



Nest Makerspace Biodesign Challenge Syllabus 2018-2019

Course title: Biomaterial Play/ Exploring Toy Kit Concepts

Instructor: Corinne Okada Takara

<http://www.okadadesign.com/> & <https://nestmakerspace.weebly.com/>

There is a need for biodesign journeys at the high school level since solutions to our pressing environmental issues will depend upon deep innovation through blended explorations across disciplines, and a teen group exploring these issues from an art/design angle can create a point of entry for biodesign conversations with a larger public and younger ages. Students and adults alike often feel overwhelmed by global large scale environmental systems issues. How might we develop playful and engaging biomaterial design experiences that make sustainability topics fun, exploratory and expand people's sense of agency and deep connection to the nature around them?

“What’s important is that children have an opportunity to bond with the natural world, to learn to love it and feel comfortable in it, before being asked to heal its wounds.” (Sobel 13)

This Biodesign Challenge team has decided to explore developing toy building kits for youth that are flexible and playful introductions to both biomaterials and locally sourced natural materials.

What are the pressure points of growing materials for building kits? How do you incorporate inevitable biological culture failures into the play experience? How do you build patience for the time it takes to grow biomaterials? Who is the target audience and how do you survey and test prototypes with them? Where will your product be sold, that is, what is the market framing for such a hybrid toy? How does it fit into a circular design economy; what existing waste flows are you tapping into for the product? What play patterns are you encouraging and what age ranges are you targeting? If you are aiming for the user to see bio materials as useful for future build structures, how might you incorporate sensors into the kits that might test how a built structure design holds up to a range of climate change pressures? These are some of the questions we will be exploring in this series.

This biodesign journey will introduce students to biomaterials through the growing of bacterial cellulose and fungus mycelium. They will explore ways to make assembly projects with the resulting materials. Students will also conduct research with their target market through test workshops in their communities. Since this project is being conducted in a garage makerspace, students will also be incorporating 3D printing, laser cutting, vacuum forming and coding with microprocessors into their prototyping. The journey will culminate in both a final Biodesign Challenge project and also in the creation of introductory biomaterial lesson plans that the team will share online and in local free public workshops.

Team webpage: <https://nestmakerspace.weebly.com/bio-challenge-team.htm>

Team project website: <https://giybiobuddies.weebly.com/>

Reading materials:

- [The Value of Play Report](#) (released Nov 2018 by LEGO Foundation, IKEA, National Geographic & Unilever)
- [Beyond Ecophobia](#), Reclaiming the Heart in Nature Education by David Sobel
- [BioArt](#), William Myers (we will review this book together via the Canvas portal and we have one print copy)
- [Animal Architecture](#), Ingo Arndt
- [Binti](#) science fiction series by Nnedi Okorafor
- [Structural Packaging Design](#) (Japanese book)

Resources:

- <https://www.materialdriven.com/>
- <https://materiom.org/>
- <https://www.circulardesignguide.com/>
- <http://www.resilientbayarea.org/bytool>
- <https://www.drawdown.org/>
- [Resource pages](#) of Bio Design Challenge
- <https://asknature.org/>

Mentor:

Tito Jankowski, founder of BioCurious and Co-Founder and CEO of [Impossible Labs](#)

First meeting with Tito in January

A 20 minute feedback/check-in with mentor every 3 week

Tito suggested we check out:

- [Magical Microbes](#) in SF, Keegan Cook
- IDEO: play lab, [Brendan Boyle](#)
- <https://vimeo.com/138899992>
- <https://inhabitat.com/e-chromi-designer-bacteria-will-color-your-poop-according-to-what-ails-you/>

Final project can be a proof of concept. Doesn't have to be fully realized solution. For example, girls can use wax paper as stand in for prototyping of kombucha wings. "Project can be important if one is making progress in biodesign engagement with people."

Examples of past kit submissions:

1. [Starter Culture](#) by the Maryland Institute College of Art 2016 team was a kit focused on introducing adults learners to the world of biomaterials
2. [Kichin](#) by the Pratt Institute 2017 team was a kit where users could create their own household items with a biodegradable alternative to plastic
3. [Werewool](#) by the Fashion Institute of Technology 2018 team won last year's prize for Outstanding Presentation. The team developed a kit for citizen scientists to produce new types of fiber by synthesizing proteins that are genetically altered to bond together.

SCHEDULE

Field Trips

- **Field trip 1: An introduction to setting up experiments with biomaterials**, the Tech Museum of Innovation BioDesign Studio. (2 hours) Anjz Scholze, PhD and Caitlin Nealon, PhD ([photos](#)) September 2018.
- **Field trip 2: An introduction to bio 3D printing and microfluidics**, SE3D. (2.5 hours) Mayasari Lim, PhD ([photos](#)) October 2018.
- **Field Trip 3: Target store visit/audit of existing toy market** (TBD)

Presentations, workshops, and surveys

- **Survey on Play at SJMADE Holiday Craft Fair** Team will set up a table to conduct a survey on play with children attending the holiday fair. They will survey favorite types of play, experience in nature, experience in growing plants and having pets, and they will document responses to several biomaterials in toy prototypes. December 15 and 16, 2018. ([photos](#)) and [more photos](#)
- **FabLearn Conference NYC** team presents bacterial cellulose toy kits and lessons. March 9th-10th, 2019 (also a survey opportunity with international makerspace educators)
- **AYA Makerspace Workshop** 4-6 pm, April 8th, 2019, An after school workshop testing out the petri dish kaleidoscopes. Mathson Middle School, San Jose, CA ([photos](#))
- **Kombucha Leather workshop at Tech Museum Bio Tinkering Lab**, San Jose, CA. 1-4 pm, April 28th, 2019. Team will test out kombucha leather kit activities: petri dish kaleidoscope, Lego compatible wings and paper doll activity.

Workshops (tentative)

Makerspace Workshop 1: Anchoring into the Challenge

October 19th, (3 hours) ([photos](#))



- A brainstorming and ice breaker workshop led by Experience Designer/Product Designer [Lisa Whitsitt](#). Introduction to circular design, project planning and storytelling an idea.
- Also hands-on exercise with kombucha leather and laser cutter

Makerspace Workshop 2: Explorations with Kombucha Leather, Part 1

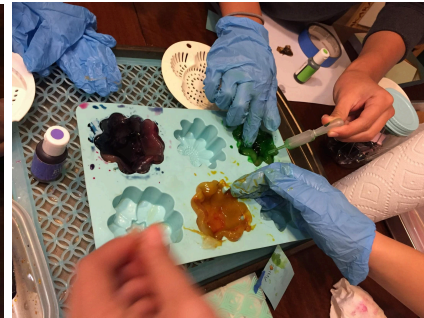
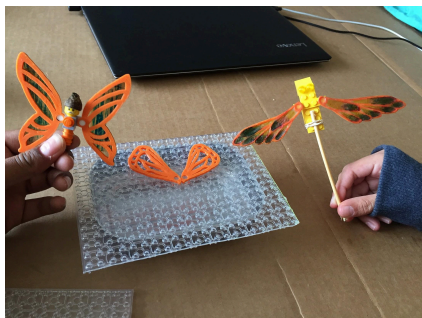


November 12th, (2.5 hours) ([photos](#))

- Exploring kombucha leather assembly design with illumination (with an eye towards writing a step by step lesson) The use of laser cutter, LED lights, 3V coin cell battery and soldering involved.
- Create starter batches of kombucha scoby cultures.

Makerspace Workshop 3: Explorations with Kombucha Leather, Part 2

December 9th, (3 hours) (pre workshop [notes](#)) ([photos](#)) and [workshop notes](#) summary from meeting 1 & 2



- Further explorations with kombucha leather (coloring, pressing into texture molds, blending sheets with 3D printed components, and starting new cultures). You will also have the opportunity to add inclusions of food waste; how might you leverage existing waste flows into product line?
- Google Hangout with Keegan Kirkpatrick CEO of [Redworks](#)



- Create survey sheets for survey to be conducted at San Jose Holiday Craft Fair.
- Create rough play prototypes with bio materials for children to interact with. ([questions to address in prototyping](#))

Makerspace Workshop 4: Explorations with Mycelium, Part 1:

January 13th, 1:00 pm - 4:00 pm

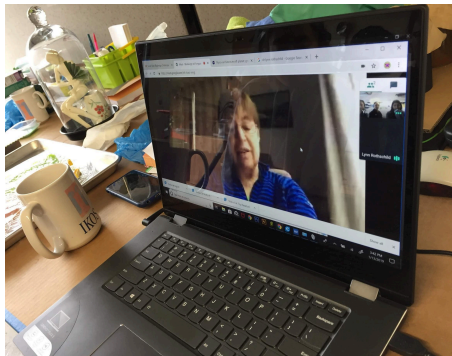
(3 hours) ([pre workshop notes](#)) ([photos](#))



- Meet with Biodesign Challenge Mentor, Tito Jankowski



- Debrief on youth survey conducted at Holiday Craft Fair.
- Google hangout with Dr. Lynn Rothschild of NASA Ames. She will talk to you about the NASA's [Myco-architecture project](#) and what they envision for Mars habitats.



- Introduction to growing fungus mycelium as a building material.
- Vacuum form molds to grow mycelium in.

Makerspace Workshop 5: Explorations with Mycelium, Part 2

January 26th, 1:00 pm - 4:00 pm

(3 hours) ([pre workshop notes](#)) ([photos](#))



- Mycelium explorations continued.
- Low res prototype of system ideas in sketches and simple models.
- Between now and next workshop, reach out to City of Cupertino regarding Earth Day/Arbor Day workshop and reach out to LEGO
- Start website assets list and develop website outline.

Google Hangout with Lego Studio, Denmark

January 29th, 7:45-8:15 am Sharing project concepts with Liam Nilsen, Learning Experience Designer



Makerspace Workshop 6: Sketching and Prototyping Concepts, Imagining Circular System

February 3rd, 1:00 pm - 4:00 pm

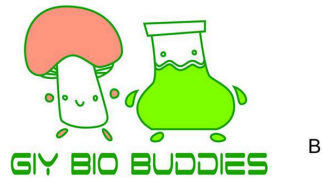
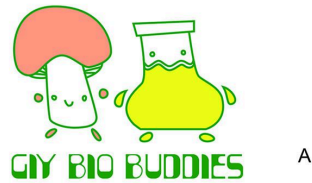
(3 hours) ([pre workshop notes](#)) ([photos](#))



- Structural experiment with mycelium in different substrates (Straw experiment suggested by NASA)

- Itemize kit components and discuss prototyping kit design
- Brainstorming on how to create a playful controlled habitat system for growth of biomaterial cultures.
- Discuss of Circular Design Guide and how to draw project feedstock from existing waste flow systems.
- Slide deck for FabLearn presentation (just outline the deck)
- Revise proposal to submit to Fablearn (*should take 5 min*)
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[Photos of exploration between meeting 6 & 7](#) (more images to be added to this folder soon)

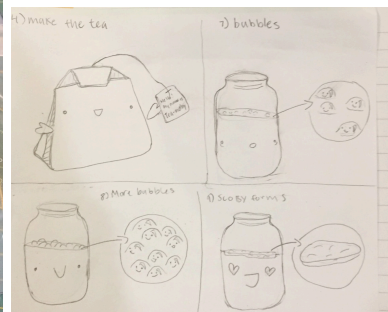


Above: Illustrator studies by team of logo

Makerspace Workshop 7: Kit Prototypes and recipes

February 24th, 1:00 pm - 4:00 pm

(3 hours) ([pre workshop notes](#)) ([photos](#)) we may not get to all items on the list



- Refine sketches of play components of kit and playful culture growing components of kits
- Visual step-by-step instructions (see Tito's samples)
- Discussion of the impact of intentional and unintentional metaphors being used in project.
- Discuss possible sensor prototyping and integration into system.
- Continue brainstorming on how to create a playful controlled habitat system for growth of biomaterial cultures.
- Create survey form for FabLearn

[FabLearn Conference](#) presentation ([photos](#))

March 9-10th NYC.



- Present on the 9th in the Student Panel presentation sharing explorations with bacterial leather.
- Collect feedback data from K-12 educators on their thoughts on the kit concepts

Makerspace Workshop 8: Kit System Incubator Prototyping ([pre-workshop notes](#)) ([photos](#))

March 23rd, 1:30 pm - 4:30 pm

- Discuss 3 point stress test with mycelium grown in different substrates in boba straws. First test failed. What went wrong and how might it be improved? How might material stress tests be incorporated into kits as part of activity?
- Play-Doh & cardboard prototyping of kit system look and feel.
- Laser cut and prototype kombucha leather paper dolls.
- Continue brainstorming on how to create a playful controlled habitat system for growth of biomaterial cultures.
- Vacuum form molds for mycelium growths
- Press incubated bark and coffee grounds into vacuum formed mold forms to grow mycelium for test workshop at Earth Day event.
- Recipe card for mycelium instructions

Makerspace Workshop 9: Sensors and Controlled Environments

March 31st, 1:00 pm - 4:00 pm ([photos](#))

- Guest Speaker Ken Hawthorn
- Visit Arduino Playground and Adafruit websites to learn about sensors to use with arduino: hygrometers, temp control, heat mat, CO2, other? Team's question, is it possible to make a long term timer (like a cooking dial, but with weeks and days on it?) Also, possible to make a mini seed heating pad for constant temp of kombucha culture?
- Sensor prototyping and integration into system.

Makerspace Workshop 10: ([pre-workshop notes](#)) ([photos](#))

April 7th, 1:00pm- 3:00pm

- Kit prototyping

AYA Makerspace Workshop April 8th ([photos](#))

This is a free after school middle school workshop at Mathson Middle School in Mayfair San Jose.

Makerspace Workshop 11 ([pre-workshop notes](#)) ([photos](#))([video created](#))

April 20th, 1:00 pm - 4:00 pm

- Incubator prototyping continued
- Review designs for timelapse petri dish mount
- Prep materials for Tech Museum workshop

Makerspace Workshop 12 ([pre-workshop notes](#))

April 27th, 1:00 pm - 4:00 pm (this will be an independent meeting without Takara as I will be at a conference)

- Prep materials for Tech Museum workshop
- Share independent work designs for kits
- Asset list for website and kit component list

Tech Museum focus group testing with kombucha activity (pre-workshop notes coming soon) ([photos](#)) ([pre assessment survey sheets](#)) ([post assessment survey sheet](#)) ([post exploration survey](#))

Raw [Survey data](#)

April 28th, 1:00 pm - 4:00 pm

Makerspace Workshop 13 ([photos](#))

May 4th (1-4:30pm), packaging design finalized and ordered. Talk with Justice Toshiba Walker

Makerspace Workshop 14

May (10th) 1:00pm -4:00pm ([pre-workshop notes](#)) ([photos](#)) video prep for submission and finalization of box.

Makerspace Workshop 15

May (18th) 4:30pm -6:30pm (pre-workshop notes) ([photos](#))

Makerspace Workshop 16

May 26th

Meeting to prepare all team materials for submission on the 27th ([photos](#))

Final assembly of mycelium coffee grounds incubator ([photos](#))

Makerspace Workshop 17

June 9th Finalist Team presentations and video files due. (Teams are required to submit their final presentations over Google Drive in either PPT or Keynote with separate video files. Late submissions will not be accepted.)

Summit Event set up : June 18th and 19th, gallery set up day

Summit Event: June 20th -June 21st

Instructor Feedback Session: 22nd, 11am-1pm

Farewell mixer: June 22nd (2pm-4pm)

REFERENCES

Sobel, David. *Beyond Ecophobia, Reclaiming the Heart in Nature Education*. Orion Nature Literacy Series, 1996.