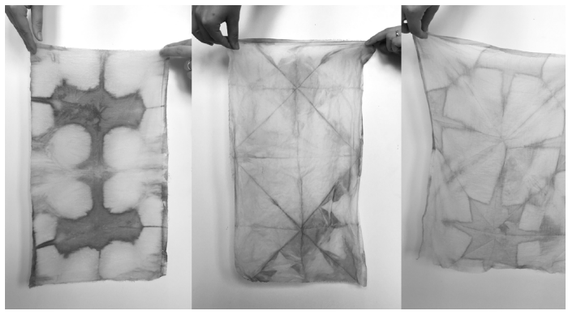
BEYOND BIOMIMICRY

MORE-THAN-HUMAN COLLABORATIONS



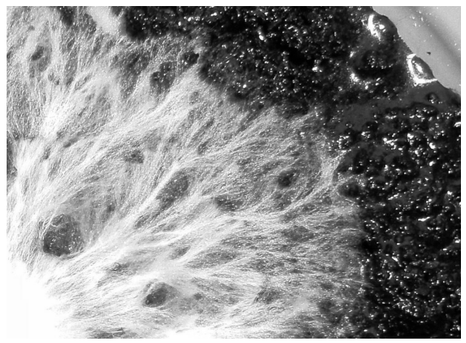
HUMAN-CENTRED DESIGN METHODS LED US INTO THE ANTHROPOCENE. WE NEED TO DEVELOP APPROACHES THAT ARE MORE IN TUNE WITH BIOLOGICAL SYSTEMS.

SEE ALSO: Biodata processing | A history of design and nature | DIY applied mycology

CRITICAL MAKING

CROSS-DISCIPLINARY READING

PERSPECTIVES ON THE KINGDOM OF FUNGI



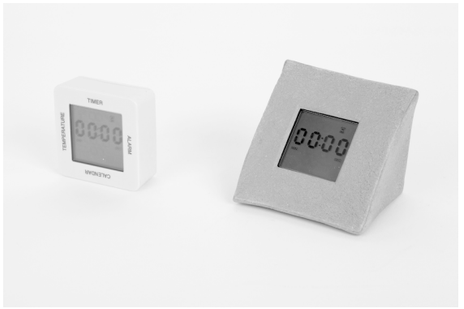
TO UNDERSTAND ANY TOPIC HOLISTICALLY, IT CAN BE ENLIGHTENING TO READ TEXTS EXPRESSING VERY DIFFERENT PERSPECTIVES ON AN AREA. WHAT CAN DIFFERENT DISCIPLINARY LENSES SHOW YOU?

SEE ALSO: DIY applied mycology | Microorganisms to get to know | A history of design and nature

CRITICAL MAKING

(UN)MAKING THE MOLD

MAKING PRODUCTS STRANGE BY LETTING THE MATERIAL SPEAK BACK



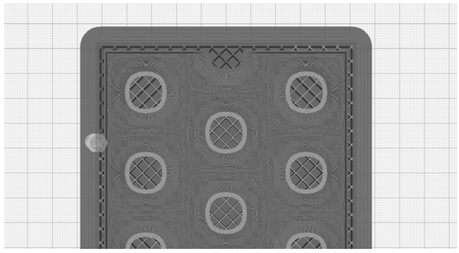
CONSUMER ELECTRONICS ARE OFTEN ENCASED BY INJECTION-MOLDED THERMOSET PLASTICS THAT LONG OUTLAST THEIR ACTUAL TIME OF USE. CHALLENGE THESE ARCHETYPES BY USING MATERIALS AND PROCESSES THAT ALLOW FOR ORGANIC DISTORTIONS AND UNEXPECTED RESULTS.

SEE ALSO: Be a 3D printer | Mono-material connections | Moulding and casting | Designed to disappear

CRITICAL MAKING

BEING A 3D PRINTER

EXECUTE YOUR OWN GCODE TO DEFAMILIARISE YOUR MAKING PROCESS



BEING THE MACHINE IS AN ALTERNATIVE 3D PRINTING PROCESS THAT OPERATES IN TERMS OF NEGOTIATION RATHER THAN DELEGATION. IT TAKES GCODE (THE INSTRUCTIONS TYPICALLY PROVIDED TO 3D PRINTERS) AND PRESENTS THEM TO HUMAN MAKERS TO FOLLOW.

SEE ALSO: Mono-material connections | (Un)making the mould | Additive manufacturing

CRITICAL MAKING

DEMYSTIFYING BIOTECHNOLOGY

HISTORIES AND ETHICS OF "USING LIFE"

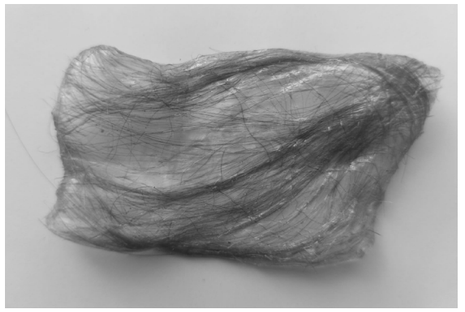
BIOTECHNOLOGIES (FROM THE GREEK 'BIOS' OR LIFE AND 'TECHNIKOS' OR USE) ARE METHODS THAT MAKE USE OF 'LIFE' FOR PRACTICAL OBJECTIVES, FROM MAKING CHEESE TO GENETIC MODIFICATION.

SEE ALSO: Glossary of Bio-everything | Developing a bio-art or biodesign project | A history of design and nature

CRITICAL MAKING

SHIT, HAIR, D(ISG)UST

TABOOS AROUND THINGS WE CONSIDER TO BE OUT OF PLACE



HUMAN AND BIOLOGICAL WASTE ARE ABUNDANT, SUSTAINABLE FEEDSTOCKS FOR MATERIAL-MAKING. NEGATIVE CONNOTATIONS AROUND SHIT, HAIR AND DUST HOWEVER AND OUR PERCEPTIONS OF BEAUTY NEED TO SHIFT FOR THESE MATERIALS TO BECOME ACCEPTABLE (AGAIN).

SEE ALSO: Waste walk | A history of design and nature

CRITICAL MAKING

(UN)MAKING THE MOLD

TIPS
Consider these parameters: compatibility between materials of mold and material being molded | accommodate need to apply pressure | accommodate need for ventilation | accommodate absorption of excess material onto a “bleeder” or sacrificial layer | release angles and release agents | warping and shrinkage

TASKS

Dissect a product
- Select a (broken) consumer electronics product
- Take it apart and study the electronics and its functions
- Make a visualization of your dissection

Develop your own mold
- Choose a biomaterial to work with (see recipe cards)
- Make a mold – to create new casing for the electronics
- Test it out by casting the material and allow it to dry (1 week)

Testing and refining
- Set new goals and iterate on your mold and method
- Document the process and results, share with class

REFERENCE
- Jeongwon Ji (2013) BioElectric https://www.dezeen.com/ 2013/07/01/bioelectric-plastic-made-of-crab-shells-by-jeongwon-ji/
- Basics Mold Making (n.d.) Smooth-on https://www.smooth-on.com/howto/basics-mold-making/
- How to Make Molds (n.d) Instructables: https://www.instructables.com/How-to-make-molds

NEXT
Draw your mold design in a CAD program (e.g. Rhino). Fabricate your design and cast models in different materials.

CROSS-DISCIPLINARY READING

WHY
Get an understanding of the different lenses different disciplines take, and what each of them allows us to see.

WHEN
When you are about to embark on a journey at the intersection of disciplines.

TASKS

In this example you study the topic of fungal reproduction through three disciplinary lenses:
DIY biology, anthropology and material science.
All texts talk about the potential of mycelium, but they do so in very different ways. Describe the framing implicit in these texts, and discuss the extent to which they differ and overlap.

Reading questions to try answer together:
- Who are they writing for?
- What prior knowledge is implied?
- What is the scope of their respective studies of these fungal systems?
- Finish this sentence: *“Author …[insert name]… studies the fungal systems by…..[activity]…. In doing so, the author wants to understand the ….. and ….. of …… fungi and what this means/what are the possibilities for …..*

REFERENCES
- McCoy, Peter. “Chapter 8: Working With Fungi” in: Radical Mycology: A Treatise on Seeing and Working with Fungi. Portland: Chthaeus Press, 2016 (1985): pp. 201-223 or beyond.
- Anna Lowenhaupt Tsing (2015) “Interlude: Tracking” in: The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins: p. 136-144.
- Haneef, Muhammad et.al. “Advanced Materials From Fungal Mycelium: Fabrication and Tuning of Physical Properties” Scientific Reports, (7), 2017: pp. 1-11.

BEYOND BIOMIMICRY

WHY
Collaborating with living systems forces you to try to understand the interrelations at work in our ecologies. How can you act within those dynamic processes without playing god?

TASKS

Design practice have proven to be destructive to our ecologies. As an antidote, come up with a design process where you collaborate with a living organism. Find an angle that doesn’t merely imitate nature but aims to enhance ecological performance in the long term.

Refer to the references and examples for background information and inspiration.

Sketch out or realize the system of collaboration and build an argument for why it contributes to the health of our ecosystems.

REFERENCE
- Bill Myers (2012) “Beyond Biomimicry” in: Biodesign: Nature, Science, Creativity: p. 10-17.

SEE ALSO:
- Edhv (2010) Debug. Poster designs and chair created in collaboration with ants. https://www.edhv.nl/design-lab/projects/debug/
- Diana Scherer (ongoing) Interwoven: http://dianascherer.nl/
- TCBL labs & Waag (2016-ongoing). Bioshades. Textile-dyeing with bacteria. https://bioshades.bio/

NOTE
Reflect on the amount of control you exert on the biological processes at work. Could you exert less control in order to give the organism more agency and live its best life? If the organisms could advocate for its needs, what would they be?

SHIT, HAIR, D(ISG)UST

WHY
Reappropriating waste materials to create art and design objects asks us to reconsider our own and others’ ideas about dirt and cleanliness, and about waste and newness.

WHEN
After you have tried out some bio-based material recipes and realise that making materials out of food grade ingredients might be unnecessary and unsustainable, and want to start looking elsewhere.

TASKS

Study the projects listed below:
- Merdacotta & the Shit Museum (2015-ongoing) by Gianantonio Locatelli & Luca Cipelletti: http://www.theshitmuseum.org/prodotti/https://materialdistrict.com/material/merdacotta/
- The New Age of Trichology (2016-ongoing) by Sanne Visser: https://sannevisser.com/The-New-Age-of-Trichology
- How Dust This Feel? (2015) by Matilda Beckman: https://www.dezeen.com/2015/02/06/matilda-beckman-furniture-made-from-dust-stockholm-2015/

Discuss the following questions:
- Which ideas, beliefs, and value systems are in place regarding the materials these artists and designers work with?
- Which strategies do the makers use to shift our perspective towards these materials?
- Are they successful in shifting your perspective on waste? Why/why not?

Find a material in your environment that is typically considered dirty or disgusting but could have interesting qualities to work with. Develop a strategy that helps shift peoples’ perspective on and connotations with that material.

REFERENCE
- Mary Douglas (1966) Purity and Danger.
- Kate Franklin & Caroline Till (2018) “Shit, Hair, Dust” in: Radical Matter: Rethinking Materials for a Sustainable Future: p. 75-107.

DEMYSTIFYING BIOTECHNOLOGY

TASKS

Biotechnology has been around for thousands of years ago when nomads accidentally made cheese by transporting milk in cow stomachs. We now know the enzymes and bacteria can turn the milk into cheese. We often think of it as being very ***high-tech*** inventions, like cloning sheep. Maybe they are both, and it’s often just a matter of time for them to become commonplace?

Find high-tech examples
- With your class, come up with 100 examples of high-tech biotechnologies

Find low-tech examples
- Try to find another 100 examples of biotechnologies that you may encounter in your everyday life. They are everywhere, keep looking!

(Do-Not)-Do-It-Yourself?
- Watch this video about biohacking: https://youtu.be/fV-Edkh1iqE
- Explore these two kits: https://amino.bio/collections/genetic-engineer-101 and https://www.the-odin.com/gene-engineering-kits/
- Some argue that biotechnology should be democratised, others mostly see dangers. Unlike in some other countries, such practice strictly controlled in the Netherlands: use of these kits without a permit is illegal in the Netherlands.

Design a speculative DIY kit for a biotechnology
- Pick one of the biotechnologies from your high-tech list and design what a DIY kit might look like and how it would be marketed.
- Use your prototype to talk to people about biohacking, and what their opinions are. Share the results.

REFERENCE
- DIY Biohacking: Do(n’t) Try This At Home (2020) Freethink: https://youtu.be/fV-Edkh1iqE

BEING A 3D PRINTER

WHY
Subverting an expected relationship between humans and machines in making 1) helps explore the semiotic effects that are produced when different materials, contexts, and processes are brought into juxtaposition with one another and 2) helps create understanding of a medium on both symbolic and technical levels.

TASKS

Prepare by reading Devendorf & Ryokai’s article. Next, follow a laser with a pencil to draw paths on paper (15 mins)

Build
- Select a 3D model to build (e.g. on thingiverse)
- Express any desires you have to modify the design
- Select an everyday, abundant material to work with
- Put the model in a slicer, and find the path viewer
- Person 1 traces the gcode paths with the laser
- Person 2 follows the laser by “printing” the paths with the chosen material
- There’s no right or wrong, only negotiation

Reflect
- How did you decide on the material selection?
- Can you describe the experience of working with the system?
- When did you deviate? Why?
- What did you learn about working with this material?
- Describe the features of your object

NEXT
Develop your own 3D printing paste by modifying one of the bioplastics recipes, and repeat the exercise with your pastes.

REFERENCE
- Laura Devendorf and Kimiko Ryokai. 2015. Being the Machine: Reconfiguring Agency and Control in Hybrid Fabrication:https://dl.acm.org/doi/abs/10.1145/2702123.2702547

OUTPUT
Users negotiate control between themselves, the system, and their materials in order to enter into meditative, reflective, and collaborative modes of making.

BIODATA PROCESSING

GIVE A VOICE TO LIVING ORGANISMS

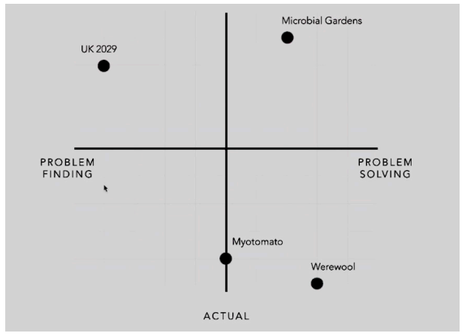
CAN WE COMMUNICATE WITH OTHER BIOLOGICAL LIFE FORMS OTHER THAN ANIMALS? READ ELECTRICAL SIGNALS (BIODATA) FROM PLANTS AND MUSHROOMS TO GENERATE BIODATA-BASED VISUALIZATIONS AND SOUNDS WITH THE PROCESSING FRAMEWORK.

SEE ALSO: A history of design and nature | Beyond biomimicry

CRITICAL MAKING

DEVELOPING A BIO ART OR BIODESIGN PROJECT

TIPS AND TRICKS TO FRAME YOUR PROJECT



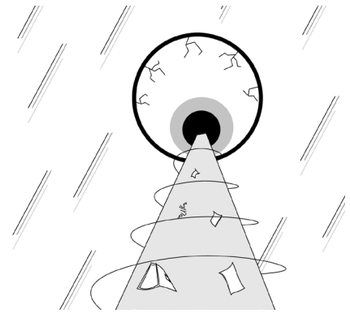
AFTER HAVING EXPLORED THE FIELD A LITTLE, YOU MIGHT HAVE FOUND AN AREA OF INTEREST TO EXPLORE MORE IN DEPTH. HOW MIGHT YOU APPROACH PROJECT DEVELOPMENT?

SEE ALSO: Morphology of ingredients | Waste walk | Demystifying biotechnology | Beyond biomimicry

CRITICAL MAKING

GLOSSARY OF 'BIO-EVERYTHING'

DISAMBIGUATE AND CRAFT A SHARED VOCABULARY



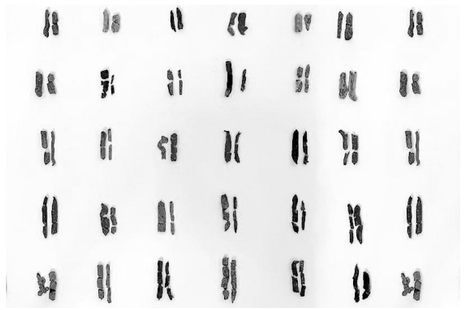
CREATING A SHARED VOCABULARY HELPS YOU UNDERSTAND THE FIELD AND THE TERMS USED TO DESCRIBE IT SO YOU CAN POSITION YOUR OWN WORK.

SEE ALSO: Beyond biomimicry | Cross-disciplinary reading Demystifying biotechnology

CRITICAL MAKING

A HISTORY OF DESIGN & NATURE

IDEAS ABOUT NATURE ARE NOT "NATURAL"



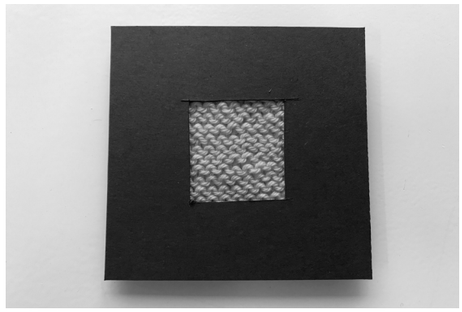
IDEAS AND KNOWLEDGE ARE CONSTRUCTED, AND COME ABOUT UNDER THE PRESSURES OF CULTURE, (GEO)POLITICS, ECONOMICS, AND HISTORICAL LEGACIES OF WHAT QUALIFIES AS "KNOWING". EXPLORE THE HISTORY OF IDEAS AROUND DESIGN & NATURE.

SEE ALSO: Beyond biomimicry |Developing a bio art or biodesign project | Cross-disciplinary reading

CRITICAL MAKING

DESIGNED TO DISAPPEAR

THE POSSIBILITY OF EPHEMERAL COLOUR AS STRENGTH



WE TEND TO SEE DURABILITY AND CONSISTENCY AS CONDITIONS FOR PRODUCTS. THESE EXPECTATIONS PUSH US TOWARD ENERGY INTENSIVE, AND OFTEN TOXIC PROCESSES. WHAT IF WE FRAMED EPHEMERALITY AND IMPERFECTIONS AS STRENGTHS?

SEE ALSO: What is a material property? | Morphology of ingredients

CRITICAL MAKING

WASTE WALK

IDENTIFY DISCARDED SOURCES OF BIOMASS THAT CAN BE TURNED INTO MATERIALS.

GOING ON A WASTE WALK HELPS YOU EXPLORE UNTAPPED LOCAL WASTE STREAMS AND HELPS TO UNLEARN OUR HABIT OF WORKING WITH VIRGIN MATERIALS.

SEE ALSO: Shit, hair, d(isg)ust | A history of design and nature

CRITICAL MAKING

GLOSSARY BIO-'EVERYTHING'

TASKS

Make groups, and assign the word sets described below.

- Biology | Microbiology | Mycology
- Biodesign | Bioart | Biofabrication
- Biodegredable | Biorenewable | Biocompostable
- Synthetic biology | Biohacking | Bioethics
- Biotechnology | Biomimicry | Bioremediation
- Bio-based materials | Biomaterials | Biomass

For each word or "lemma" of your glossary, find at least one example from each of the following areas: fine arts | popular culture and literature |scientific publications | everyday life | laws and regulations.

Make a mind map for each lemma, including the examples you found.

Put away your phones and laptops and discuss the keywords based on the examples and formulate your own definitions of what they each mean, based on the mindmaps you made (no internet allowed).

- Document your definitions in a shared text document.
- Each person creates an image for one of the each keywords/ lemmas.
- Compile it all into a booklet and print your shared Glossary of Bio-everything.

BONUS
- Make the book with atypical materials that fit the topic(s): https://www.pbs.org/video/make-a-book-with-meat-or-other-atypical-materials-e428h8/

DEVELOPING A BIO ART OR BIODESIGN PROJECT

WHEN
As you develop a project in the field of bio art or biodesign.

TASKS

Envision a (near-)future application of biotechnology. Decide on a timeline with milestones and other conditions fitting your situation.Some tips:

- Do the research. Read up on the issues so you can be precise about the problems you are addressing. What cultural issues are you responding to? Are you posing a solution or raising a question? Are you focused on a solution for today or speculative future applications and scenarios? Whatever the case, try to understand the scientific evidence of the possibilities, either by reading or by speaking to experts, to argue for the feasibility of the ideas.
- If your project is speculative or critical, formulate a diagnosis of the problems you identify. What are its problems? What underlying structures and systems keep it in place? How does your project address this? Does it pose a solution or call to action?
- Identify the communities your design will serve and include. Can you find ways to give voice to this target community and its unique aspects? Design ***with*** these people rather than ***for*** them.
- Challenges and mistakes have a place in your project, they can lead to good insights and feedback. When presenting your process: share both accomplishments and shortcomings of your progress.
- Record your thought process and reflect on it often. Ask others to help you identify biases, assumptions, and values (implicitly) at work in your project. Assess which ways you are speaking and thinking from a place of privilege that might disadvantage others or overshadow their needs.

REFERENCE
- Adaptation from: "Questions to Consider as you Develop your BDC Project", Biodesign Challenge. https://www.biodesignchallenge.org/

NOTE
Keeping a process book or diary is tremendously helpful in taking some distance from what you are doing day to day. It helps you find perspective.

BIODATA PROCESSING

WHY
Plants and fungi are sentient creatures, but modern societies seem to disregard this fact, perhaps because we lack a common language to establish communication between humans and non-humans. How can we begin to imagine communicating with other living beings besides animals?

TASKS

Download Arduino IDE and Processing IDE software, and code from Github
- https://www.arduino.cc/en/software
- https://processing.org/download
- https://github.com/dnllvrvz/BioData-Exploration by Danilo Vaz
- Go to: Code > Download .ZIP

What you need
An Arduino-compatible prototyping board, a 10K resistor, short jumper wires and longer ones for probing

Read data with Arduino, store it using Processing
Open the file "SaveData" and copy lines 1-12 to an empty Arduino sketch.
Copy lines 13-91 to an empty Processing sketch.

Look up the address of the Arduino board's active serial port (> Tools > Serial Port). Then find the line that says:
`myPort = new Serial(this, "/dev/cu.usbmodem1421", 9600);`
Replace the address starting with "/dev…." with the location of yours.
Run the Processing sketch and record data using the probes you connected.

Visualize and sonify
Open the file "finalcodecoursera" in Processing. Follow the instructions in the comments. Tinker with the code and create your own visualization/sonification of the plant data. What do you imagine plants communicate about? What could be ways to express that in the visualization/sonification?

REFERENCE
- Assignment and materials by Danilo Vaz: https://github.com/dnllvrvz/BioData-Exploration

NOTE
This exercise requires a basic understanding of the Arduino and Processing frameworks. If you are not familiar yet, take some more time to familiarize yourself and look at documentation and examples.

WASTE WALK

WHY
Learn to identify discarded sources of bio-materials that can be turned into materials of value for artmaking and design.

OUTPUT
A catalogue of potential local waste streams and their uses.

TASKS

Split up into groups and decide on a location where you will do the waste walk

Walk around the area for 2 hours, and identify any waste streams of biological origin (e.g. natural materials) you encounter. Take a picture of each of them.

Start in your home and expand outwards:
- Start in your kitchen (the fridge, your waste bin, maybe your garden or balcony)
- Expand to your neighbourhood, include streets, parks, even shopping streets.
- Look at plants and trees and identify which parts they shed and when (e.g. leaves, branches), both naturally and through maintenance (e.g. mowing, pruning)
- Go into food shops like fish mongers and cafes to ask about the type of waste they produce a lot of (e.g. coffee waste, stale bread, fish skins, overripe fruit, fruit skins, and so on)

Make a catalogue of all the potentially useful waste streams you identified, and research historical crafts techniques that make use of them. Think of: basket weaving branches, paper-making, fish leather tanning or combining materials into composites. Use the references below for inspiration.

Optional: try out some of the techniques you found.

REFERENCE
- Kate Franklin & Caroline Till (2018) Radical Matter: Rethinking Materials for a Sustainable Future
- Seetal Solanki, ed. (2018) Why Materials Matter: Responsible Design for a Better World.

DESIGNED TO DISAPPEAR

TASKS

- Research natural pigments and dyes (references below). Learn how to prepare protein and cellulose fabrics for dyeing.
- Pick one natural pigment and use it to dye some protein and cellulose swatches, make sure you have two of each, measuring 10x10cm. Label everything so you can remember what's what.
- Optional: if you have enough material, put a second batch of swatches (again, sets of two) into the leftover bath, i.e. the exhaust bath.
- Bring your swatches to class and exchange one set of samples to a class mate. Take theirs home and overdye their samples with your dyestuff.
- Do a light test: cover part of each sample with some cardboard and hang it in a window for at least a month.
- Bring the results to class and study each other's results
- Develop a textile product that uses the changing qualities of one or more pigments/dyes in such a way that it adds quality to the experience of the product.

REFERENCE
- Levende Kleuren (2013-2015) Report of SIA Raak research project. Avans Hogeschool. https://www.avans.nl/onderzoek/projecten/detail/levende-kleuren
- Joy Boutrup & Catherine Ellis (2019) The Art & Science of Natural Dyes: Principles, Experiments.
- Jenny Dean's Wild Colour (ongoing) Jenny Dean: https://www.jennydean.co.uk
- Wildcolours (ongoing) Teresinha Roberts: www.wildcolours.co.uk

NEXT
Expand the idea of ephemerality beyond colour, and go through the same process for a different kind of "unstable" material.

A HISTORY OF DESIGN & NATURE

WHY
Understanding this old search provides designers, artists, academics with a number of frameworks and spaces to ***rehearse***, ***critique*** and ***learn*** as well as position their own work.

NOTE
St. Pierre's text describes how designers throughout history have been searching for ways to design with nature. She organizes them by looking at the way ecology is understood in the different design frameworks since the 1500s.

TASKS

1. Select a biodesign or bioart project that inspires you
2. Read Louise St. Pierre's text
3. Assess whether the project you selected is more aligned with the mechanistic or the organicist view of ecology (see below).
4. Present your argument in the form of an essay, a diagram, image, poem or other.
5. Take the same topic as your chosen project, and develop an activity taking the opposite approach.

Mechanistic view of ecology:
Ecological design as mastery
Keywords: ***human-centric (solving human problems), mastery, rationality, economic growth, emotional and intellectual distance, perfection, nature as passive/controlled/mute, colonialism***

Organicist views of ecology
Design and nature as experiential exploration
Keywords: ***spiritual, philosophical, embodied/physical explorations, ritualistic, humility, interdependence, intimacy, vulnerability, slow design, practices of care, capacity of nature to organize itself, decolonizing***

REFERENCE
- Louise St. Pierre (2019) "Design and Nature: a History" in: Kate Fletcher, Louise St. Pierre & Mathilda Tham (eds.) Design and Nature: A Partnership: p. 92-108.
- Paola Antonelli & Ala Tannir (2019) Broken Nature: Design Takes on Human Survival. Catalog of the XXII Triennale Exhibition Milan.