



### Potential Outcomes

- <http://sv-vivi.com/a-figure-returning-from-dust/>
- <http://thisisalive.com/biocouture/>
- <http://news.fitnyc.edu/2017/06/19/team-growapair-to-present-at-biodesign-challenge-summit/>

### Additional Resources

- For images of molding into 3D forms: <https://www.designboom.com/design/suzanne-lee-eco-textile-fashion/>
- Growing Materials Google Plus Community: <https://www.designboom.com/design/suzanne-lee-eco-textile-fashion/>
- Biocouture on Biodegradable Fabric: <https://www.designboom.com/design/suzanne-lee-eco-textile-fashion/>
- TED Talk by Suzanne Lee – Grow Your Own Clothes: [https://www.ted.com/talks/suzanne\\_lee\\_grow\\_your\\_own\\_clothes](https://www.ted.com/talks/suzanne_lee_grow_your_own_clothes)
- For more recipes or additional resources, visit [www.healthymaterialslab.org](http://www.healthymaterialslab.org).

### Current Material Challenges/ Questions

- How can we increase the material's durability and water resistance while keeping it 100% biodegradable?
- How can we increase the speed of growth?

### Share Your Work!

This is an evolving body of research, and we're excited to hear from you. Want to connect? Shoot us an email at [affordhealth@newschool.edu](mailto:affordhealth@newschool.edu), or share your #HMLBioWorks creations with @HealthyMaterialsLab on Instagram!

### Image Credits

- 1 Closeup shot of dried cellulose sheets. Photo by Christopher Gannon. [news.iastate.edu/news/2016/04/26/sustainableclothing](http://news.iastate.edu/news/2016/04/26/sustainableclothing)
- 2 Suzanne Lee, BioCouture jacket details. <http://www.ecouterre.com/u-k-designer-grows-an-entire-wardrobe-from-tea-fermenting-bacteria/>
- 3 Harvest: A biotextile future. Handbag and clutch designed by Dean Brough, Alice Payne, and Peter Musk. <https://eprints.qut.edu.au/93547/>

### HOW TO GROW

# KOMBUCHA "LEATHER"

PREP TIME: 30 MINS + BOILING/COOLING TIME

GROW TIME: 3 – 4 WEEKS

DRY TIME: 1-2 WEEKS




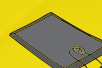
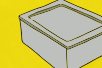
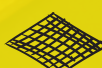




YIELD: 1 PIECE, 5 x 7 INCHES

This flexible bio-material alternative to leather is made from cellulose nanofibrils spun by bacteria and yeast. This material grows thicker over time and can become paper thin or leather like. This material can be treated like a traditional textile and dried into sheet form, or can be molded around a form during the drying process. This material has the potential to be an alternative to animal sourced textiles and their harmful environmental impacts.

### INGREDIENTS

This recipe will produce enough for a 5"x7" container 2-3 inches deep.

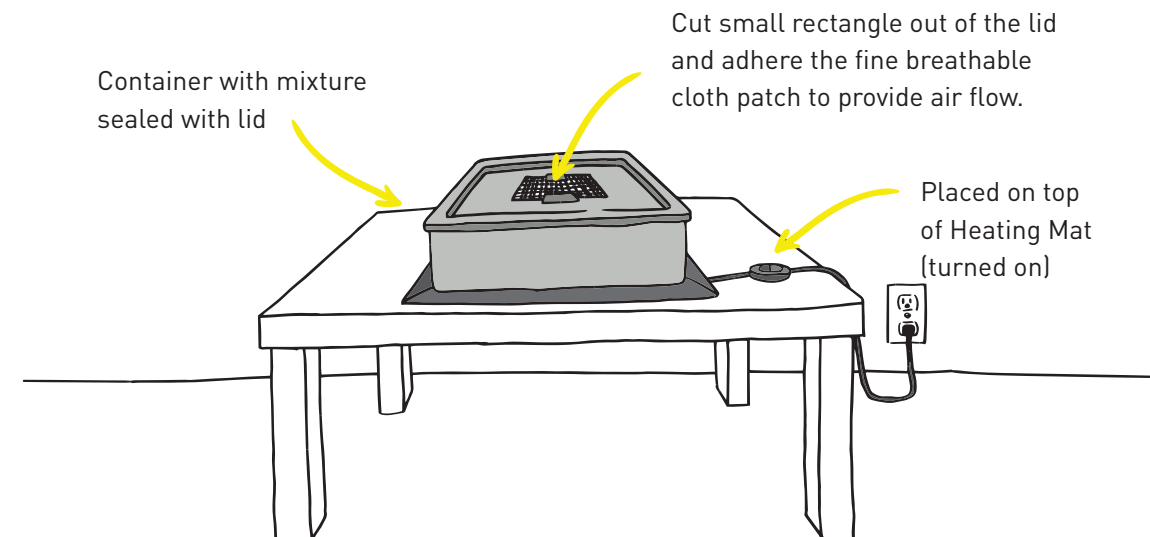
Multiply recipe for larger containers.

 1 Kombucha Culture	 200 Milliliters Apple Cider Vinegar	 200 Grams Granulated Sugar	 1 Seedling Heat Mat (ideally covers the entire footprint of container)	 1 Non-porous Container with Lid	 4" x 4" (approx) Tightly Woven Breathable Cloth Patch (Medical Gauze works well)
 2 Black or Green Tea Bags	 2 Liters of Water		 1 Wooden or Absorbent Board (for drying leather)	 1 Measuring Cup	

### EQUIPMENT

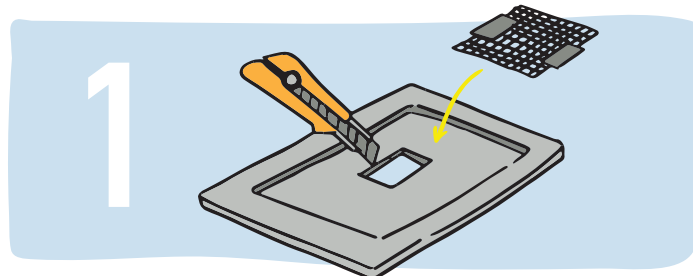
 1 Pair Rubber Gloves	 Spray Bottle of Rubbing Alcohol	 1 Duct Tape Roll
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### SETUP

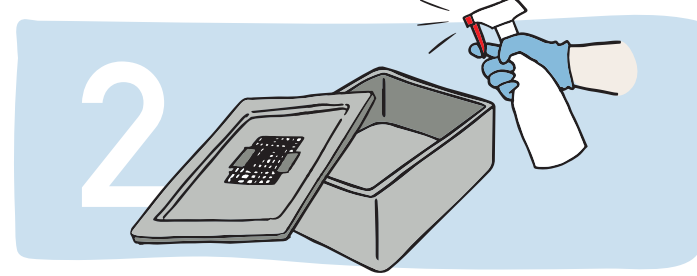


## HOW TO GROW

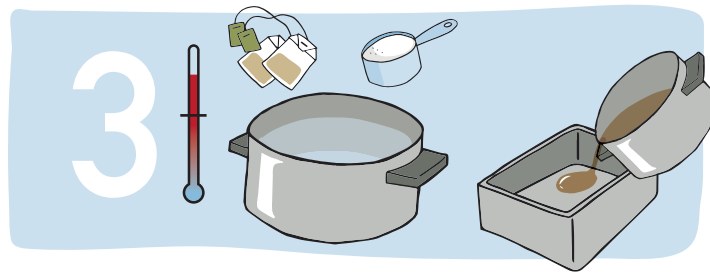
# KOMBUCHA "LEATHER"



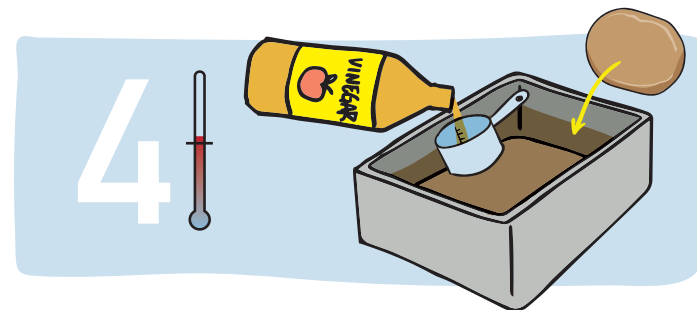
- **Cut a 3" x 3" hole in container lid.**
- **Adhere breathable cloth patch** with duct tape. (This is to let oxygen in, keep heat in, and keep insects out.)



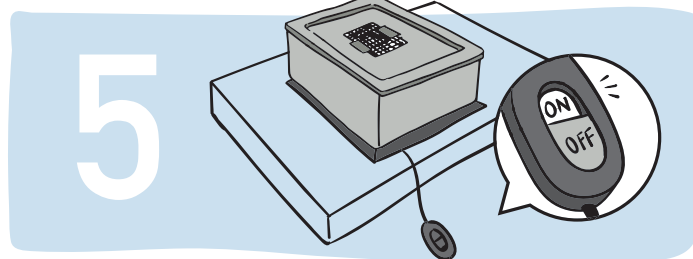
- **Sterilize container.** Rinse container with water. Spray 70% alcohol in the interior and let air dry.
- **Place heating mat under container.** (Do not turn mat on.)



- **Make tea/sugar mixture.** Bring water to a boil. Remove from heat. Add tea bags and then remove after 15 minutes. Add sugar and dissolve.
- Pour liquid into sterilized container.



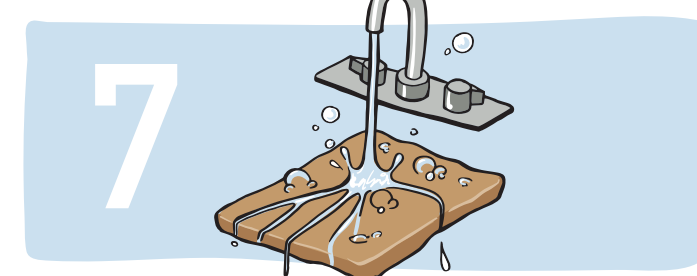
- **Let liquid cool** to room temperature (below 86° F)
- **Add organic cider vinegar.**
- **Add live Kombucha culture.** It will sink to the bottom of container. Fermentation begins after 48-72 hours, thin skin and bubbles will appear and culture will rise to the surface.



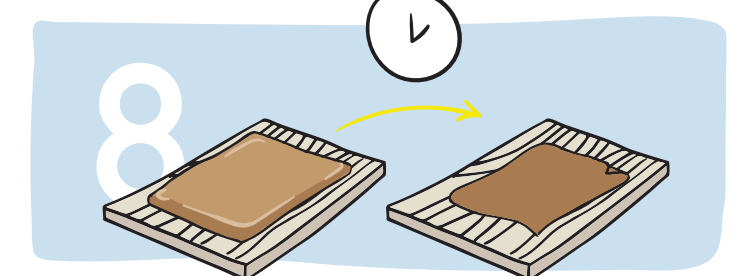
- **Cover container with lid** with breathable cloth, after combining ingredients.
- **Turn on heating mat.**



- **Check weekly under lid with sterilized gloves** to make sure there is no contamination. (See Avoiding Contamination)
- In about 4 weeks product will become about 1/2-3/4" thick. Remove sheet from container.



- **Wash with soapy water.** Dish soap works well.



- **Lay sheet out to dry on a porous surface** like wood, wire mesh, felt, etc. Drying can take 1-2 weeks.
- Experiment with drying into a 3D form by draping around an absorptive mold.

## BEST PRACTICES

### Avoiding Contamination

- Spray the inside of the lid and container with 70% alcohol and let air dry.
- Wear gloves and sterilize with alcohol when handling ingredients or interior of container.
- Breathe away from the container to prevent bacteria from entering.
- When handling SCOBY, always wear gloves that have been cleaned with alcohol.
- Fruit flies will be attracted to sugar and could contaminate the experiment. Ensure airflow through fine mesh properly sealed around the growth container.
- SCOBY should never come into contact with metal (rulers, tongs, containers, etc) while in the process of growing.

### Warning Signs...

- Pungent fermented, rotting, foul odors.
- Mold and bubbling dark splotches indicate contamination. (Time to start over)

## EXPERIMENTAL FABRICATION TECHNIQUES

### During Growth

- Create holes in the sheet by adding objects in the container before growth. These objects should be taller than the surface of liquid.
- Submerge a tube of wet kombucha "leather" upright in kombucha culture liquid and new material will grow around tube's opening.

### After Growth

- Drape wet pieces on top of each other, and they will grow together while drying, instead of joining by sewing.
- Seal material with natural waterproofers to prolong biodegradation. **Material will easily absorb water.**
- Dye like traditional textiles.
- Create texture on material by using textured surface for drying.
- Experiment with heat to expedite the drying process.
- Drape and dry over 3D form. (Porous materials work best) The "leather" will remain in 3D form after removal. The material has high water content and will mold if water cannot evaporate.
- The wet "leather" is heavy and will need to be held around 3D forms where it would otherwise hang off. Use wire mesh, wire, or string to support the material.