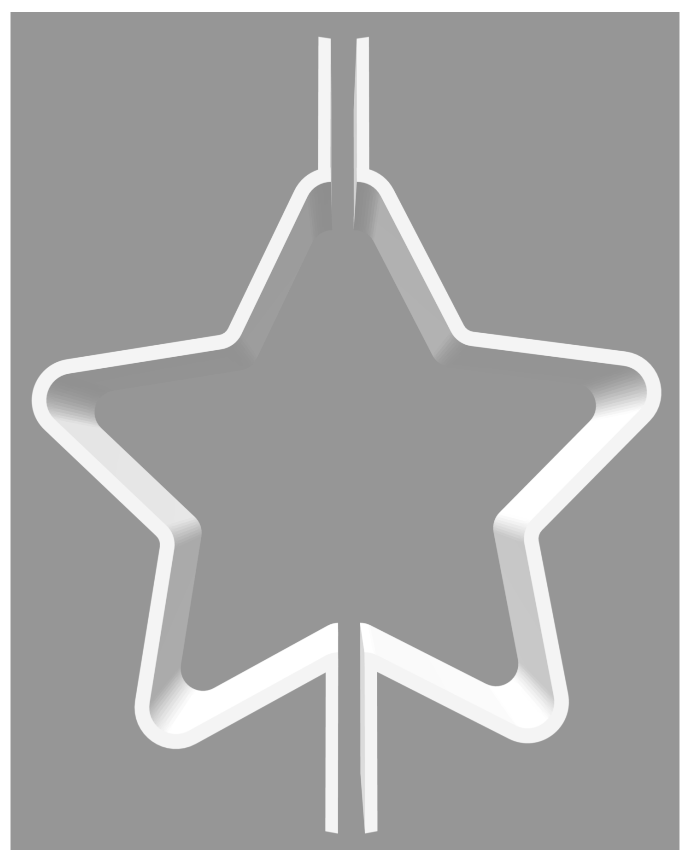


Iterations of the First Mold Designs

We initially tried using a peg to connect the top and the bottom of the mold so it could be removable, however, as seen with the star at the bottom, there was not enough room to air out the mold so it could fry sufficiently.

Furthermore, when we tried making an indentation into the brick using a top mold, the indentation did not stay and the overall shape of the brick (like the star) was ruined when we tried to remove it.

However, we were at least able to save some of the stars by slicing off the ruined parts since the mold was relatively deep. We made multiple sizes of the stars, of which we were at least able to get one or two sizes of each successfully.



Final Mold Design and Stars

Finally, we decided to try out a completely different method. We made a cookie-cutter-like mold that could split in half and was relatively thin so we could easily take out the shape. The mold still slightly stuck to the 3D print, but it came out much nicer and more evenly shaped.

The main issue was that we had used tape to cover the bottom, but the heat from the mixture softened the tape, causing most of the mold to pour through the bottom. The only reason it was able to have some thickness is that we quickly put it in the dehydrator and hardened the bottom of the Biofoam star.

In the end, we were able to make a decent star shape from BioFoam that could stand on its own with our own 3D printed mold design.

Conclusion

Working with Biodegradeable materials can get very tricky due to their volatile nature and form. Even when the substance dries, it can be tricky preserving the design and ensuring it dosen't degrade too quickly. However, we learned how to work with different substrates and strengtheners to get different kinds of materials that could be used for different ocascions.

For instance, the BioComposite Vegan may have been tricky to work with, but it dired extremely quickly and was a tough material. It could perhaps be used for stability as long as it is aired out well.

We still learned multiple skills in a short amount of time such as mount making and a bit of chemistry. With more time we definitely would have had a thicker Star product, but it is still satisfying to see how quickly we were able to learn and develop our project.

We would also like to apperciate Professor Beth Ferguson and TA Damien Mitchell for helping us with this assignment and mentoring us along the way.