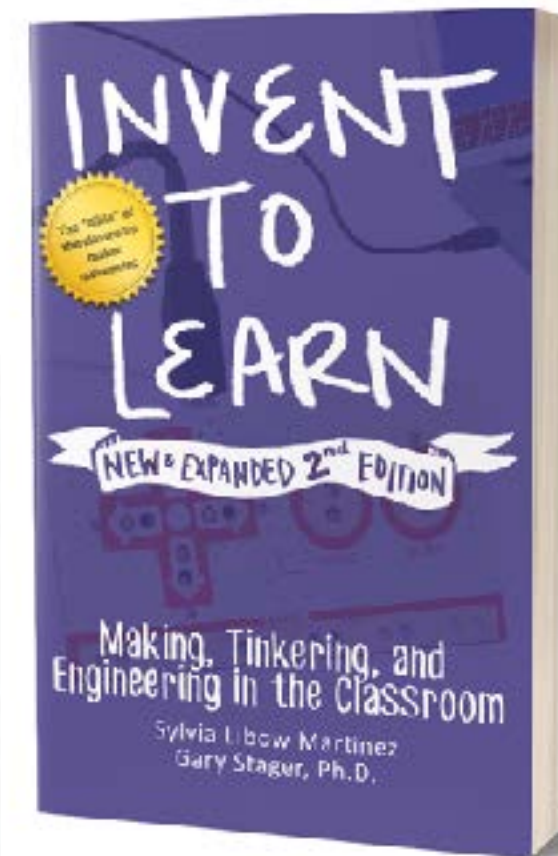
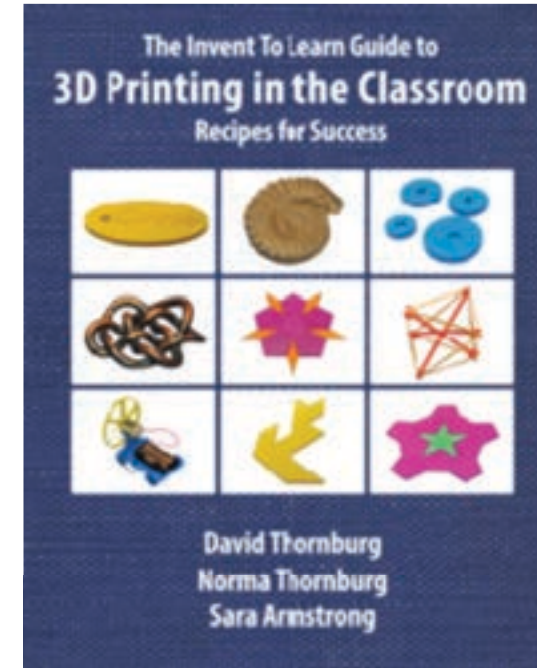
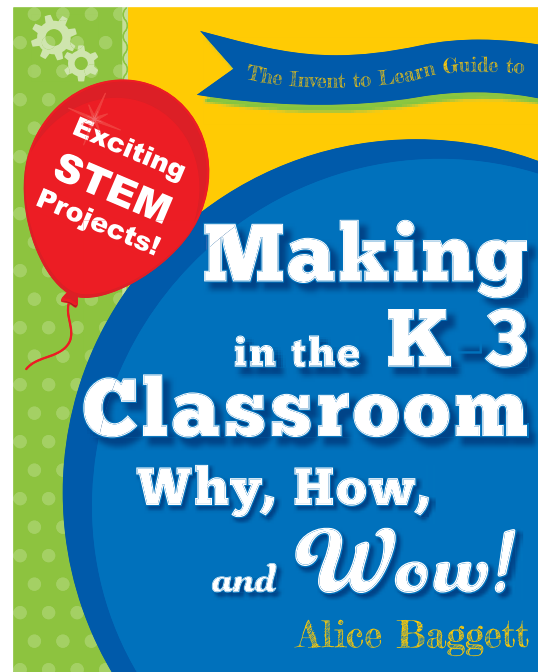


Resources for Grow is the New Make: Biomaking and Biohacking

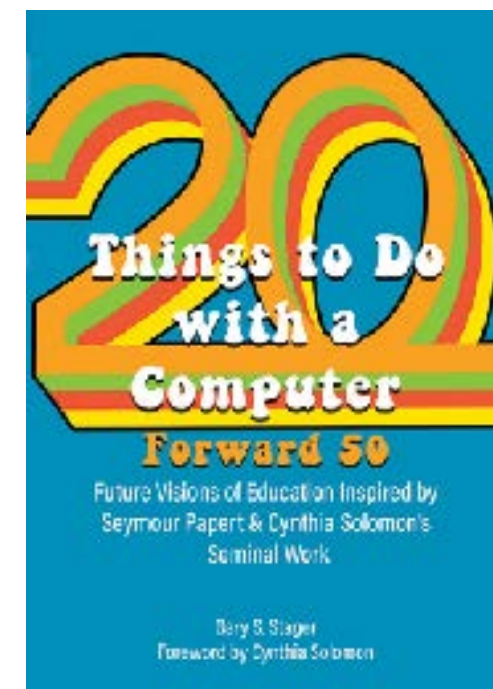
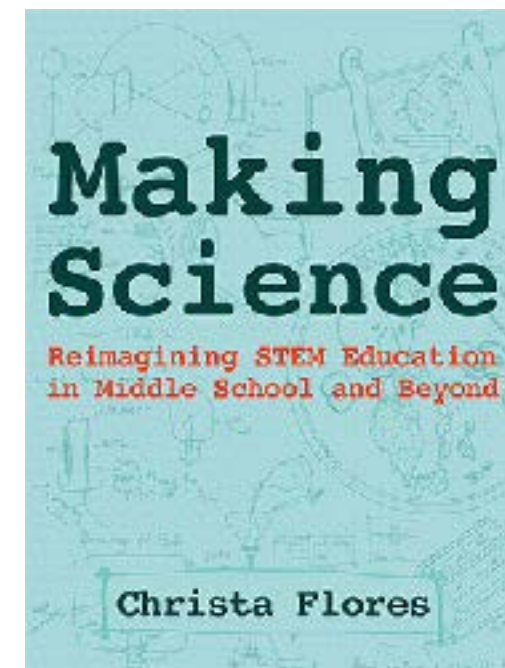
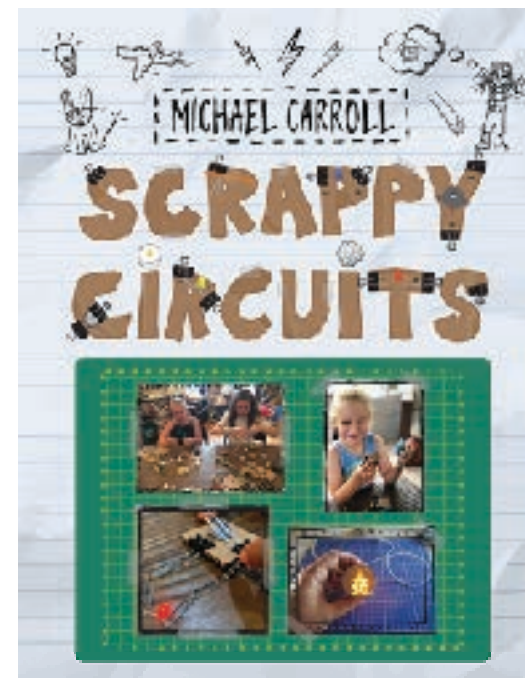
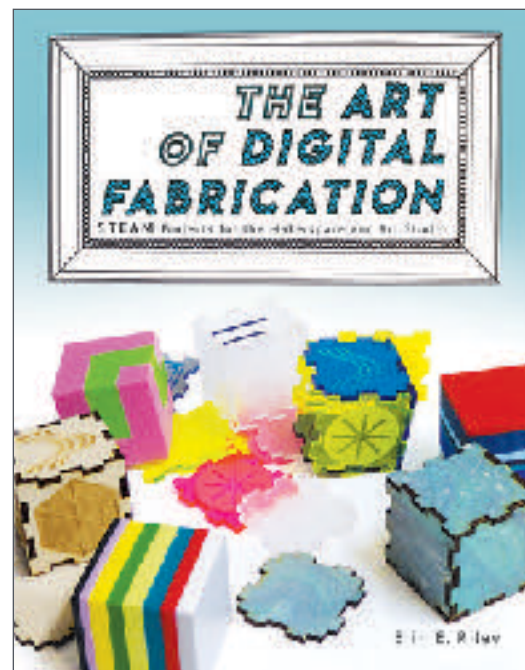
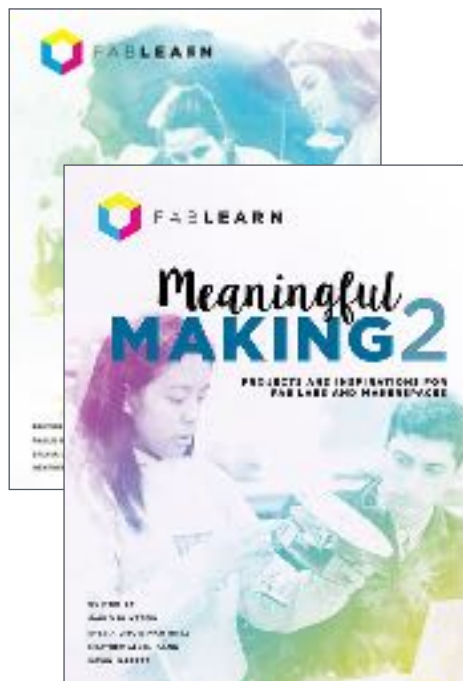
Sylvia Martinez sylvia@inventtolearn.com
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Biomaking & Biohacking

Biomaking - *Making with Biology*

- Grow materials out of fungus, bacteria, and other organisms
- Students learn about the invisible living world around us
- Connections to global cultures that make, eat, and use materials that might seem “yucky”
- Understand global ecological issues
- Accessible now



Fungus “monster” pots

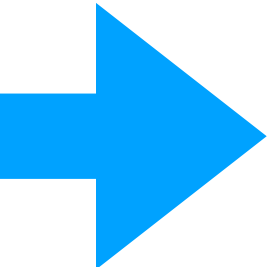
Biohacking - *Biology Making*

- Synthetic biology
- Design with biological materials, including manipulating genetics
- Students learn how biology is another tool for design.
- Connect to cutting edge real-world research and applications: new drugs, bacteria that detect chemicals, smart materials, programmable bio-organisms
- For brave pioneers



**Genetically modified
bacteria glows in
presence of pollution**

Starting Biomaking

- 
1. **Mycelium fungus.** The root structure of fungus can be coaxed to grow into a wide variety of shapes and properties from flexible leather-like to styrofoam to wood-like and more.
 2. **Kombucha leather.** Bacterial cellulose sheets of leather-like material that are grown by creating a culture of bacteria and yeast in kombucha (fermented tea).
 3. **Bioplastics.** Easy to use materials like agar (red algae) or chitin (crustacean and insect shells) can mimic plastic material.

Mycology

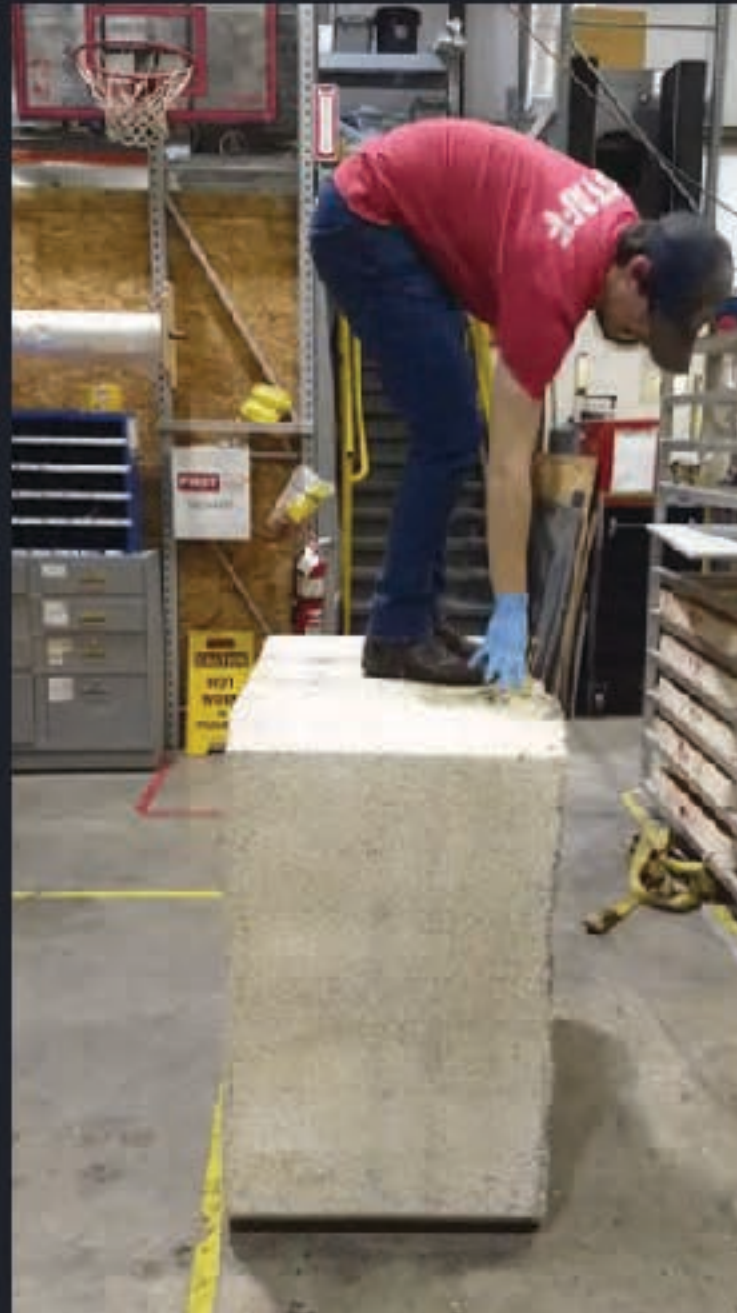
- The root structure of fungus (mycelium) can grow materials that act like styrofoam but are 100% compostable
- Packaging, acoustics, insulation, containers
- Fungi Mutarium eats plastic and converts it into an edible material.



**Mycelium-based products are available NOW.
They can be grown into molded shapes of
varying weight, strength, and flexibility**



Grown molded shapes



Large panels and blocks



High performance foams



Fungus as a Design Material

youtu.be/jBXGFOk5_Rs

Growing mycelium as a building material

Step 1

Grow fungus in bark that has been sterilized and then incubated with fungus. Press into mold forms.



Step 2

Grow for 1-2 weeks



Step 3

Bake at 200 degrees fahrenheit for a few hours.





Coffee Grounds



Hemp Bark



Mycelium “Monster” Planters - Forms designed in Tinkercad & 3D printed



used with permission - Corinne Takara



Following

Corinne Okada Takara

@CorinneTakara Follows you

Artist and arts educator who enjoys following and working on collaborative public arts projects. Also, diving into bio materials nestmakerspace.weebly.com

📍 Cupertino, California 🌐 okadadesign.com

📅 Joined October 2010

1,854 Following 1,804 Followers

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Tweets

Tweets & replies

Media

Likes



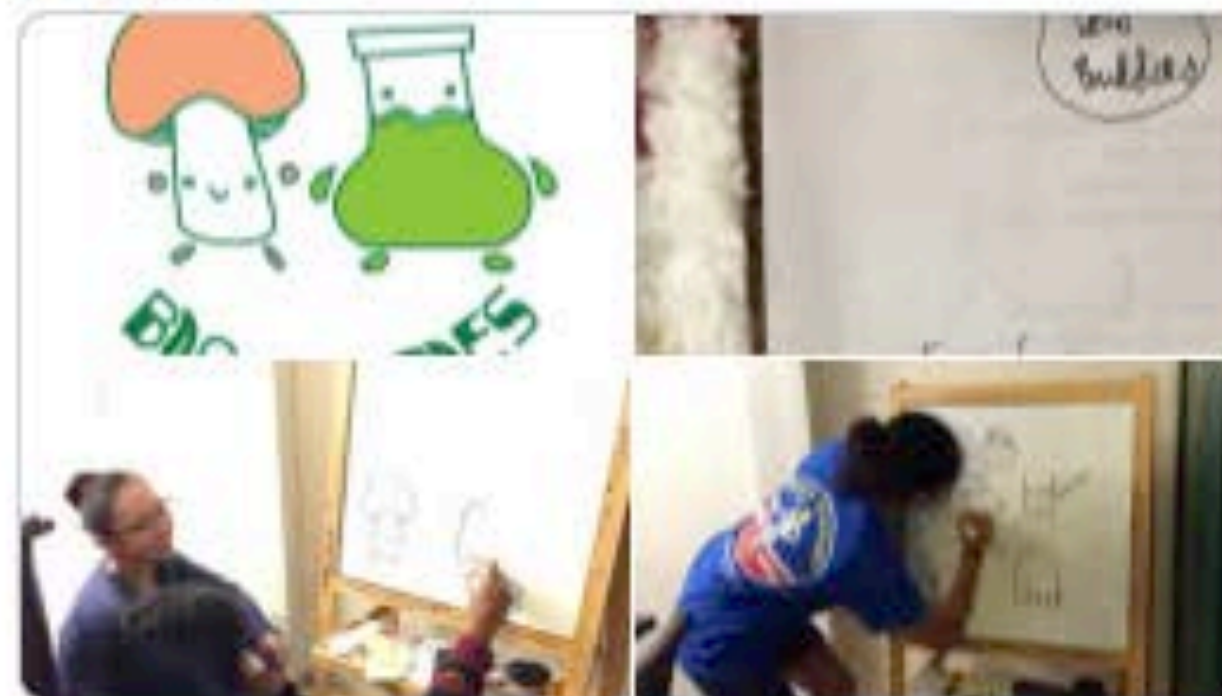
Corinne Okada Takara @CorinneTakara - 2h

Teens' 2 part mix & match creature planter containers. vacuum forms of these grow mycelium. Team iterating designs 4 better molded cavity



Corinne Okada Takara @CorinneTakara - 2h

Teen [#biotinkering](#) project logo 4 [@Biodesigned](#). They're creating toy kits that explore growing mycelium & kombucha leather as creative building materials. Anne's notebook sketch led to group sketching which led to them creating final rendering. Project website up soon 4 [@FabLearn](#)



Ecovative and 9 others



2



7



Corinne Okada Takara @CorinneTakara - 2h

Template for Petri dish kaleidoscope will be up on their website soon.



4



[Show this thread](#)



Corinne Okada Takara @CorinneTakara - 2h

Teen [@Biodesigned](#) team designing Petri dish kaleidoscope 4 extended play w/ bacterial cellulose scraps. [#biotinkering](#) [#frugalscienceplay](#)



RESOURCES

SCHOOLS

SPONSORS

LEARN. CREATE. GROW.

Biodesign Challenge

biodesignchallenge.org

@Biodesigned



GIY BIO BUDDIES

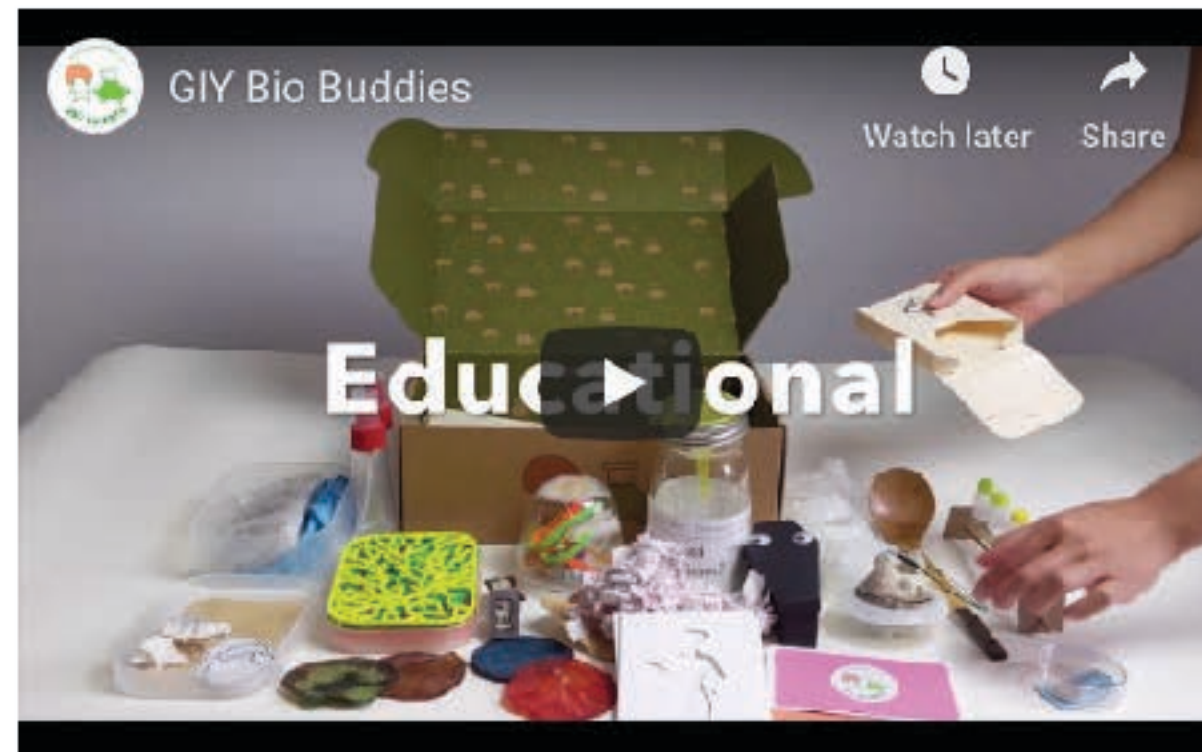
the grow-it-yourself toy kit that makes biomaterial design fun.



[SCOBY KIT CLICK HERE](#)



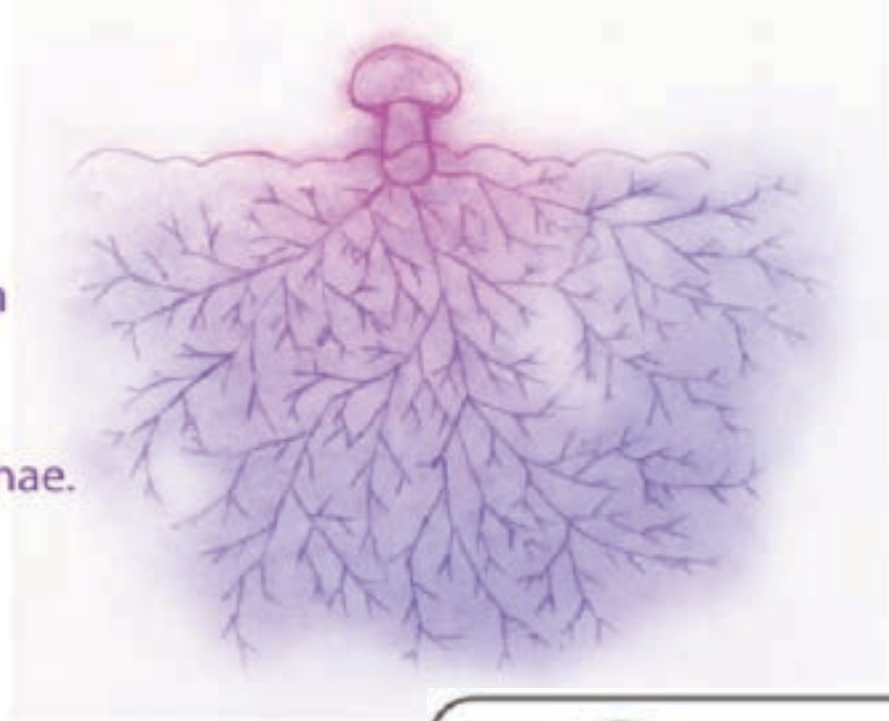
[FUN-GUS KIT CLICK HERE](#)





MYCELIUM FUN FACTS!

A mushroom is the fruiting body of a larger organism that is mostly underground in the form of mycelium – the root-like mass of branching single-cell strands called hyphae.



MYCELIUM FUN FACTS!

Fungi are not animals or plants. They belong to their own kingdom.

Did you know that the biggest organism on earth is a fungus?

Did you know that trees and plants depend on fungi? Fungi extend roots and enable communication among trees.

Fungi are more closely related to animals than to plants!

Mycelium is the root-like structure of filamentous fungus and, as a material, is water and fire resistant.



Grow-It-Yourself Material

\$13.00

Select a Substrate

Quantity

Original Blend (Hemp hurds)

1

+

ADD TO CART

This bag of Grow-It-Yourself Mushroom® Material is the perfect way to bring your Earth friendly creations to life! Whether you have a product idea in mind, or just want to experiment with the material at home, GIY Mushroom® Material is meant for you!

WE ARE NOT CURRENTLY SHIPPING INTERNATIONALLY. IF YOU ARE OUTSIDE OF NORTH AMERICA, PLEASE ORDER FROM A LOCAL SUPPLIER.

Resources

How-to Video

Instructions

Material Specs

- Density: 7.6 lbs/ft³
- Compressive Stress/Strength at 15% compression: 18 psi
- Flexure Strength: 34 psi

Each bag will grow to fill 0.12ft³ (3398cm³).

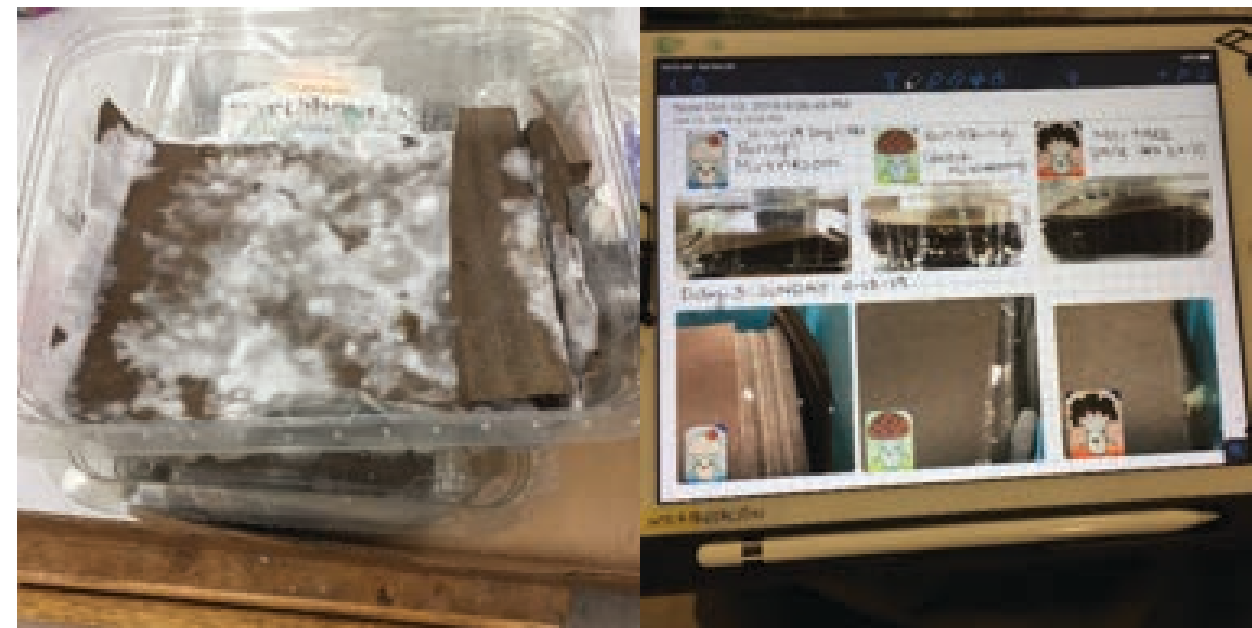


Growing options

- Buy prepared mycelium incubated bark material. Costs \$\$ but less chance of contamination.
- Grow your own mycelium using mushrooms and cardboard. Or buy pre-packaged spores.
- Add mycelium to bark, coffee grounds, ramen, or other material to grow into building material. (Note: this material must be sterilized with a pressure cooker, autoclave, or pasteurized with a crockpot)
- Collect data and experiment with growing conditions
- BSL 1 Lab protocols - found in most high school bio labs.



[instructables.com/id/Making-Mycelium/](https://www.instructables.com/id/Making-Mycelium/)



Alba Cardenas of the East SJ STEM Workshop in Alum Rock, San Jose, CA.

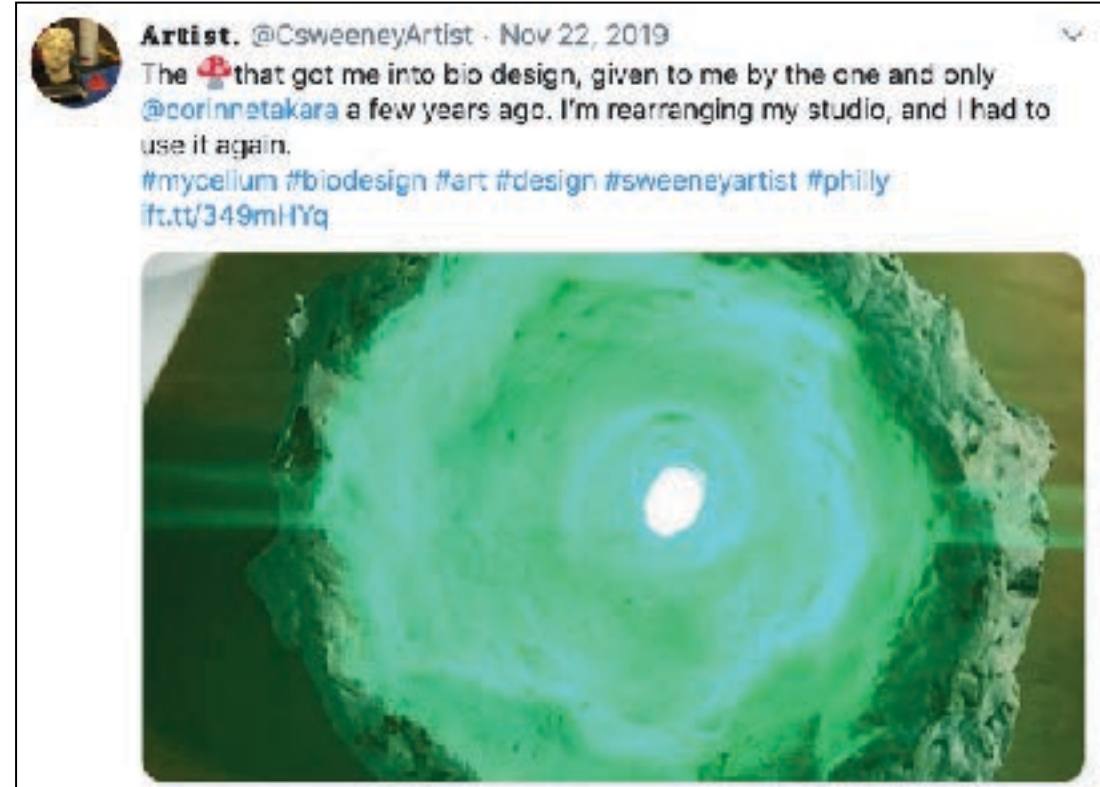


Mycelium Resources

- Evocative - Design resources ecovatedesign.com. Buy the GIY material grow.bio
- Growing mycelium - biofabforum.org/t/growing-materials-at-home-hard-mycelium-materials-manual/201
- Erik Nauman blogs about his classroom lessons learned making mycelium packaging - metatek.blogspot.com/2019/03/learning-with-mycelium-packaging-of.html
- Mycoworks - Fungus-based leather <http://www.mycoworks.com>
- Mycoworks video - youtu.be/jBXGFOk5Rs
- Fantastic Fungi - a documentary about how mushrooms might save the planet fantasticfungi.com
- Radical Mycology -a book and website with essays about the importance of fungi to the world and resources for growing radicalmycology.com
- Dezeen - Mycelium projects (wide variety of difficulty) dezeen.com/tag/mycelium-design/
- Midwest Grow Kits - buy pre-packaged spores and other mushroom growing products midwestgrowkits.com

Follow

#biomaking
#mycellium
@FantasticFungi



Starting Biomaking

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3. **Bioplastics.** Easy to use materials like agar (red algae) or chitin (crustacean and insect shells) can mimic plastic material.

SCOBY - symbiotic culture of bacteria and yeast



How to Grow a SCOBY

By CyberJaws in Cooking > Homebrew 1,826 12 4 Featured



By Lukas Chin - Own work, CC BY-SA 4.0
<https://commons.wikimedia.org/w/index.php?curid=39194866>



By Hexatekin - Own work, CC BY-SA 4.0
<https://commons.wikimedia.org/w/index.php?curid=74530889>



By CyberJaws

Follow

More by
the author:



About: I work in the mental health field as a community based clinician in both outpatient setting and mobile crisis. I also have a dual career in health and wellness doing massage and personal exercise training. ... [More About CyberJaws](#)

05-16-16

This new edible packaging is grown from kombucha

Scoby looks like a dried pig bladder. It's actually the product of fermentation, and it could let farmers grow their own packaging.



1/8 [Photo: courtesy Roza Janusz]



Left: Growth of cellulose with Kombucha.
Right: Wet Kombucha cellulose left to dry.



Left: Suzanne Lee draping the wet Kombucha cellulose onto a mannequin.
Right: The dried garment made out of bacterial cellulose.



Pieces of 'Kombucha Couture' by Sacha Laurin.



BY JESUS DIAZ 7 MINUTE READ

Polish design student [Roza Janusz](#) describes her work as "a process between making and growing." *Scoby*—her graduation project at the [School of Form in Poznan, Poland](#)—is a perfect example of this philosophy. *Scoby* is a biological, fully edible, fully recyclable packaging solution that can be grown by farmers to wrap their products and bring them to market with zero waste.





Elena Amato creates sustainable cosmetics packaging from bacteria



Natashah Hitti | 28 February 2019 | [Leave a comment](#)

Guatemalan designer Elena Amato has created sheets of bacterial cellulose with paper-like qualities as a [sustainable](#) alternative to the [plastic](#) packaging used in personal care products.

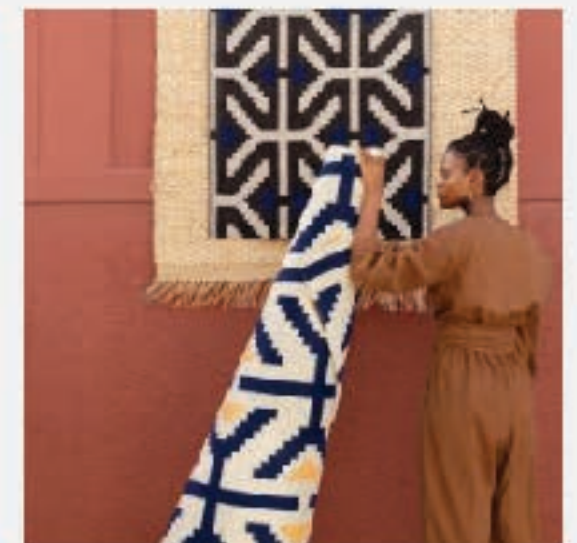
The bacterial cellulose sheets were developed using a mixture of water and a [bacteria](#) (Acetivibrio) culture, which is blended together before being spread out on a flat, [dried](#) in a new tab, [dried](#) in a new tab, and left to dry.



Top design stories

Most
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1 [IKEA and Design Indaba launch Överallt furniture by African designers](#)

McVenger Monday: Wendy's Widow and the SCOBY Research

By: Ashley Schwellenbach
September 18, 2018



Christine Knobel (@thestarflower) doesn't consider herself a professional cosplayer but that didn't stop her from devoting her graduate studies at UC Davis to developing and understanding sustainable materials for cosplay construction. More specifically, she discovered that Symbiotic Culture of Bacteria and Yeast (SCBY), traditionally used to ferment tea into kombucha, makes an effective faux leather substitute for cosplay. Her thesis project—a biodegradable Wonder Woman costume designed from the material—was displayed at the University's Menetti Shrem Museum.

Of all the materials Knobel has shaped, fashioned and sewn in 12 years of cosplay, SCOBY was the most difficult, in part because there was nowhere to turn for advice.

"There were no tutorials and only a handful of papers published on its potential use as a textile. It was a lot of trial and error," she explained. "But now I find it super easy to use. I can grow the textile in my kitchen, build my forms and patterns for wet-forming and sewing while it grows and when it's done growing I can use it right away." She's currently working on developing a website where she can post tutorials and share information and resources with other cosplayers interested in learning to work with the biodegradable material.



Knobel discovered her passion for making costumes at a young age. In kindergarten and elementary school she played dress up with her sister—and frequently wore costumes to school. As she grew older, she'd come home from school and immediately change into her costume of choice. In high school the anime-obsessed Knobel made a Sailor Moon costume that she would wear to the mall with her friends, followed by a Radical Edward costume from *Cowboy Bebop* that she wore to shows. In 2006, she moved to California and attended her first convention, which happened to be San Diego Comic-Con. Her first official convention cosplay was Jet Girl from *Tank Girl*. She hasn't missed a San Diego Comic-Con, or opportunity to cosplay, since. But the quality and ambition of her projects has increased considerably.

Like many new cosplayers, Knobel's early costumes largely featured ready-made clothing that she would modify and adjust as she went along. Now she "starts from scratch to obtain perfect fit and optimal comfort." It doesn't hurt that she acquired an A.A. in Fashion Design, B.A. in Design and M.F.A. in Sustainable Fashion Design along the way. Depending on the amount of time she has, she might still work from a store-bought pattern but she's just as capable of creating a flat pattern and draping and sewing her costume entirely herself. Quality matters to Knobel—and not just because she wants her costumes to look good.

"Today the biggest misconception I get about cosplay is that you have to suffer in your cosplay," she explained. "I think that given enough time designing, any cosplay can be made to sit in, eat in and easy to use the facilities while wearing."



When Knobel first started cosplaying, she stumbled upon a different misconception entirely, one that thankfully seems to have diminished over the years.



Find at: <http://bit.ly/FETCSM>

https://publiclab.org/system/images/photos/000/023/355/original/k_leather_HealthMLab.pdf



Potential Outcomes

- <http://sv-vivi.co/mya-figure-returning-from-dust/>
- <http://thisisalife.com/biocouture/>
- <http://news.hmc.edu/2017/04/19/learn-grow-part-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
- For more recipes or additional resources, visit 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, or share your #HMLabWorks creations with @HealthyMaterialsLab on Instagram!

Image Credits

1. Close-up shot of dried, textured sheets. Photo by Christopher Gannon, newschool.edu/news/2015/04/28/sustainable-ethics
2. Suzanne Lee, Biocouture jacket details. <http://www.acouture.com/eco-designer-grows-an-entire-wardrobe-from-lab-to-making-bodily>
3. Harvest: A biotextile future. Handbag and cloth designed by Dean Brough, Alex Payne, and Peter Mark. <https://reports.qut.edu.au/2354/>

Healthy Materials Lab BioWorks Recipes

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

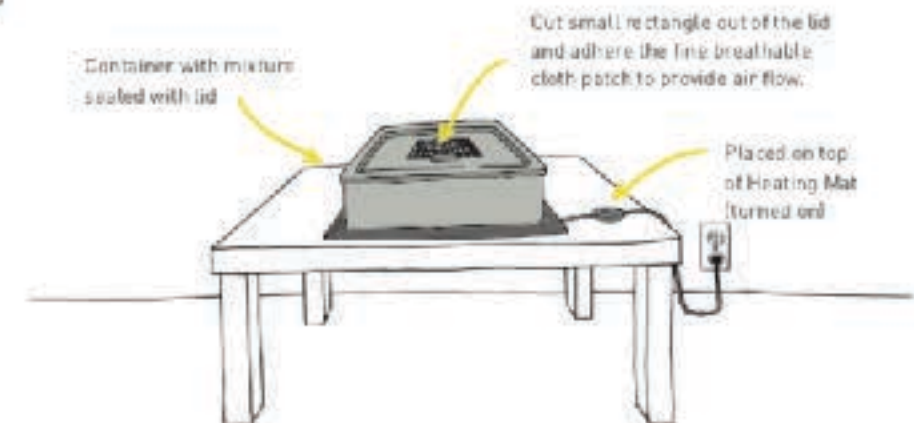
This recipe will produce enough for a 5"x7" container 3-3 inches deep.
Multiply recipe for larger containers.

1 Round cake of yeast	200 Milliliters Apple Cider Vinegar	200 Grams Granulated Sugar
2 Black or Green Tea Bags	2 Litters of Water	

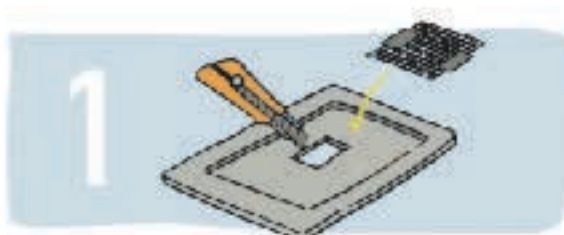
EQUIPMENT

1 Pair Rubber Gloves	1 Spray Bottle of Rubbing Alcohol	1 Box of Tape Cloth
1 Heating Mat (stably warm in a grow foodprint container)	1 Sheet of Glass or Lid	1 Piece of Paper or Cloth (to weigh down material)
1 Wooden or Absorbent Foam Drying surface	1 Measuring Cup	

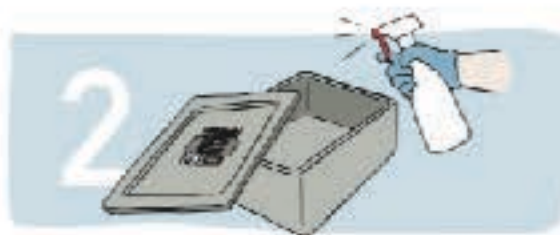
SETUP



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.)



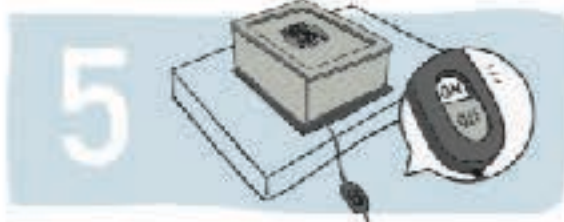
- **Sterilize container.** Rinse container with water. Spray 70% alcohol in the interior and let air dry.
- **Place heating mat under container.** (Do not turn mat on.)



- **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.



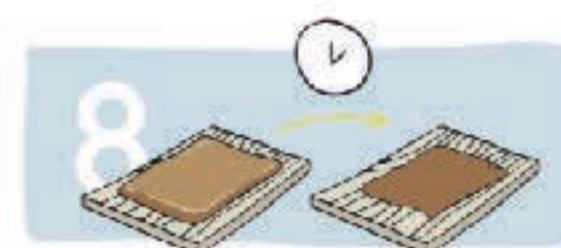
- **Cover container with lid** with breathable cloth, after combining ingredients.
- **Turn on heating mat.**



- **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 spots 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.

Simsbury High Student Makes 'Leather' Out Of Kombucha



By MICHAEL WALSH
HARTFORD COURANT

JAN 06, 2020 | 12:52 PM | SIMSBURY



Julia Sica, a junior at Simsbury High School, is growing faux leather out of kombucha tea. (Michael Walsh / Coura

A school project done by Simsbury High School junior Julia Sica exists at the c
art and science.

Sica, who is 16, has been making faux leather out of kombucha tea, with the en
making a complete jacket out of the material.

17-YEAR-OLD ACCEPTED TO LONDON COLLEGE OF FASHION WITH VEGAN KOMBUCHA SCOBY LEATHER DESIGN



An Australian student has created a sustainable vegan leather jacket made from kombucha. The cruelty-free jacket is the creation of 17-year-old Heather Weir, who created it for her higher secondary certificate fashion project. It earned her admission to the London College of Fashion. She's the youngest Australian to be accepted into the program.

As reported by The Sydney Morning Herald, Weir created the material by following tips for making homemade kombucha. She combined green tea with sugar, water, apple cider vinegar, and SCOBY (symbiotic culture of bacteria and yeast), a slime-like "community" of bacteria that's used to ferment kombucha. The tub was then covered with a clean blanket and left to ferment for 10 weeks.

"Let's just say my parents were very supportive," Weir said. "It does have a smell, a very strong vinegar scent, and it waited over everything. But they said, 'She's got a vision, she wants to make it for a purpose.'"

Corinne Takara's BioBuddies Kombucha Leather Sun Dials/Pockets

<https://giybiobuddies.weebly.com/resources.html>



GIY: KOMBUCHA LEATHER

How to grow your own happy batch of bacterial cellulose.

1 GET YOUR MATERIALS



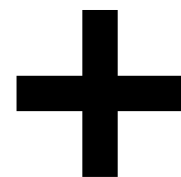
Ingredients

- 7 cups water
- 1/2 cup white granulated sugar
- 4 bags of green tea or Coking tea
- 1 cup unflavored, unpasteurized store-bought kombucha



Tools

- 2-quart or larger saucepan
- Long-handled spoon
- 2-quart or larger glass jar, like a canning jar (not plastic or metal)
- Coffee filters or paper towels to cover the jar
- Rubber band to hold coffee filter cover in place
- Disposable gloves
- Isopropyl alcohol in a small spray bottle
- Tongue or chopsticks (for removing tea bags)
- Cookie tray (work surface)
- Small funnel (for pouring (optional))
- For growing sheets: Deep dish baking pan with a lid
- For better growing: seed warmer



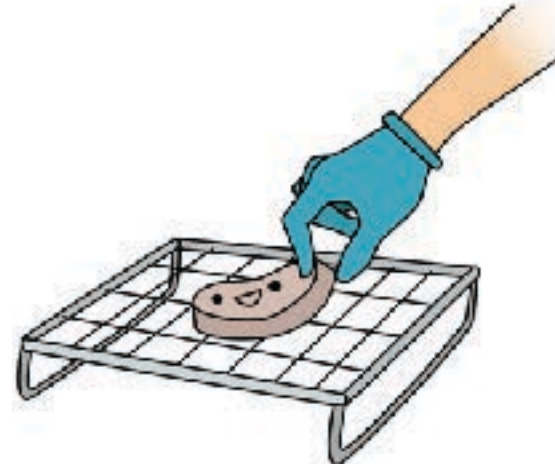
2 - 3 weeks

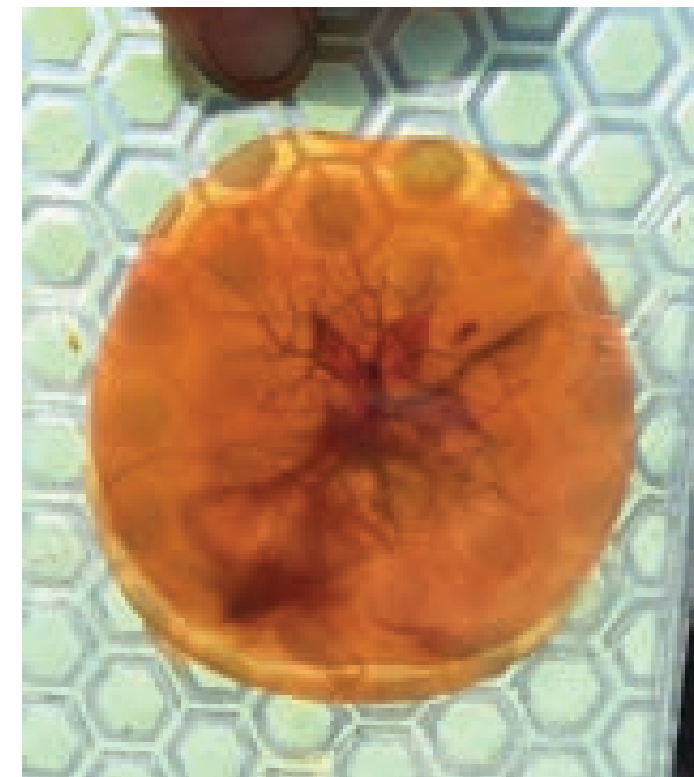
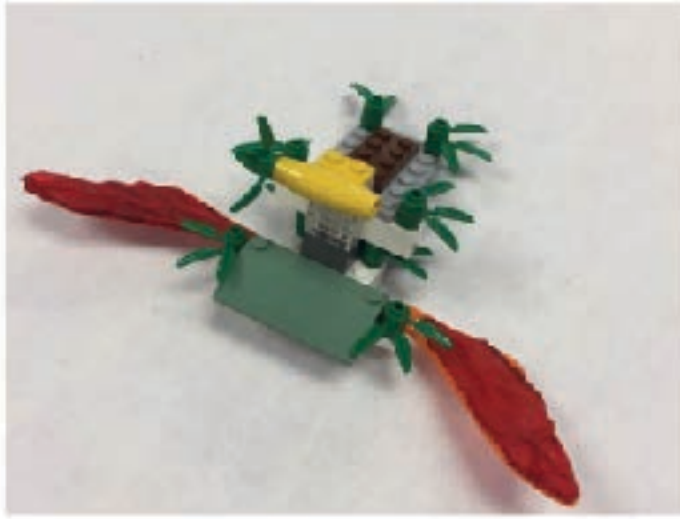
7 HARVESTING

1) Place the SCOBY on a drying rack. Place the rack in the sun or a bright well ventilated space to dry.

Note: do not place SCOBY on aluminum foil to dry as it will stick to it (we found this out the hard way). A cookie drying rack works well.

You can also get interesting textures by placing the SCOBY on a textured form like envelope embossers.





Corinne Takara - used with permission

Bacterial Cellulose Resources

- NEST Makerspace - nestmakerspace.weebly.com
- Corinne Takara - Winning BioDesign Challenge Project giybiobuddies.weebly.com
- BioDesign Competition - biodesignchallenge.org
- The Tech Interactive Museum BioDesign Studio - thetech.org/biodesignstudio
- Suzanne Lee TED Talk - How to Grow Your Own Clothes ted.com/talks/suzanne_lee_grow_your_own_clothes
- Public Lab - Kombucha Leather open resources and Q&A publiclab.org/wiki/kombucha-leather
- Parsons Healthy Materials Lab - Recipes, guides, research healthymaterialslab.org
- Materiom - recipes materiom.org
- Is Kombucha Alcoholic? - delishably.com/beverages/Is-Kombucha-Alcoholic

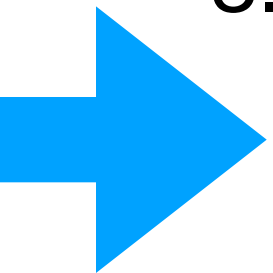
Follow

#biomaking
#kombuchaleather
#biofabrication
#veganleather



Starting Biomaking

1. **Mycelium fungus.** The root structure of fungus can be coaxed to grow into a wide variety of shapes and properties from flexible leather-like to styrofoam to wood-like and more.
2. **Kombucha leather.** Bacterial cellulose sheets of leather-like material that are grown by creating a culture of bacteria and yeast in kombucha (fermented tea).
3. **Bioplastics.** Easy to use materials like agar (red algae) or chitin (crustacean and insect shells) can mimic plastic material.



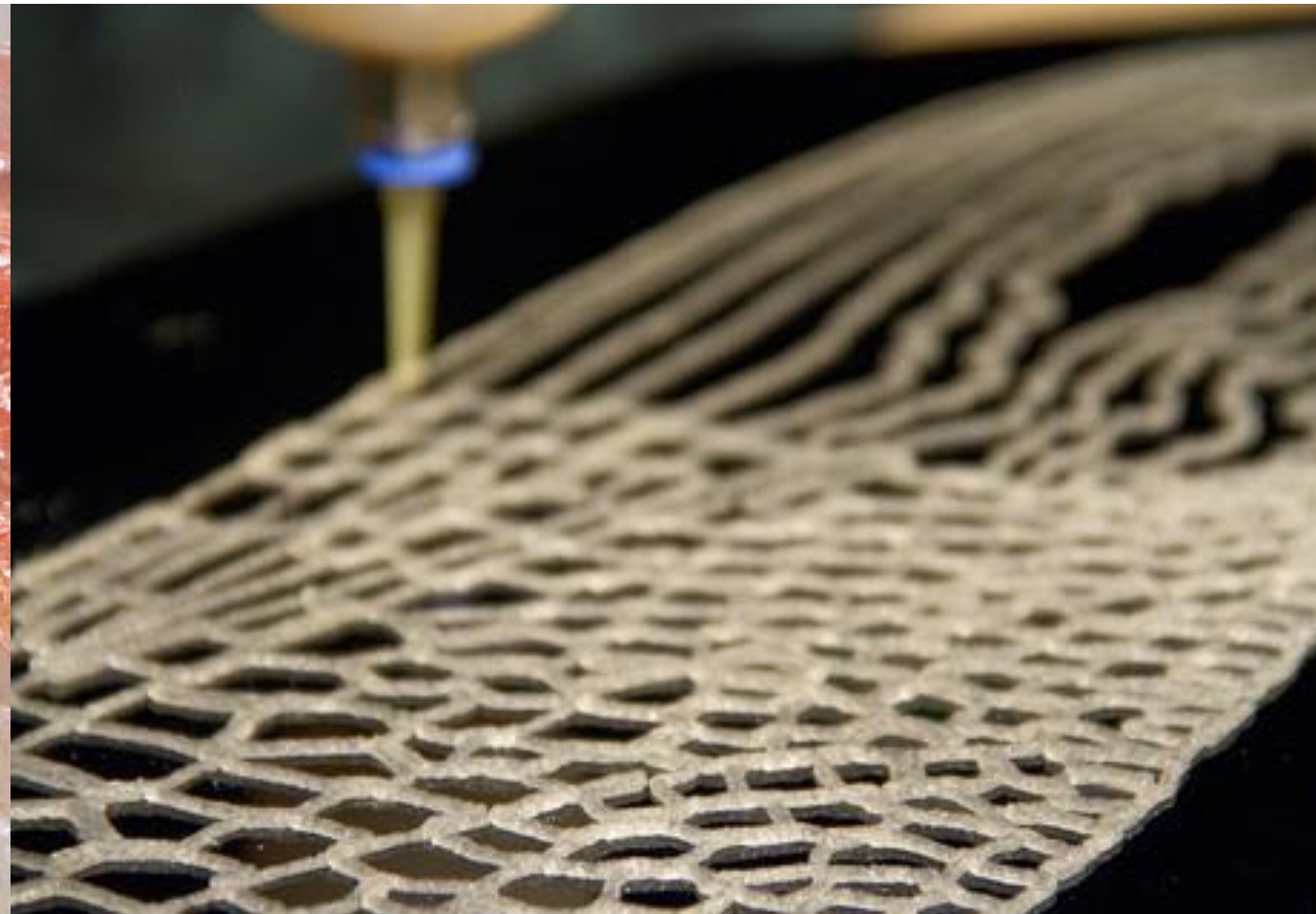
BIOPLASTICS

“The world has produced over nine billion tons of plastic since the 1950s. 165 million tons of it have trashed our ocean, with almost 9 million more tons entering the oceans each year. Since only about 9 percent of plastic gets recycled, much of the rest pollutes the environment or sits in landfills, where it can take up to 500 years to decompose while leaching toxic chemicals into the ground.”

The Truth About Bioplastics - Columbia University Earth Institute

Bioplastics

Chitosan (shrimp shells) second most abundant organic material on Earth



Water soluble 3D printed architectural panels made from shrimp shells with light sensitive organisms trapped in air bubbles
Neri Oxman, MIT

Ooho!

Edible and biodegradable.
The alternative to plastic.

Ooho is a flexible packaging for beverages and sauces. It's made from Notpla, our material combining seaweed and plants. Ooho biodegrades in 4-6 weeks, or you can just eat it, making it ideal for on the go consumption.



London Marathon Runners Were Handed Seaweed Pouches Instead Of Plastic Bottles

notpla.com



LEGO now uses a polyethylene plastic made from ethanol produced from sustainably sourced sugar cane for the trees, leaves and other vegetation in kits. It hopes to produce all LEGO pieces from the bioplastic by 2030.

Best materials for classrooms for bioplastics investigations

- Agar (agar agar) - Red algae. Used in Japanese cooking, petri dishes.
- Chitosan - made from chitin (mainly shrimp & crab shells). Used as a natural bio-pesticide, water filter, bioadhesive, wound dressing.
- Gelatin plastic - easy to source and make (but is an animal product).



source: wikimedia

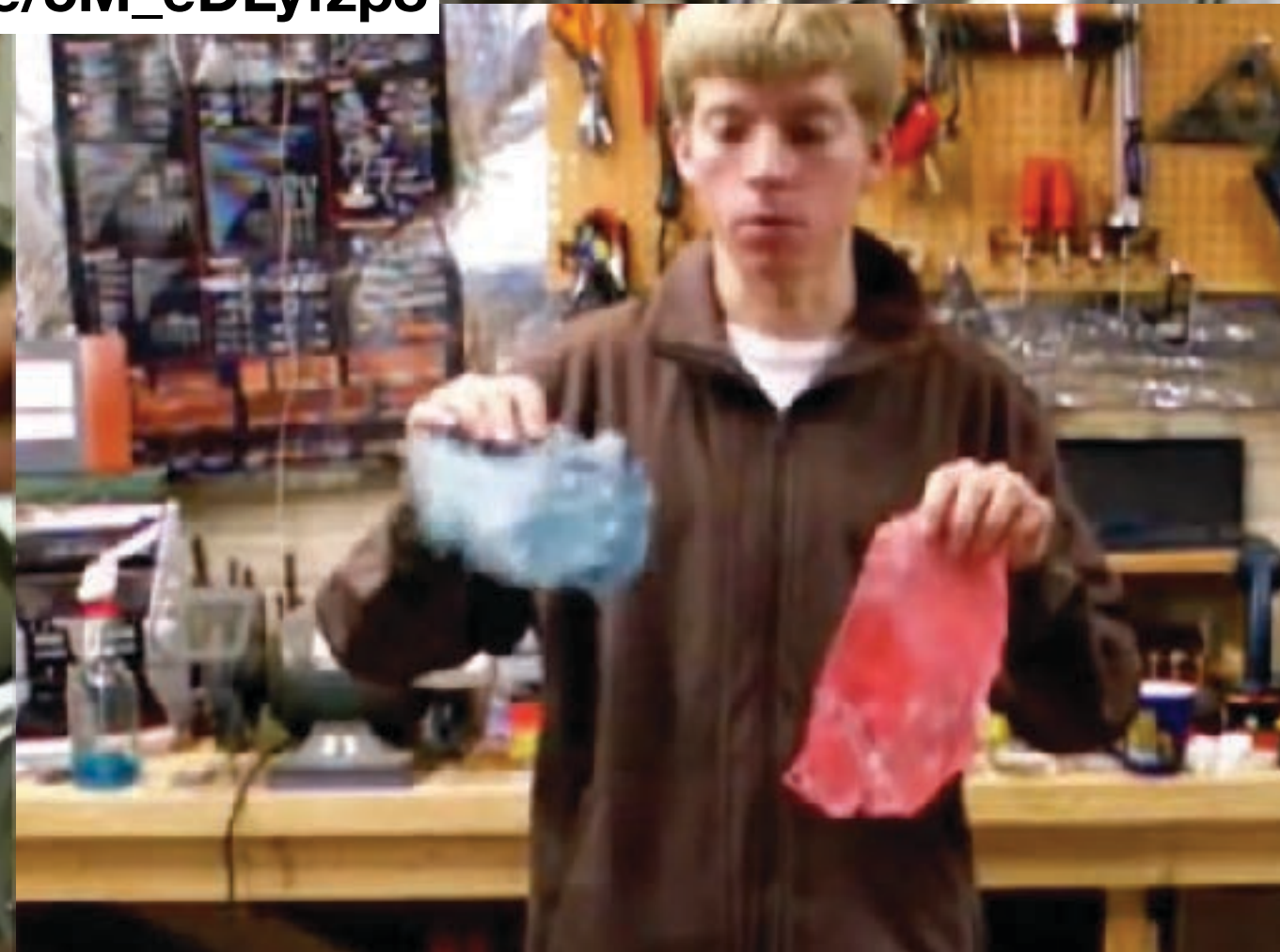
Classroom friendly bioplastic recipe

- Agar agar, glycerin, water
 - Dried agar agar bars can be purchased at Japanese markets
 - Powdered agar can be purchased from a scientific supply online stores like Carolina Biological Supply Co carolina.com
- Cook, cool, and pour into sheets or shallow molds
- Dry 1-2 days





https://youtu.be/5M_eDLyfzp8





Corinne Takara - used with permission

BioPlastics Resources

#bioplastics

Follow #breakfreefromplastic
#sustainabledesign

- Notpla Food pods - notpla.com
- Wyss Institute for Biologically Inspired Engineering (Harvard) - wyss.harvard.edu
- Agar based packaging - materialdistrict.com/article/agar-plasticity-exciting-potential-seaweed-based-packaging/
- Multiple recipes for making your own algae based plastic making-biodiesel-books.com/algae-bioproductions/algae-bioplastics/make-bioplastics-from-algae/
- Materiom - Chitosan plastic - materiom.org/recipe/48. Gelatin plastic materiom.org/recipe/22

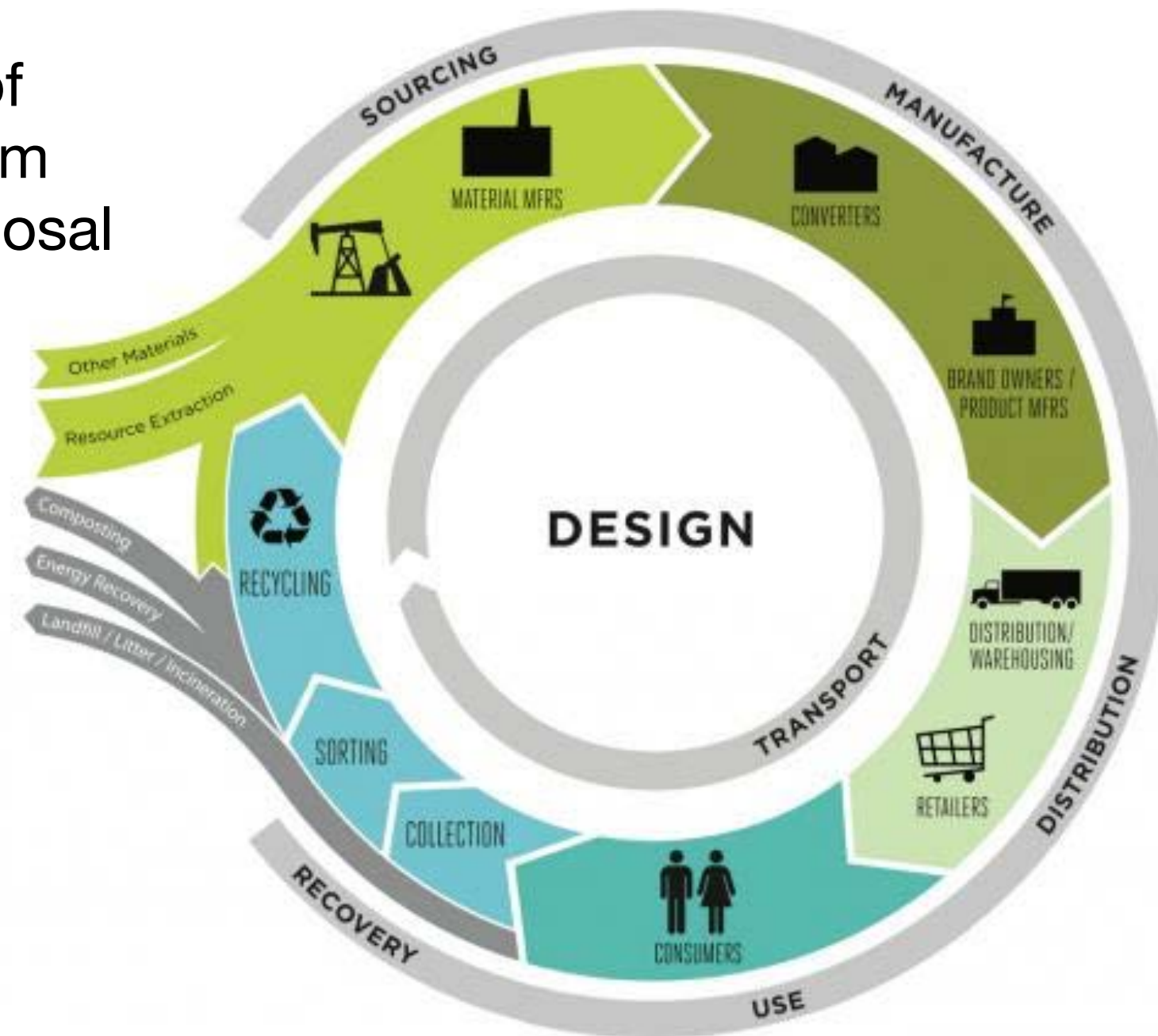


Outcomes

- Extend projects over time, integrate with other ongoing projects. Growing things takes time
- Teach students to slow down
- Improve observation skills
- Improve relationship with natural world - especially “icky” things
- STEAM - artistic use of materials, cultural connections, ecology, concern about environment
- Encourage young people that the problems of the world can be solved - by them

Circular Design

- Takes into account all aspects of product or system life-cycle, from material source to eventual disposal
- Use waste-stream products as source materials
- Design to eliminate waste and pollution
- Sustainability
- True life-cycle costs



Encourage evidence-based conversations



Earth Day Network  @EarthDayNetwork · Jan 2

There's always a huge argument about which packaging is the most sustainable. Cotton? Plastic? Paper? **Bioplastics**? The truth is they each have their own issues and the most [#sustainable](#) packaging is none at all. [#EndPlasticPollution](#) [#Reduce](#) [#Reuse](#) [#zerowaste](#)



Biomaking & Biohacking

Biomaking - *Making with Biology*

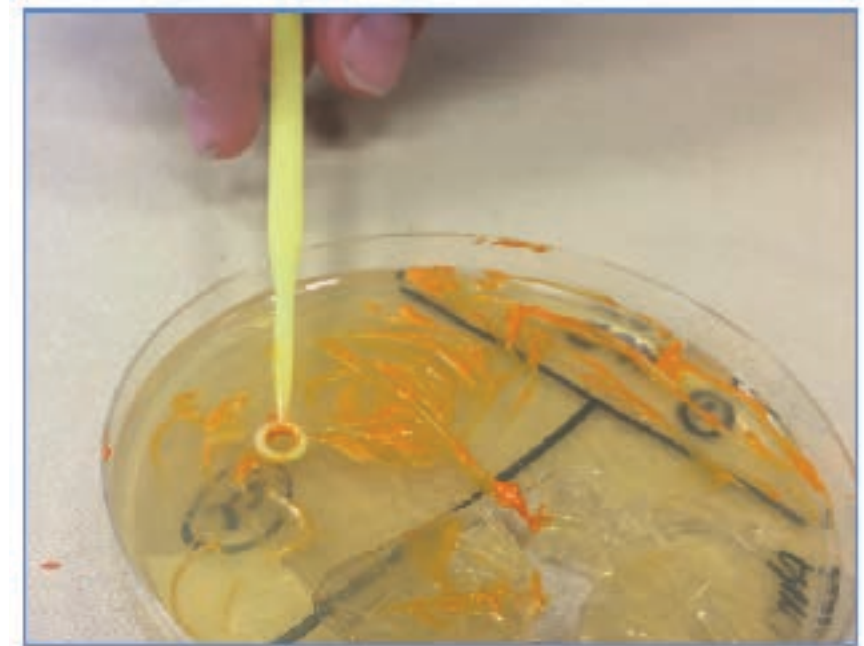
- Grow materials out of fungus, bacteria, and other organisms
- Students learn about the invisible living world around us
- Connections to global cultures that make, eat, and use materials that might seem “yucky”
- Understand global ecological issues
- Accessible now



Fungus “monster” pots

Biohacking - *Biology Making*

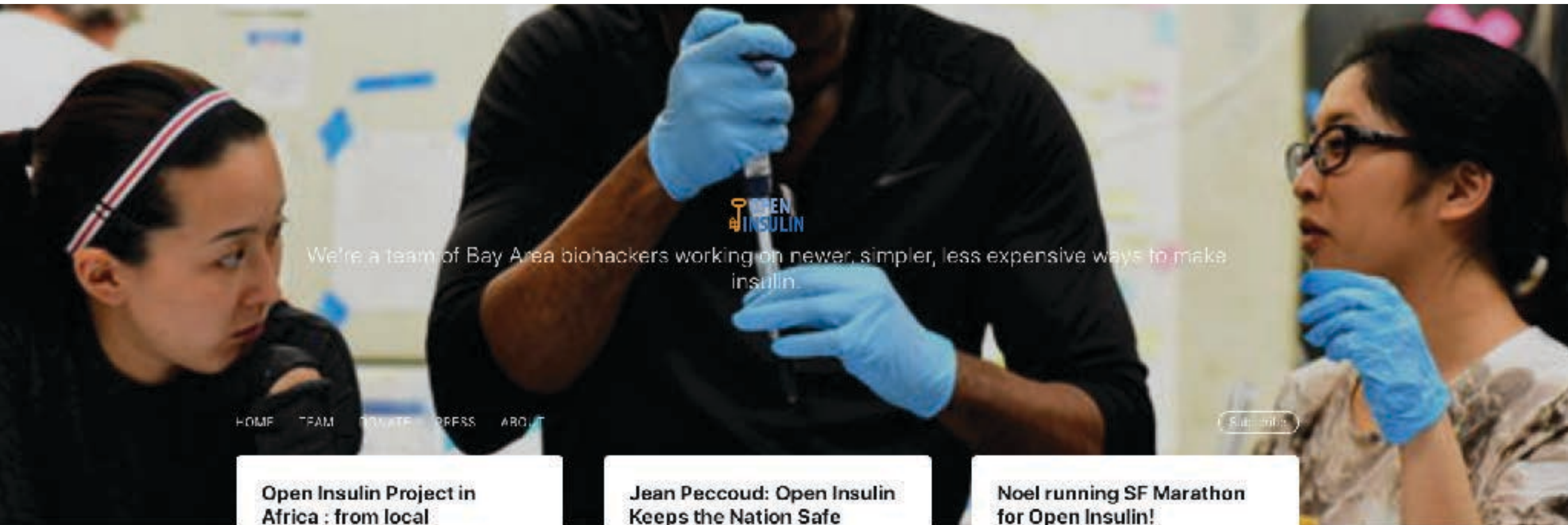
- Synthetic biology
- Design with biological materials, including manipulating genetics
- Students learn how biology is another tool for design.
- Connect to cutting edge real-world research and applications: new drugs, bacteria that detect chemicals, smart materials, programmable bio-organisms
- For brave pioneers



Genetically modified bacteria glows in presence of pollution

The Open Insulin project

Biohacking as a tool for justice, empowerment, & development



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[Subscribe](#)

Open Insulin Project in Africa : from local communities to the lab

Contact With the Open Insulin Project
In September 2017, I gave a talk at the Biosummit (organised by MIT-Medialab) on the topic : Biohacking in Africa : a tool for justice, empowerment and development. During

THOMAS MBOA

Jean Peccoud: Open Insulin Keeps the Nation Safe

The following is a guest post by Jean Peccoud, Department of Chemical & Biological Engineering, Colorado State University. Jean hosted Anthony's talk at CSU in September of 2016, and remains engaged in the

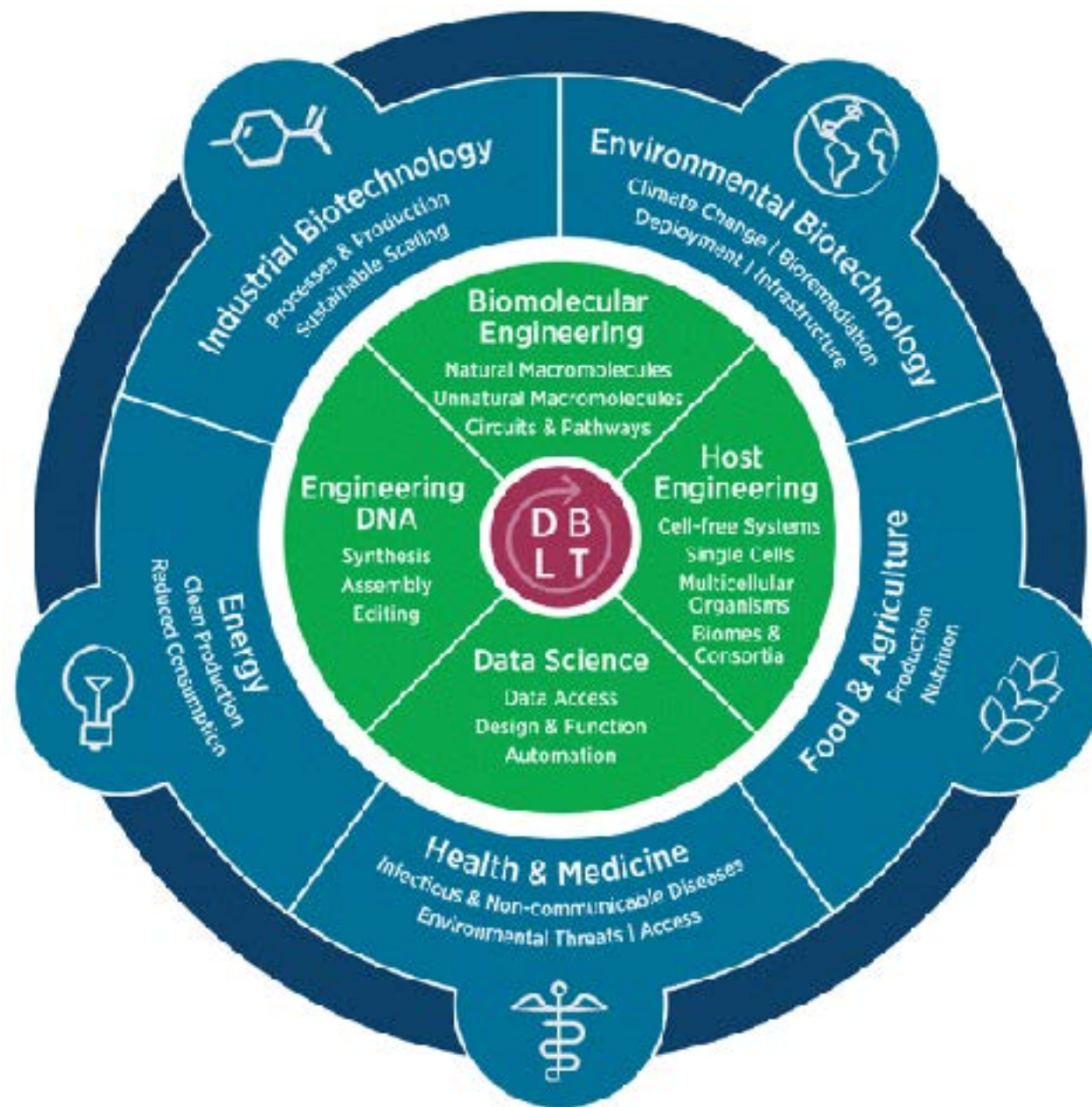
ANTHONY DI FRANCO

Noel running SF Marathon for Open Insulin!

Hi all, our computational protein modeling expert Noel is running the San Francisco marathon this weekend to raise funds for the project! He's made a mini-documentary about the project as well which you

ANTHONY DI FRANCO

Synthetic biology



- We can design building blocks of life, combine and remix them
- DNA can now be fabricated, genetics altered to create desired characteristics
- Don't have to wait for evolution
- Design microbes that generate cheap alternative energy, attack tumors, deliver medicine, detect fertilizer runoff in drinking water, reveal the location of land mines...

Iterative Biological Design

- Identify new genetic modifications that have desirable characteristics - like glow in the presence of pesticides
- Computer models generate DNA sequences
- Assemble DNA molecules from synthesized building blocks
- Test in living cells and compare to simulated predictions





Synthetic Biology

based on standard parts

About

What is iGEM?

iGEM Values

Previous Competitions

Leadership

Staff

Financials

FAQ

Contact

Blog

Programs

iGEM Competition

Labs Program

Parts Registry

Alumni



Welcome to iGEM

The iGEM Foundation is dedicated to education and competition, advancement of synthetic biology, and the development of open community and collaboration.

The main program at the iGEM Foundation is the International Genetically Engineered Machine (iGEM) Competition. The iGEM Competition is the premiere student competition in Synthetic Biology. Since 2004, participants of the competition have experienced education, teamwork, sharing, and more in a unique competition setting.

iGEM is also much more than a competition; our community has a long history of involving students and the public in the development of the new field of synthetic biology.

iGEM 2016 Competition

Late registration ends May 1! Late registration runs from April 1 to May 1 and is an extra \$500 USD.

Visit 2016.igem.org for more information.

Giant Jamboree

October 27 - 31 -- Hynes Convention Center -- Boston

Join us at the iGEM 2016 Giant Jamboree! More information about the Giant Jamboree will soon be available at 2016.igem.org/Giant_Jamboree. You can find information about the iGEM 2015 Giant Jamboree [here](#).

iGEM 2016 Announcements



Receive up to 20 kb of free
DNA for your iGEM project

[Get my free DNA »](#)



WHAT

- Hack & Make with living matter
- Open Documentation
- Upcycle

WHO

We are a biohacking community in Renens, an association, based on 20 CHF/month membership, open to everyone on wednesdays. We like zombie kittens.

BIONACKING

Hacking is about appropriating technology & building something new, allowing other realities to exist.

CODE

It's about breaking the rules, not the law. We respect the DIYbio code of ethics European Delegation, May 2011 (Source: diybio.org)

BECOME A MEMBER

If you wanna join and access 24/7 drop us an email to hello@hackuarium.ch and we'll get in touch.

WHY

WE WANT
TO BRING BIOLOGY
TO THE WORLD
AND THE REAL
WORLD BACK TO
BIOLOGY IN A
NEUTRAL, OPEN,
NONCOMPETITIVE
AND
NOT-FOR-PROFIT
ENVIRONMENT.

WE DO OPEN RESEARCH,
OPEN INNOVATION, ROCKET
SCIENCE, ART & DESIGN EXPERIMENTS
AND WE DO IT TOGETHER!

Open
Hackuarium
Nights

Every wednesday
7pm - midnight

we have
always been
biohackers!
we are all
lichens!

FOLLOW
THE GREAT
OCTOPUS
WWW.HACKUARIUM.CH



COPYRIGHT SAATCHI 2007 Hackuarium, Vincent Lemaire

Hackuarium

- wiki.hackuarium.ch/
- Resources, projects, open source activities, tool lists

START LEARNING

BioBuilder for Students

What would you build with biology if you could build anything? A plant that can detect carbon monoxide? A fish that can clean up oil spills? With BioBuilder, you can explore the vast opportunities that exist in the worlds of biology and engineering. And while some ideas remain more fiction than science, it's possible to explore them in different ways with our curriculum, in [afterschool clubs](#), and through [local apprenticeships](#).



What is Synthetic Biology?

Synthetic biology combines the facts we've learned in biology textbooks with the tried and true principles of engineering so we can make and model useful living systems. The best-case scenario: we make novel systems that work reliably and address important world problems. The worst case: the systems we build fail the first time, and the second, and the third – possibly in surprising or dangerous ways. At this early stage, both the successes and the failures teach us a great deal, and while we still have a long way to go before it's easy to genetically program cells to perform particular tasks, we learn by trying and ultimately advance everyone's understanding in this emerging field.

MORE RESOURCES FOR STUDENTS

Purchase the [BioBuilder textbook](#), published by O'Reilly Media.

Access more of BioBuilder's curriculum on [Amazon Inspire](#).

biobuilder.org

BioBuilder

Open source curriculum



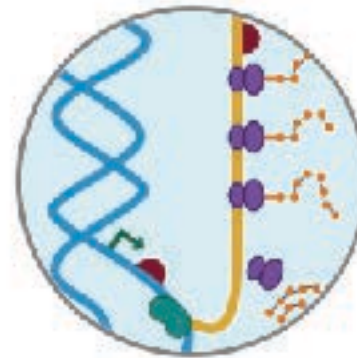
EAU THAT SMELL

In this lab, normally stinky smelling bacteria are made to smell sweet, like bananas. You can learn to grow microbial cells, measure their growth, analyze their genes on a molecular level, and learn basic synthetic biology concepts related to system design and logic gates.



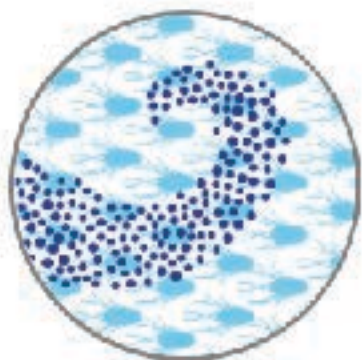
GOLDEN BREAD

With this lab you can explore the science, engineering, and bioethics of a yeast that's genetically modified to make a vitamin-enriched food. Explore how the cell's "break," how to fix them, and what they might do in locations where Vitamin A deficiency affects public health.



ITUNE DEVICE

This lab focuses on predictable design. You can learn to assess the strength of genetic "parts," such as promoters and ribosome binding sites, to see how they influence the output of a genetic device.



PICTURE THIS

Modeling and design of a genetic circuit is presented through three activities. You'll learn how a two component sensing system can be modeled and then re-engineered to produce bacterial photographs.



WHAT A COLORFUL WORLD

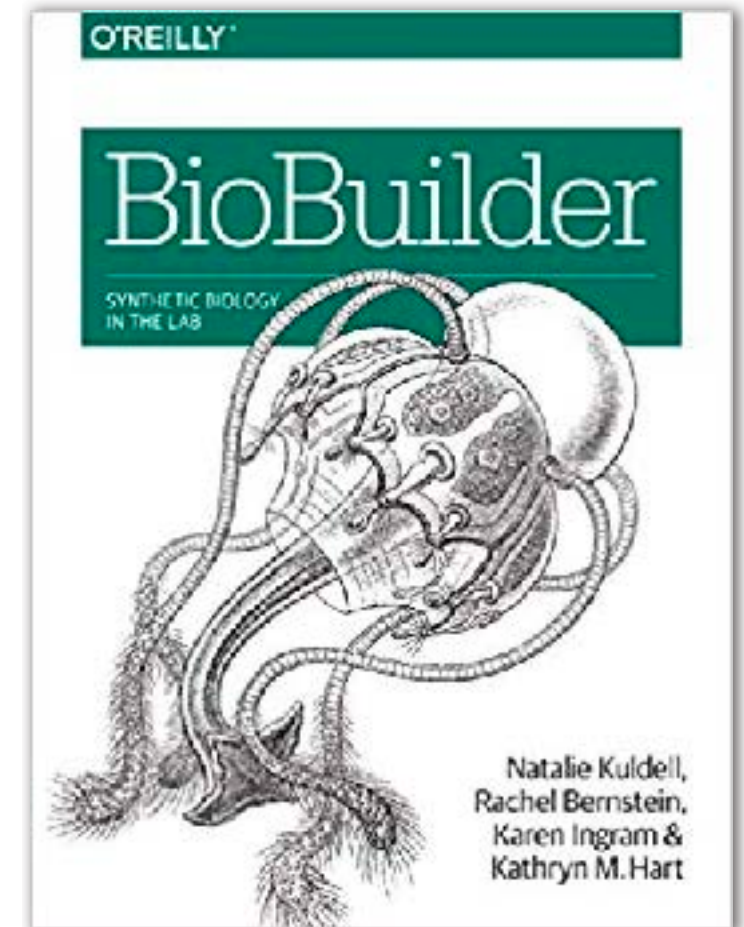
In this lab, two cell types are transformed with two color-generating plasmids, a process that is fundamental to genetics and inheritance lessons, molecular biology, and research examining DNA and gene expression.

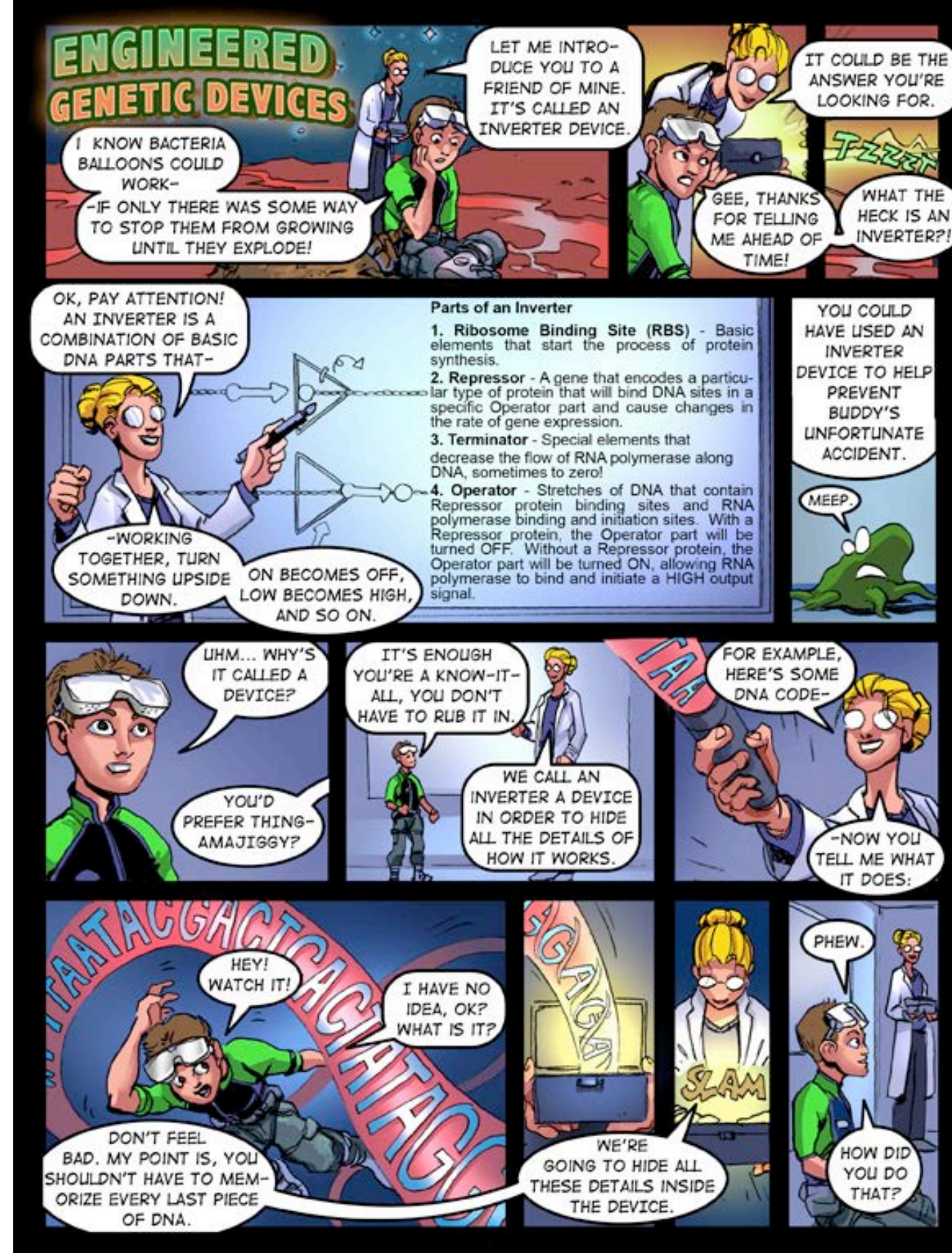
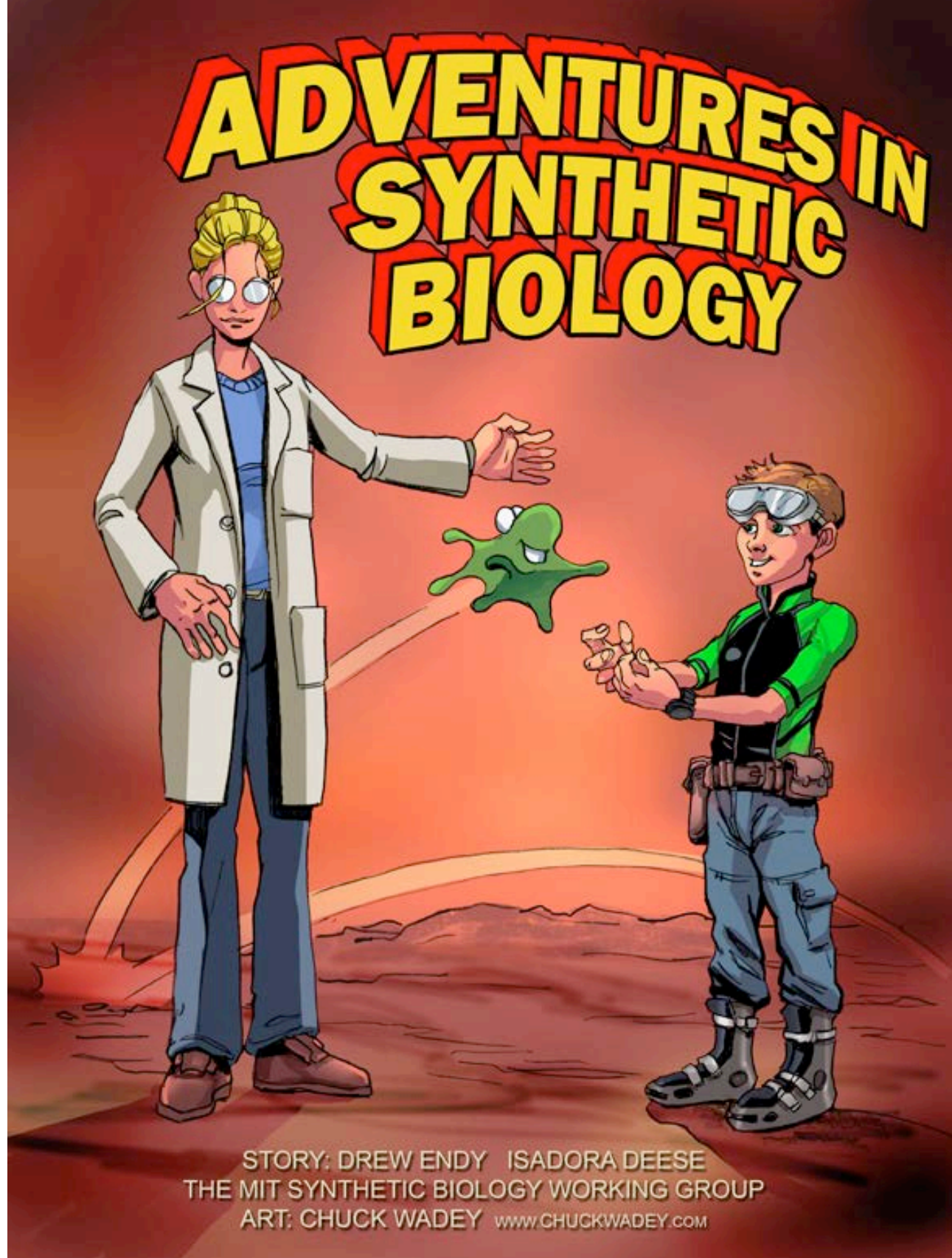


BIOETHICS ESSAY

Synthetic biology has only recently emerged as an engineering discipline. Students are asked to weigh in on the question: Do the potential contributions to society warrant the potential risks inherent in synthetic biology?

Textbook





biobuilder.org

Resources, lab kits, workshops

[ALL PRODUCTS](#)[HUMAN CELL CULTURE](#)[CLASSES](#)[GENE ENGINEERING KITS](#)[PLANTS](#)[T-SHIRTS](#)[SALE](#)[Search our store](#)[MY CART \(0\)](#)[Call us on \(707\) 879-8635](#) [My Account](#) [Wish Lists](#) [Order Status](#) [Gift Certificates](#) [Sign in or Create an account](#)

DIY Bacterial Gene Engineering CRISPR Kit

\$169.00

Shipping: Calculated at checkout



★★★★★ 15 product reviews

Quantity:

1

Add To Cart



Add to Wishlist

Product Description

We ship 2-3 day in the US.

Due to the overwhelming number of emails we will not respond to emails asking when your item will be shipped. Understand we are doing our best to get it to you.

Comes with an example experiment that teaches you many molecular biology and gene engineering techniques.

Want to really know what this whole CRISPR thing is about? Why it could revolutionize genetic engineering? This kit includes everything you need to make precision genome edits in bacteria at home including Cas9, tracrRNA, crRNA and Template DNA template for an example experiment.

Includes example experiment to make a genome mutation (K43T) to the rpsL gene changing the 43rd amino acid, a Lysine (K) to a Threonine (T) thereby allowing the bacteria to survive on Strep media which would normal prevent its growth.

Kit contains enough materials for around 5 experiments or more.



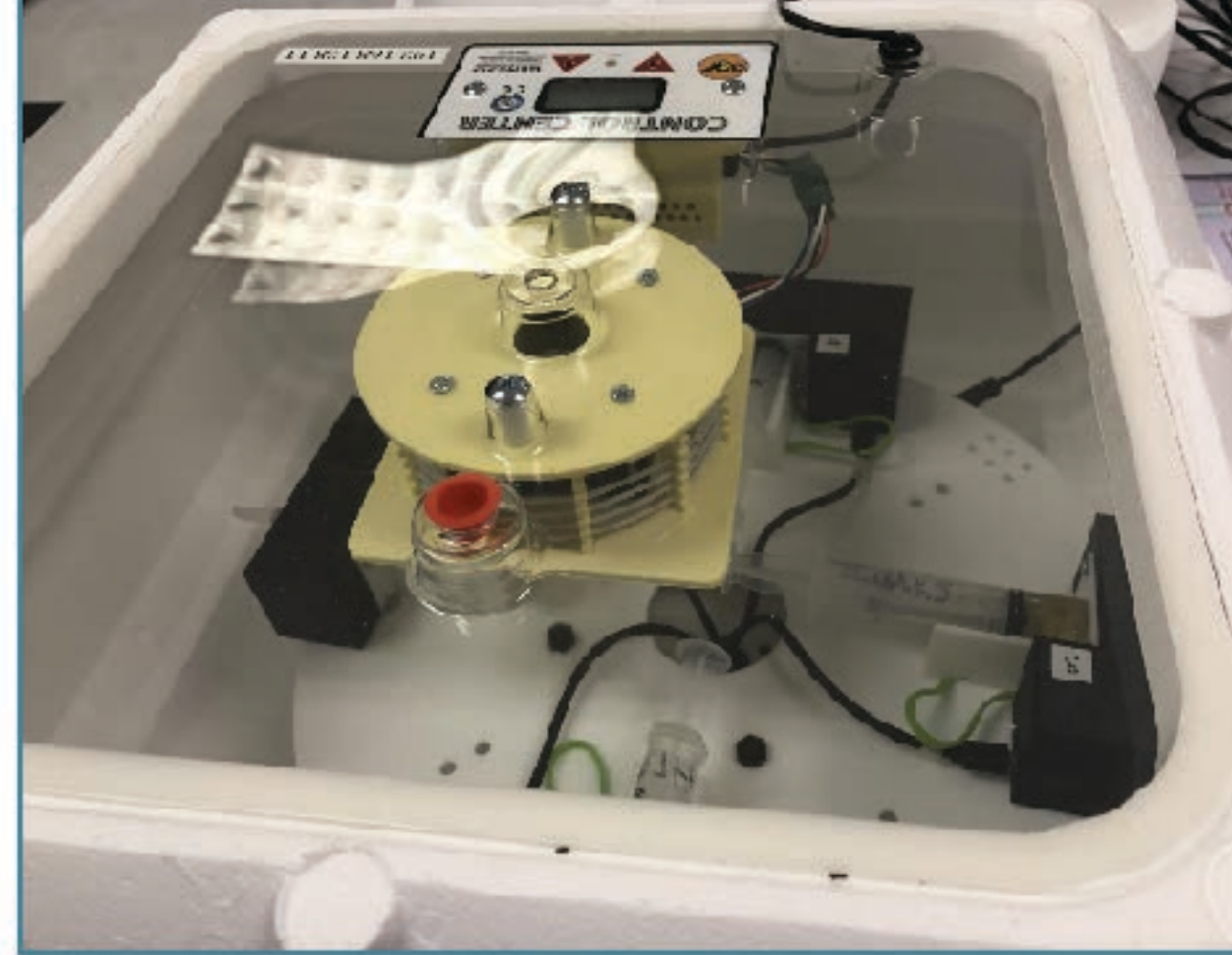
Roll over to magnify and click to enlarge



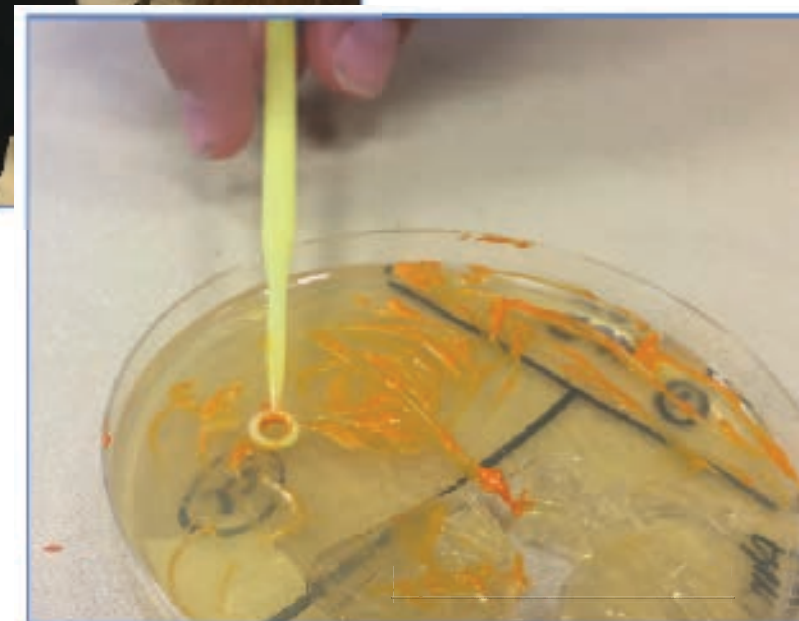
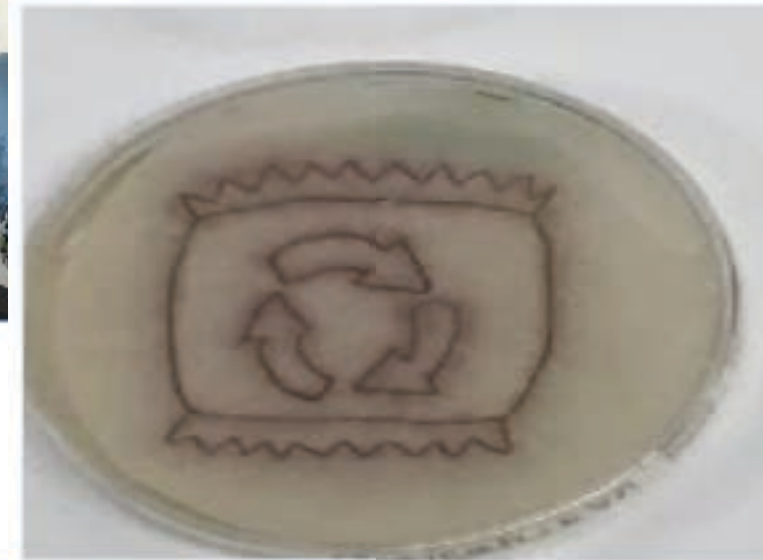
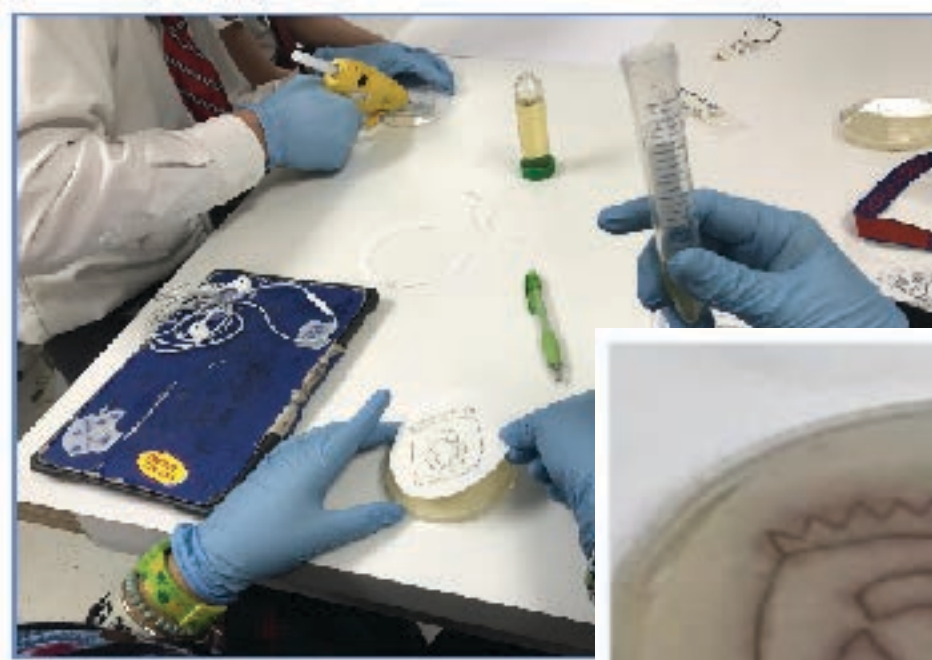
the-odin.com

biomakerlab

- Prototype stage: a low cost mobile lab device used to genetically modify and fabricate (grow) bacterial or yeast cells
- 3 units of HS curriculum being developed with UPenn (PennDesign Emerging Design Practices, and Grad School of Education)



- bioLOGO - genetically modify bacteria cells to produce pigments
- bioCAKES - design nutrient rich food products with synthetic yeast cells
- bioSENSOR - design a sensor that detect pollutants by creating a bacterial cell that fluoresces in their presence



biomakerlab.github.io



This high school synthetic biology workshop used a microblogging site to host discussions led by students of the social and scientific impacts of synthetic biology.

What is your initial reaction and why? Mentimeter

I think this is good idea. It doesnt hurt anybody and keep animal safe. There's no evidence that anything will happen to ocean so who cares.

I like this. The spider's web is not getting affected by humans. (we are already causing problems). Also more insects will be killed.

It depends because there are benefits, but at the same time we are unsure of how it will be disposed and the negative disruption of food webs

I agree with this idea because humans themselves already damage the enviroment as it and plastic is far worst than this silk they've created

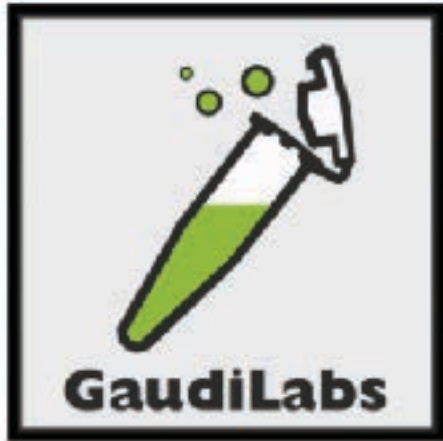
I agree with this idea because even though I don't favor spiders, it's still saving their lives. The environment is already very polluted...

there is no proof that 7tthis would cause global warming, but I like the idea of not using real spiders.

9

Welcome to

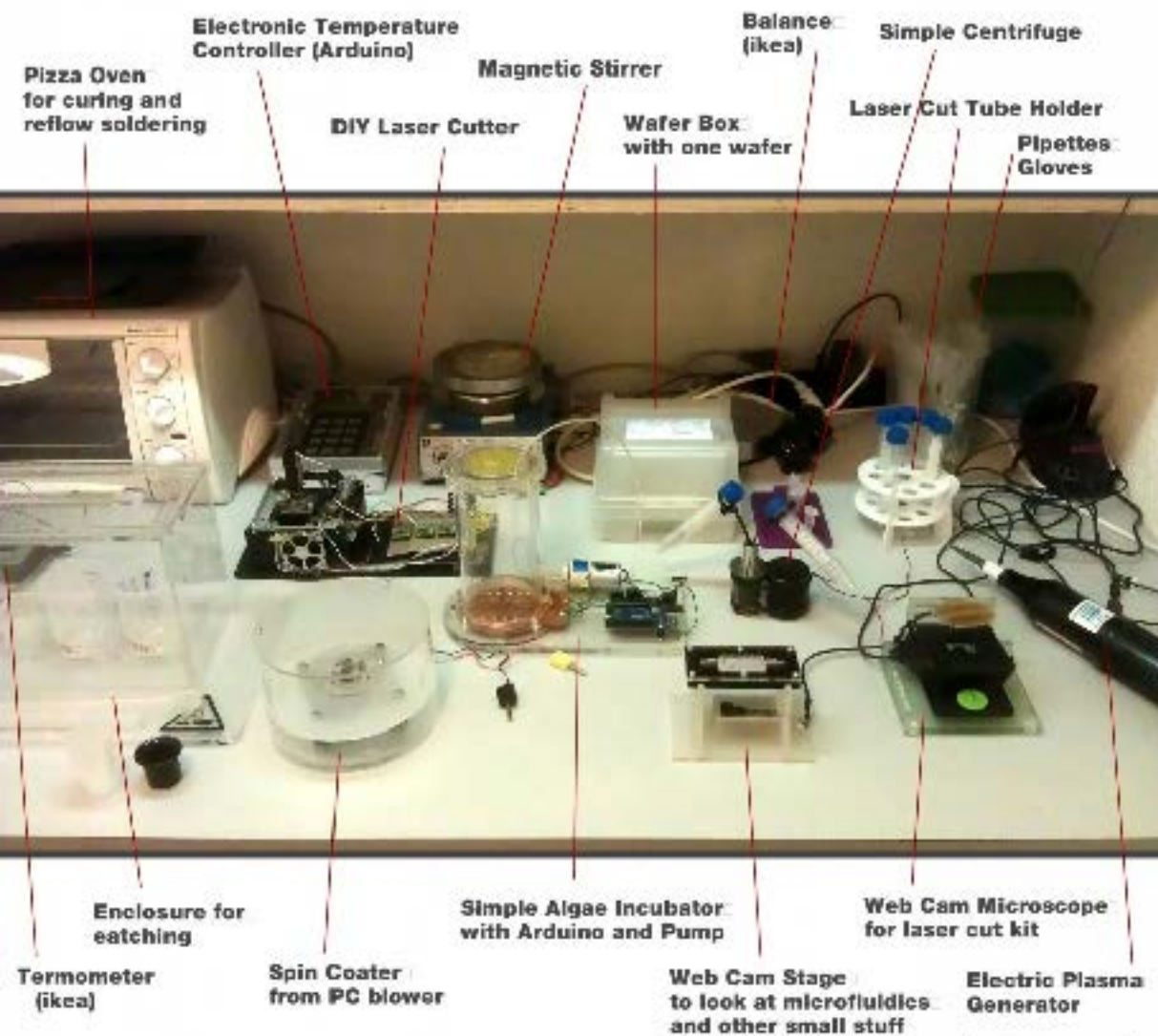
OPEN CULTURE TECHNOLOGY



GaudiLabs

gaudi.ch/GaudiLabs/

DIY Lab Equipment



BLOG

THE LAB

PROJECTS

TRANSFORMATIONS

SHOP

CONTACT

Generic Lab Equipment



To start up an independent and open lab it is crucial to get affordable lab equipment. Most of the tools we use are do it your self (DIY) and open source and are built from widely available and recycled parts found in consumer products such as DVD drives, hard disks and pc fans. Building the specific devices further helps to understand the basic principles behind and learn more about the technologies and methods used. The discussions among scientists and engineers in the process of rethinking the devices to make them more accessible are very fruitful and often lead to new and innovative designs.

Support the pursuit and growth of knowledge through open science hardware (GOSH):

<http://openhardware.science/gosh-manifesto/>

See also summary of [Hackteria Open Source Hardware](#)



**Where
educators
invent the
future!**

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July 25-28 2022

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constructingmodernknowledge.com

Thank you!

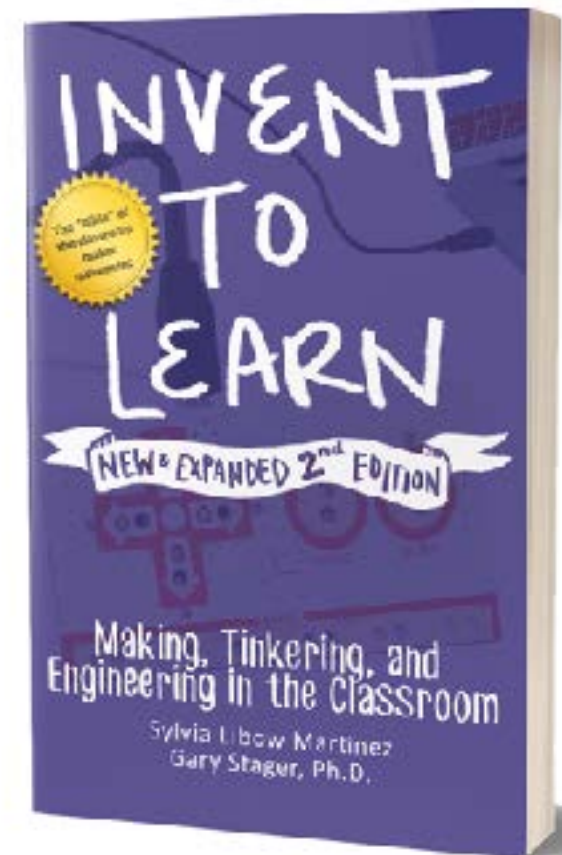


Sylvia Martinez

sylvia@inventtolearn.com

sylviamartinez.com

Twitter: @smartinez



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