MICROBES, FUNGI, YEAST

AND OTHER ORGANISMS

xxx

SEE ALSO: xx

EST. TIME:

MICROBES, FUNGI, YEAST

INGREDIENTS
XX

TOOLS
XX

TASKS

XX
- XX

REFERENCE: XX

BIOLAB RULES

PRACTICING MICROBIOLOGY SAFELY

BIOLAB RULES ARE AIMED AT CONTAINING UNCONTROLLED SPREAD OF MICROBES, TO PROTECT YOUR EXPERIMENTS FROM BECOMING CONTAMINATED WITH EXTERNAL MICROBES. THEY ALSO PROTECT YOU FROM THE SMALL POSSIBILITY OF INFECTION.

SEE ALSO: Handwash experiment

EST. TIME:

BIOLAB RULES

WHY
Learn why lab rules exist, and what Good Microbiological Laboratory Practice entails. Design a poster to commit to the rules when working in the lab.

WHEN
This is a good introductory activity to familiarize students with key concepts, tools and rules in a biolab, before starting any investigations.

TASKS

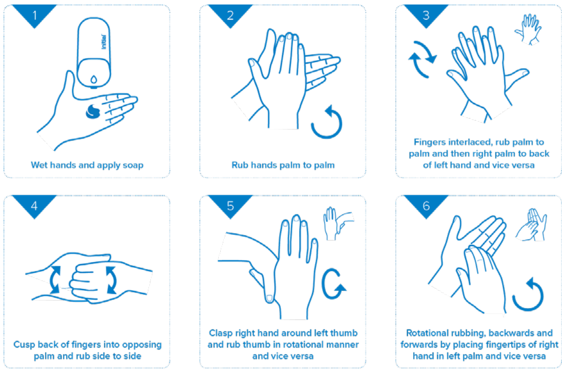
Study *Basic Practical Microbiology: A Manual* in preparation for class and design a poster visualizing the biolab rules:

1. Report spills and damages immediately to a lab technician
2. No food, drink or mouth to face contact in the lab
3. Wash and disinfect your hands before and after lab work. Wear a lab coat and PPE where necessary.
4. Keep personal objects outside the lab (jackets, phones, etc)
5. Don’t leave heat sources or gas flames out of sight
6. Avoid aerosol formation by using proper flaming technique
7. Label all bottles and plates
8. Disinfect surfaces with 70% alcohol or a freshly prepared 10% bleach solution before and after.
9. Autoclave all biological waste and contaminated surfaces

REFERENCE: Basic Practical Microbiology: A Manual (2016) Microbiology Society: https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html

HANDWASH EXPERIMENT

WHAT IS LIVING ON YOUR HANDS?



THE HANDWASHING EXPERIMENT DEMONSTRATES HOW EASY AN EXPERIMENT CAN BE CONTEMINATED WITH EXTERNAL MICROBES AND WHY IT IS IMPORTANT TO FOLLOW THE LAB-RULES.

SEE ALSO: Biolab rules

HANDWASH EXPERIMENT

WHY
Learn why lab rules exist, and what Good Microbiological Laboratory Practice entails, practice with a hands-on experiment.

WHEN
This is a good introductory activity to familiarize students with key concepts, tools and rules in a biolab, before starting any investigations.

TASKS

Study ***Basic Practical Microbiology: A Manual*** in preparation for class, followed by the handwashing experiment. Students practice pouring plates using aseptic technique, and learn to use the autoclave to sterilize media and materials.

- Prepare a nutrient agar (500 ml water, 1.5 g yeast extract, 2.5 g peptone, 2.5 g non-iodized salt, 7.5 g agar agar)
- Autoclave for 45 mins, allow to cool to 35C
- Pour agar into sterilized petri dishes using aseptic technique
- Take a bathroom and coffee/tea break until agar sets
- Group 1 washes hands w soap and warm water for 20 sec
- Group 2 washes hands with only water
- Group 3 desinfects hands with hand sanitizer
- Group 4 does not wash or desinfect their hands at all
- Ask each student to press a finger onto the agar, close the dish, seal with parafilm and label it
- Incubate for 2-7 days at room temperature
- Study the results without opening the plates
- Autoclave the plates for 20 mins afterwards

REFERENCE: Basic Practical Microbiology: A Manual (2016) Microbiology Society: https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html

BIOSAFETY LEVELS

OR: CONTAINMENT LEVELS

Kelsey Chisamore, The Noun Project.

FAMILIARISE YOURSELF WITH BIOSAFETLY LEVELS TO MAKE SURE THAT MICROBIOLOGY EXPERIMENTS STAY SAFE AND THAT THE WORK-ENVIRONMENT IS HEALTHY.

SEE ALSO:Starting a community lab

EST. TIME:

BIOSAFETY LEVELS

WHY
Starting to understand how required levels of cleanliness and containment depend on a number of interrelated factors (skill level, protocol and use, volume of culture) enables you to critically assess risks and possibilities.

WHEN
After you have done some textbook experiments, and are starting to wonder and ideate what else might be possible.

TASKS

Discussion prompt 1:
Read ***Basic Practical Microbiology: A Manual*** and discuss the importance of ***biosafety levels*** or ***levels of containment***. What is the difference with the school levels discussed in the manual? Why do you think they address those specifically?

Discussion prompt 2:
Find out under which biosafetylevel each of these organisms is typically classified (may differ per strain!). Discuss whether you would consider using these organisms in a school biology setting: why/why not?

Pleurotus ostreatus | Serratia Marcescens | Janthinobacterium lividum | Komagataeibacter Xylinus

Discussion prompt 3:
Why is working in the lab with ***Pleurotus ostreatus*** to make materials different from growing grey oysters in your kitchen and different from eating store-bought grey oysters to use for dinner? Why can you eat the mushrooms that you grow in your kitchen (see also Rotterzwam growkits), but you <u>cannot</u> eat mushrooms you grow in a lab where you are also experimenting with other organisms?

REFERENCE: Microbiology Society (2016) Basic Practical Microbiology: a Manual: https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html

SET UP A COMMUNITY LAB

CREATE AN OPEN-ACCESS LABORATORY FACILITY

SAFE PRACTICE IN MICROBIOLOGY REQUIRES A DESIGNATED, LIMITED ACCESS SPACE AND TRAINING. A PROPER ENVIRONMENT PREVENTS CONTAMINATION AND HEALTH HAZARDS. THIS CARDS CONTAINS POINTERS TO GET INFORMED BEFORE DOING PRACTICAL WORK.

SEE ALSO: Biolab rules, Biosafety

EST. TIME:

SET UP A COMMUNITY LAB

WHY
Establishing a shared foundation for biosafety and security practices is key when you are considering to set up a community lab in your institution or community. Familiarizing yourself with resources to do so enables you to conduct safe lab practices with non-biologists.

WHEN
When you want to create an open-access laboratory facility that supports non-biologists such as artists and designers to explore micro-biology in a hands-on way.

TASKS

- Study *Basic Practical Microbiology: A Manual* thoroughly with your team (see reference)
- Consult someone with experience as lab technician overseeing practical microbiology work in high schools.
- Find a biosafety advisor who can help with risk assessments
- Find suppliers of high school lab materials (e.g. Eurofysica,Carolina)
- Learn aseptic technique and Good Microbiological Laboratory Practice (GMLP) by getting training from an expert
- Write step-by-step protocols defining the acceptable experiments in your lab, review protocols and changes in the future with an expert

REFERENCE: Microbiology Society (2016) Basic Practical Micro-biology: a Manual: https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html

SEE ALSO: Angela Armendariz, Patrik D'haeseleer and others (ongoing) Community Biology Biosafety Handbook: https://bit.ly/3k9Tkz9

LEVELS OF CLEAN AND DIRTY

WHAT IS WASTE?

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: XX

EST. TIME:

LEVELS OF CLEAN AND DIRTY

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 biomaterial recipes and realize 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/ and 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? And/or 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: Kate Franklin & Caroline Till (2018) "Shit, Hair, Dust" in: Radical Matter: Rethinking Materials for a Sustainable Future: p. 75-107.

SEE ALSO: Mary Douglas (1966) Purity and Danger.

BIOLAB ETIQUETTE

VVV

LEARN THESE RULES BY HEART AND REMIND EACH OTHER TO STICK BY THEM ENSURES SAFES PRACTICE IN YOUR BIOLAB.

SEE ALSO: VV

EST. TIME:

BIOLAB ETIQUETTE

WHY

Good Microbiological Laboratory Practice (GMLP) is one of the main ways to ensure safe practice when working with microorganisms.

WHEN

Before starting any practical microbiological work.

TASKS

Study ***Basic Practical Microbiology: A Manual*** (see reference) to understand the importance for Good Microbiological Laboratory Practice (GMLP). Design a poster together, listing all the rules, to make them visible in your shared lab space:

- You are responsible for reporting spills or damage immediately to a lab technician.
- Only do work you are trained and instructed to do. When in doubt: ask!
- No eating, drinking or hand-to-face contact: may cause accidental ingestion of hazardous materials or culture.
- Label everything, always: so other people are aware of their contents (date, name, organism, growth medium)
- Handwashing: before microbiological work to avoid contami nating your experiments with unknown organisms, and after to ensure no living cultures accidentally leave the lab on your hands. Wear a lab coat when in the lab.
- Never leave open flames or running pressure cookers: they are potential fire hazards and need to be monitored, always
- Dispose of waste properly: all living cultures and materials that have been in contact with living cultures need to be steam autoclaved before disposal.
- Keep personal items (notebooks, phones, laptops, coats) outside the lab and at all times away from the lab bench.
- You are not allowed to take any living cultures from the or bring in living cultures without permission from a technician.

REFERENCE: Basic Practical Microbiology: A Manual (2016) Microbiology Society: https://microbiologysociety.org/publication/education-outreach-resources/basic-practical-microbiology-a-manual.html

LAB DESIGN

RECOMMENDATIONS FOR DESIGNING A BIOLAB

WHETHER SETTING UP A SPACE FOR THE FIRST TIME, OR MOVING TO A NEW SPACE, CONSIDER THE FOLLOWING LIST OF RECOMMENDATIONS FOR MATERIALS TO USE, AND THE INFRASTRUCTURE REQUIRED TO HANDLE THEM WHEN DESIGNING A BIOLAB.

SEE ALSO: cards

EST. TIME:

LAB DESIGN

CONSIDERATIONS

- Walls and floors should be smooth, impermeable to liquids and easy to clean. No carpets or flammable materials.
- Benchtops should be impermeable to liquids including disinfects, and chemicals. Benchtops should be scratch-resistant and have no open seams.
- Sink for handwashing, dishwashing and disposal of non-toxic and non-hazardous liquids should be provided.
- Lab furniture such as chairs and stools should be non-porous and easily cleaned (e.g. vinyl, hard plastic, rubber)
- PPE storage such as lab coats should be available upon entry. Lab coats need to be separated, not stacked.
- Personal storage space non-lab items need to be stored outside the lab (e.g. coat racks, closets, lockers).
- Office space is separate from labspace. Demarcate space for eating, drinking and office work
- Fire safety equipment and smoke detectors are often legally required. Fire extinguishers should use carbon dioxide or dry chemical type A-B-C extinguishers.
- Ventilation ideally provides inward airflow without circulation. If mechanical ventilation is not possible, install screens to prevent insects from entering through windows.

For the Netherlands, see also article 9.1.1.1.1 and 9.1.1.1.2 of the laws regarding work with genetically modified organisms as a guideline for space design: https://wetten.overheid.nl/BWBR0035072/2021-10-01#Bijlage9

REFERENCE: Angela Armendariz, Patrik D'haeseleer and others (ongoing) "Lab Infrastructure & Design" in: Community Biology Biosafety Handbook: https://bit.ly/3k9Tkz9

MORPHOLOGY OF TOOLS

SUBSTITUTING EQUIPMENT WITH EVERYDAY ITEMS

Many people in the DIY biology realm have considered ways to make microbiological work more accessible by finding alternatives to expensive specialist equipment. Some tools and materials can be substituted.

SEE ALSO:VVV

EST. TIME:

MORPHOLOGY OF TOOLS

GLASSWARE

You might find that lab grade glassware such as glass bottles can get expensive. Sterilizing media can also be done in glass jam and yogurt jars with a lid. Glass is used because it can withstand the heat of an autoclave (121 degrees C), polypropylene (PP5) plastic, often used in the production of food containers, is also autoclavable.

GAS EXCHANGE

Many microorganisms are aerobic, which means they require fresh air to grow. Others release gases, which can build up in a plate or jar. Parafilm is commonly used to ensure gas exchange while providing a barrier for contaminants. Syringe filters, synthetic filter disks (Tyvek) or synthetic wool (e.g. Polyfill, or non-absorbent cotton wool) can be used to plug a little air vent drilled into the lid of your jar or bottle.

STEAM AUTOCLAVE

Pressure cooker pans are used in many schools as an alternative. Use of autoclave tape is recommended. For steam sterilization to occur, the entire item must completely reach and maintain 121°C for 15–20 minutes with steam exposure at 15 PSI (longer for higher volumes).

INCUBATOR

Make your own using instructions from the Biohack Academy program, or look for incubators used to hatch reptile eggs.

AUTOCLAVEABLE WASTE BAGS

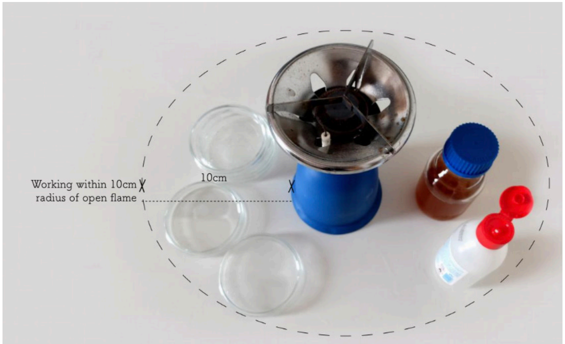
Invest in different sizes as they can also function as a container for incubated cultures, when closed with rubber band and plugged with a material that serves as gas exchange material (see above).

SEE ALSO:

- https://learn.freshcap.com/growing/using-pressure-cookers-for-growing-mushrooms/#
- https://archersmushrooms.co.uk/how-to-make-grain-spawn-jars/
- https://github.com/BioHackAcademy/BHA_Incubator

STERILE BUBBLE

BVV



[redacted]DIT: kickstart your myco-culture – Open

TRANSFERRING ORGANISMS OR INOCULATING PLATES OR SUBSTRATES WITH ORGANISMS NEEDS TO BE DONE IN A CLEAN ENVIRONMENT TO PREVENT CONTAMINATION. WORKING WITH A STERILE BUBBLE IS A STERILE TECHNIQUE FOR WORKING ON AN OPEN BENCH.

SEE ALSO:PRACTICE INOCULATING

EST. TIME:

STERILE BUBBLE

INGREDIENTS
vv

TOOLS
Bunsen burner, lighter, alcohol 70%

TASKS

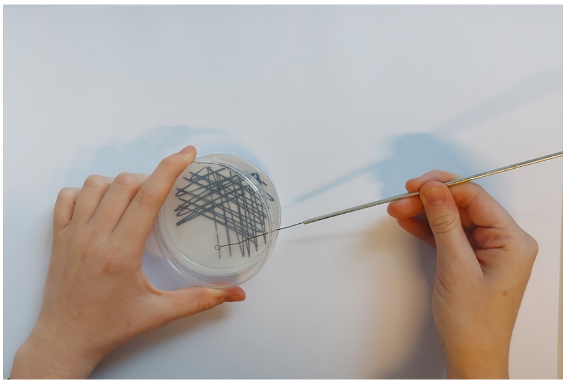
The updraft from the heat generated by the Bunsen burner prevents particles in the air from falling into your petri-dish. The cold air that is sucked in from beneath comes from the alcohol-covered bench, thus creating a sterile bubble with a diameter of 20-25 cm. Keep the organisms and dishes within the bubble and keep your movements (with a scalpel or inoculation needle) within the bubble.

- Close windows and doors and let everyone know you will be inoculating and lighting the flame
- No talking, no walking around
- Work on a smooth, even and cleaned surface
- Clean everything with 70% alcohol (let it dry on its own)
- Light the Bunsen burner. The blue flame is the hottest (tweak the oxygen supply to change the flame from yellow to blue)
- Work within 10 cm radius of flame
- Don't wear gloves or synthetic face masks (can glue to skin when hot)
- Point tip of alcohol bottle away from flame at all times!
- Open petri dishes as little as possible, open petri dishes towards the flame (open top like a clamshell towards the flame)
- Pass neck of bottle through the flame before and after

REFERENCE: kickstart your myco-culture – Open source practices from Fabtextiles lab https://issuu.com/nat_arc/docs/myceliumfabtextiles

PRACTICE INOCULATING

BVV



Inoculating means the introduction of a microorganism into a growth medium with the purpose of growing the microorganism. Familiarize yourself with the tools and steps that come with working with a sterile bubble before you work with real organisms.

SEE ALSO:STERILE BUBBLE

EST. TIME:

PRACTICE INOCULATING

INGREDIENTS
vv

TOOLS
Bunsen burner, alcohol, scalpel and/or inoculation loop, micropi-

TASKS

With inoculating there are three important aspects to keep in mind:

- work within the sterile bubble, control your movements to stay in the bubble
- open lids towards the flame, open lids as little as possible and run openings of bottles through the flame to sterilize them before using them (again).
- sterilize your scalpel or loop through the flame before and after every movement involving organisms

Practice working with the scalpel

- To practice sterilizing the scalpel, move the tip of the scalpel through the flame until the metal is red hot.
- Carefully open the lid of the petri dish in a clamshell motion
- Cool the top of the scalpel by pressing it into a spot of agar on the side of the plate
- Cut out a square of 1x1cm and try to slice only the top layer of the agar (only transfer as little old growth medium as possible into a new petri dish)
- Move your agar square out of the petri dish, open the lid of your other petri dish and place the agar square in the

REFERENCE: Basic Practical Microbiology: A Manual (2016) Microbiology Society: https://microbiologysociety.org/publication/education-outreach-resources/

DIY BIOFILMS

BVV

VV

SEE ALSO:vv

EST. TIME:

DIY BIOFILMS

INGREDIENTS
vv

TOOLS
vv

TASKS

vv

REFERENCE: bbb

DIY APPLIED MYCOLOGY

VVV

MYCOLOGY IS THE STUDY OF FUNGI AND THEIR APPLICATIONS IN SEVERAL INDUSTRIES (FOOD, MATERIALS, PIGMENTS, MEDICINE, BIOREMEDIATION). THE AVAILABILITY OF TOOLS AND DIY PROCESSES MAKE THIS FIELD ACCESSIBLE TO ENTHUSIASTS.

SEE ALSO: VV

EST. TIME:

DIY APPLIED MYCOLOGY

INGREDIENTS

light malt extract, yeast extract, potatoes, dextrose, water, vial of liquid culture (sporeless), coffee, hemp, wood dust, wood chips, agar, 70% alcohol, bleach

TOOLS

pressure cooker, glass bottles/jars, petridishes, parafilm, scalpel, sterile syringes, autoclaveable polypropylene (PP5) bags or boxes, autoclave tape, hammer, nails, non-absorbent synthetic wool (e.g. fiberfill)

TASKS

Set up a basic biolab (see card: ***Setting up a community lab***)
- Find suppliers of lab materials (e.g. Eurofysica)
- Learn aseptic technique and Good Microbiological Laboratory Practice (GMLP)

Choose a well-documented strain
- Pleurotus Ostreatus (Gray Oyster) or Ganoderma Lucidum (Reishi) foodsafe strains that are suitable for beginners
- Find a supplier who can sell you sporeless strains to avoid unwanted sporulation (e.g. Homegreen in NL)

Learn how to grow mycelium in a petri dish
- Learn how to make a malt-yeast-agar
- Learn how to make a potato dextrose agar

Learn how to create a grain jar/grain spawn
- Learn how to ***sterilize*** a grain jar
- Learn how to ***inoculate*** a grain jar

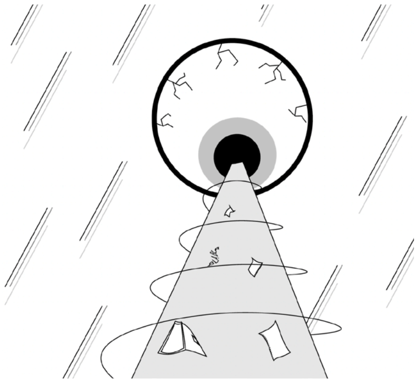
Learn how to colonize a bulk substrate (for materials)
- Find out which substrates your strain thrives on
- Learn how to ***pasteurize*** bulk substrates
- Learn how to ***inoculate*** a bulk substrate
- Learn how to ***incubate*** and maintain a bulk substrate
- Learn how to dry a bulk substrate

Learn how to train a strain (for mycoremediation)

REFERENCE: Peter McCoy (2016) Radical Mycology; Freshcap Mushrooms Blog and video channel https://learn.freshcap.com/growing/ and https://www.youtu-be.com/c/freshcapmushrooms

GLOSSARY OF ‘BIO-EVERYTHING’

UNDERSTANDING THE VOCABULARY OF THE FIELD



Defining a shared vocabulary helps you understand the field and the terms used to describe it so you can position your own work. Craft a shared vocabulary and created a – printed – glossary of bio-everything together.

SEE ALSO: ///

EST. TIME:

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.

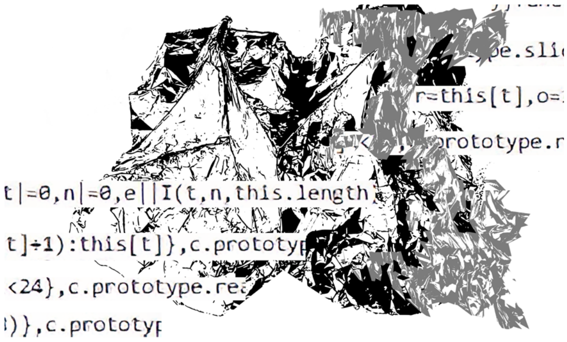
Put away your phones and laptops and discuss the keywords based on the examples and formulate your own definitions of what they each mean, based on the mindmaps you made (no internet allowed).

- 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.

RECOMMENDATIONS: 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/

BIODATA PROCESSING

VVV



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: VV

EST. TIME:

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?

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.

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
- 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

@HOME MATERIALS KITCHEN

DIY BIOMATERIALS FROM YOUR KITCHEN CUPBOARD

Exploring your kitchen is a good starting point for a lot of biomaterials. DIY Bioplastics are often made with ingredients and equipment found in your kitchen cupboard, and natural dyes can come from food waste such as pits or peels.

SEE ALSO: bbb

EST. TIME:

@HOME MATERIALS KITCHEN

INGREDIENTS & TOOLS
See ingredients and tools list on the back of the folder/booklet.

RECOMMENDATIONS
Collect old pans, pots and utensils for bioplastics and natural dye. Do not use them for cooking and store them separately.

TASKS

Collect the ingredients and tools on the list found at the back of the folder/booklet of the toolkit.

Give a small video tour in your kitchen: show us how you have converted your kitchen into a Biomaterials-fabrication site.

REFERENCE: vvv

RECYCLING

INDUSTRIAL PROCESSING AND CONVERSION TECHNIQUES

Fabrication is about processing raw materials and making parts that are suitable for assembly or manufacturing of goods for consumers. Knowing the major techniques for processing or conversion of materials helps you explorepossibilities of biomaterials in depth.

SEE ALSO: ALLE SOORTEN INDUSTRIAL PROCESSING CARDS

EST. TIME:

RECYCLING

WHY

When making biomaterials, we talk about biofabrication. To imagine possible applications, we need to understand how they can be made into semi-manufactured materials and functional parts.

TASKS

Explore your material recipes by subjecting them to different processing techniques. Curate a series of samples showing possible processing techniques for one of your material recipes.

Research the method listed below:

Recycling is re-using materials. Materials can be re-used for fabrication but often need to be decomposed before they are ready for fabrication. Depending on the nature of the material you can choose between several manners to decompose a material.

- *Chemical recycling* (treatment to separate constituents for reuse)
- *Mechanical recycling* (shredding, beating, grinding, crushing)
- *Organic recycling* (composting to produce fuel or fertilizers)

REFERENCE:Daniel Kula & Élodie Ternaux (2008) Materiology: The Creative Industry's Guide to Materials and Technologies.

EXTRACTIVE MANUFACTURING

INDUSTRIAL PROCESSING AND CONVERSION TECHNIQUES

Fabrication is about processing raw materials and making parts that are suitable for assembly or manufacturing of goods for consumers. Knowing the major techniques for processing or conversion of materials helps you explorepossibilities of biomaterials in depth.

SEE ALSO: ALLE SOORTEN INDUSTRIAL PROCESSING CARDS

EST. TIME:

EXTRACTIVE MANUFACTURING

WHY

When making biomaterials, we talk about biofabrication. To imagine possible applications, we need to understand how they can be made into semi-manufactured materials and functional parts.

TASKS

Explore your material recipes by subjecting them to different processing techniques. Curate a series of samples showing possible processing techniques for one of your material recipes.

Research the method listed below:

Extractive Manufacturing is starting with a block, plate or sheet of material and getting what you want by extracting material from it. You can either remove material (machining and engraving) or cut material (cutting).

- ***Cutting*** (e.g. saws, scissors, knives, lasercutting, hotwire, piercing)
- ***Machining*** (drilling, milling, turning, abrasion)
- ***Engraving*** (laser engraving, etching, carving)

REFERENCE:Daniel Kula & Élodie Ternaux (2008) Materiology: The Creative Industry's Guide to Materials and Technologies.

ADDITIVE MANUFACTURING

INDUSTRIAL PROCESSING AND CONVERSION TECHNIQUES

Fabrication is about processing raw materials and making parts that are suitable for assembly or manufacturing of goods for consumers. Knowing the major techniques for processing or conversion of materials helps you explorepossibilities of biomaterials in depth.

SEE ALSO: ALLE SOORTEN INDUSTRIAL PROCESSING CARDS

EST. TIME:

ADDITIVE MANUFACTURING

WHY

When making biomaterials, we talk about biofabrication. To imagine possible applications, we need to understand how they can be made into semi-manufactured materials and functional parts.

TASKS

Explore your material recipes by subjecting them to different processing techniques. Curate a series of samples showing possible processing techniques for one of your material recipes.

Research the method listed below:

With **additive manufacturing**, you build your design by adding or fusing materials in layers on top of one another.

- *3D printing* (manual or digital/automated)
- *Contact moulding* (alternating plastics with various substrates e.g. fibres, using a lay-up method. Also called composites)

REFERENCE:Daniel Kula & Élodie Ternaux (2008) Materiology: The Creative Industry's Guide to Materials and Technologies.

CASTING AND MOULDING

INDUSTRIAL PROCESSING AND CONVERSION TECHNIQUES

FABRICATION IS ABOUT PROCESSING RAW MATERIALS AND MAKING PARTS THAT ARE SUITABLE FOR ASSEMBLY OR MANUFACTURING OF GOODS FOR CONSUMERS. KNOWING THE MAJOR TECHNIQUES FOR PROCESSING OR CONVERSION OF MATERIALS HELPS YOU EXPLOREPOSSIBILITIES OF BIOMATERIALS IN DEPTH.

SEE ALSO: ALLE SOORTEN INDUSTRIAL PROCESSING CARDS

EST. TIME:

CASTING AND MOULDING

WHY
When making biomaterials, we talk about biofabrication. To imagine possible applications, we need to understand how they can be made into semi-manufactured materials and functional parts.

TASKS

Explore your material recipes by subjecting them to different processing techniques. Curate a series of samples showing possible processing techniques for one of your material recipes.

Research the method listed below:

Casting and moulding are both processes in which materials in a non-defined shape or stage are directly converted into a defined shape. Casting is mostly done with metals and clay, and moulding with plastics.

- ***Sintering*** (heating powders with or without binder, laser sintering)
- ***Cast-moulding*** (using liquids, open/closed mould)
- ***Rotational moulding*** (multi-layered, open-closed)
- ***Extruding*** (extruding and co-extruding, blow-moulding)

REFERENCE:Daniel Kula & Élodie Ternaux (2008) Materiology: The Creative Industry's Guide to Materials and Technologies.

TRANSFORMING

INDUSTRIAL PROCESSING AND CONVERSION TECHNIQUES

Fabrication is about processing raw materials and making parts that are suitable for assembly or manufacturing of goods for consumers. Knowing the major techniques for processing or conversion of materials helps you explorepossibilities of biomaterials in depth.

SEE ALSO: ALLE SOORTEN INDUSTRIAL PROCESSING CARDS

EST. TIME:

TRANSFORMING

WHY

When making biomaterials, we talk about biofabrication. To imagine possible applications, we need to understand how they can be made into semi-manufactured materials and functional parts.

TASKS

Explore your material recipes by subjecting them to different processing techniques. Curate a series of samples showing possible processing techniques for one of your material recipes.

Research the method listed below:

Transforming encompasses techniques that change the state of a solid body of material in a controlled way. Although these techniques focus on the plasticity of a material, the coherence of the material and the mass of the material body remain intact. These techniques can be applied to cold material, semi-hot or hot material.

- *Folding* (cold vs hot, optional: scoring, applying stiffeners)
- *Thermoforming* (vacuum forming, dome blowing)
- *Stamping* (cold pressing sheets using molds)

REFERENCE:Daniel Kula & Élodie Ternaux (2008) Materiology: The Creative Industry's Guide to Materials and Technologies.

ASSEMBLING

INDUSTRIAL PROCESSING AND CONVERSION TECHNIQUES

Fabrication is about processing raw materials and making parts that are suitable for assembly or manufacturing of goods for consumers. Knowing the major techniques for processing or conversion of materials helps you explorepossibilities of biomaterials in depth.

SEE ALSO: ALLE SOORTEN INDUSTRIAL PROCESSING CARDS

EST. TIME:

ASSEMBLING

WHY

When making biomaterials, we talk about biofabrication. To imagine possible applications, we need to understand how they can be made into semi-manufactured materials and functional parts.

TASKS

Explore your material recipes by subjecting them to different processing techniques. Curate a series of samples showing possible processing techniques for one of your material recipes.

Research the method listed below:

Many products exist out of several parts, and even the smaller parts can be assemblages of different components. **Assembling** is connecting these parts in such a way that they can perform their intended function and can withstand the occurring load (in the form of pressure or friction, or else).

- *Joinery* (wood joinery, snap fit, interlocking, screws, nails)
- *Sewing* (stitches: running-, basting-, slip-, back-, zigzag-, overlock-)
- *Bonding* (using adhesives, heat or solvents)
- *Folding* (riveting, rolled edges)
- *Heat sealing* (heat welding, soldering, laser welding, friction welding)

REFERENCE:Daniel Kula & Élodie Ternaux (2008) Materiology: The Creative Industry's Guide to Materials and Technologies.

FINISHING

INDUSTRIAL PROCESSING AND CONVERSION TECHNIQUES

Fabrication is about processing raw materials and making parts that are suitable for assembly or manufacturing of goods for consumers. Knowing the major techniques for processing or conversion of materials helps you explorepossibilities of biomaterials in depth.

SEE ALSO: ALLE SOORTEN INDUSTRIAL PROCESSING CARDS

EST. TIME:

FINISHING

WHY

When making biomaterials, we talk about biofabrication. To imagine possible applications, we need to understand how they can be made into semi-manufactured materials and functional parts.

TASKS

Explore your material recipes by subjecting them to different processing techniques. Curate a series of samples showing possible processing techniques for one of your material recipes.

Research the method listed below:

Finishing is a surface treatment, either for protection or decorative purposes. Biomaterials can also be developed as a finish for other materials.

- *Painting* (mix of binder, pigment, additives and solvents)
- *Coating* (finishing processes for textiles and paper)
- *Varnishing* (transparent paints, with or without color)
- *Sanding & polishing* (sanding, chemical polishing, rubbing)
- *Printing* (gravure, silkscreen, offset, UV-printing, stenciling, RISO)

REFERENCE:Daniel Kula & Élodie Ternaux (2008) Materiology: The Creative Industry's Guide to Materials and Technologies.

MORPHOLOGY OF INGREDIENTS

IN BIOFABRICATION

STUDYING THE STRUCTURE OF BIOMATERIALS, AND UNDERSTANDING THE FUNCTIONS OF INGREDIENTS IN RECIPES WILL HELP YOU FIND NEW ALTERNATIVES TO EXPERIMENT WITH. WHAT ARE POSSIBLE ALTERNATIVES FOR EACH INGREDIENT?

SEE ALSO: cc

EST. TIME:

MORPHOLOGY OF INGREDIENTS

WHY

Many biomaterials recgipes include purified store-bought virgin materials and foodstuffs. In order not to compete with food, it's worth finding alternatives that can be sourced from waste streams, or alternatives that are more abundant in your environment. In many cases very pure food-grade ingredients can be avoided.

WHEN

You've experimented with bioplastics and want to dig a little deeper so you can start developing new materials that are embedded and tuned to a specific local context.

TASKS

Make a hypothesis

- Select a biomaterial recipe
- Research what kind of compound each ingredient is
- Use the functions graph as reference
- Make a hypothesis of the function(s) of each ingredient

Morphology

- Determine what could be alternatives for each ingredient
- Locate alternatives that can be found in waste streams
- Locate alternatives that are more locally abundant

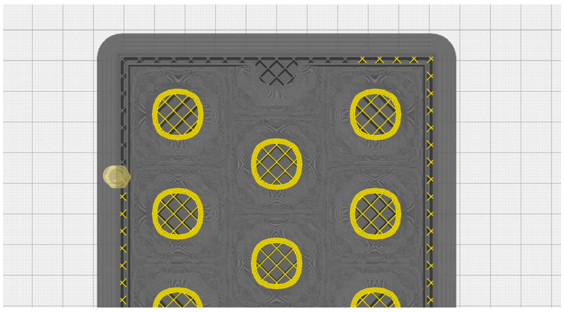
Experiments

- Recreate the biomaterial recipe by replacing one ingredient
- Analyse the results, reassess your hypotheses
- Do this with at least 3 times, changing one variable at a time

REFERENCE:Functions graph (2021) Loes Bogers, Cecilia Raspanti & Sam Edens

BEING A 3D PRINTER

BEING THE MACHINE



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:RECIPE CARDS

EST. TIME:

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.

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

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

(UN)MAKING THE MOLD

UNDERSTANDING AND RECREATING CASINGS

BioElectric by Jeongwon Ji (2013)

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: VV

EST. TIME:

(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

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

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)

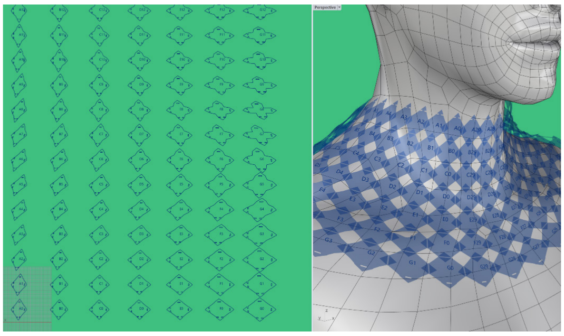
Testing and refining
- Set new goals and iterate on your mold and method
- Document the process and results, share with class

REFERENCE: Jeongwon Ji (2013) BioElectric https://www.dezeen.com/2013/07/01/bioelectric-plastic-made-of-crab-shells-by-jeongwon-ji/

SEE ALSO:
- 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

MONO- MATERIAL CONNECTIONS

DESIGNING INTERLOCKING CONNECTIONS



Interlocking necklace design, Lorenzo Massini (2020)

DESIGNING INTERLOCKING CONNECTIONS – OR HOW YOU CAN CONSTRUCT BY CONNECTING A MATERIAL TO ITSELF - IS A USEFUL DESIGN STRATEGY TO CREATE OBJECTS MADE FROM ***MONO-MATERIALS***.

SEE ALSO:RECIPE CARDS

EST. TIME:

MONO-MATERIAL CONNECTIONS

WHY

Many waste materials (e.g. leather offcuts) often come in small pieces, and making your own materials will initially happen on smaller scale before scaling up in size. Moreover, materials are easier to recycle when they are made of one single materials or mono-materials.

WHEN

When you want to design products that don't need to be deconstructed to be recycled. When you decide to work with a material feedstock that typically comes in small pieces.

TASKS

Select a material
- Select the material you want to design a connection for. Not all connections are transferable to other materials, so choose first, design after.

Paper prototyping
- Prototype your material connections by drawing and making paper prototypes using scissors.

Testing
- Test your paper prototypes with more accuracy. Design them in a vector drawing software and cut them with a laser cutter.

Play & iterate
- Play with your modules, experiment with the kinds of shapes and structures you can make with them. Iterate on their design as new ideas come up.

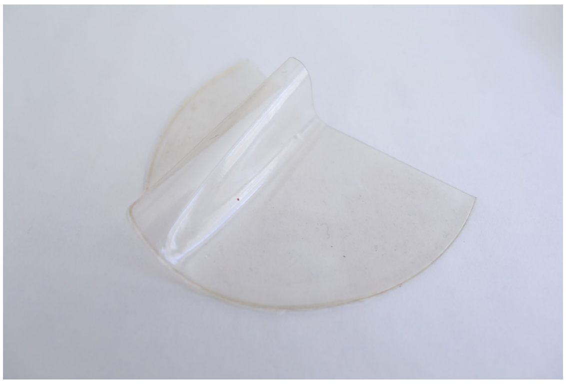
NEXT
Translate your interlocking connection mechanism into a generative design. Using parametric design tools, you can make your modules adaptive, expanding their potential for creating complex 3D shapes, rather than only flat materials.

REFERENCE: Zoe Romano (2019) Circular Open-Source Fashion, for Fabricademy. https://class.textile-academy.org/classes/2019-20/week03/ and https://oscircularfashion.com/

SEE ALSO:
- Tutorial interlocking tesselation design with Rhino & Grasshopper by Lorenzo Massini (2020) https://youtu.be/Nb_lfpgM9WU

AGAR BIOPLASTIC

GUM POLYSACCHARIDE FOUND IN RED ALGAE



Agar, carrageenan, and alginate are gum polysaccharides. As food-safe biopolymers they are used widely in the food industry as thickeners and stabilizers but they also have good film-forming qualities.

SEE ALSO: Alginate bioplastic, Carrageenan bioplastic

EST. TIME:

AGAR BIOPLASTIC

INGREDIENTS
5 g Agar, 15 g Glycerine, 250 g Water

TOOLS
Scale, pot, stove, spoon, wide mold or casting surface

TASKS

Weigh the ingredients
- Bring water up to 80 degrees C
- Add glycerine and agar, stir gently to avoid bubbles

Allow mixture to thicken
- Keep the temperature around 80C
- Stir gently throughout for 30 mins
- Allow water to evaporate until liquid is like light syrup

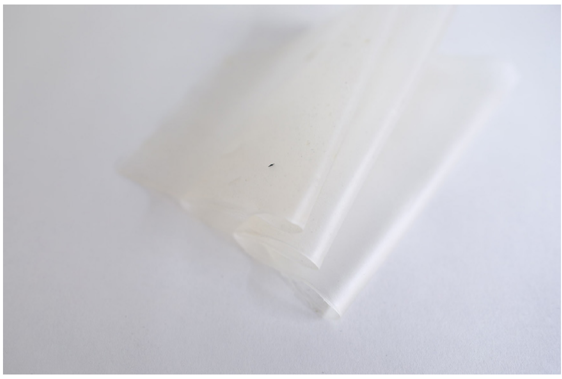
Cast the bioplastic
- Cast the bioplastic slowly in the center of the mold
- Allow to dry for a week without touching

Release the bioplastic
- Check that the plastic no longer feels cold to the touch
- Gently peel it off the surface

REFERENCE: Biofabricating Materials lecture notes, by Cecilia Raspanti, Fabricademy 2019: https://class.textile-academy.org/classes/2019-20/week05A/

ALGINATE BIOPLASTIC

GUM POLYSACCHARIDE FOUND IN BROWN ALGAE



Agar, carrageenan, and alginate are gum polysaccharides. As food-safe biopolymers they are used widely in the food industry as thickeners and stabilizers but they also have good film-forming qualities.

SEE ALSO: Agar bioplastic, Carrageenan bioplastic

EST. TIME:

ALGINATE BIOPLASTIC

INGREDIENTS
For the bioplastic:
•10 g Sodium Alginate, 20 g Glycerine, 200 g Water.
For the cross-linker:
•10 g Calcium Chloride, an additional 100g water.

TOOLS
Scale, blender, spray bottle, glass jar, casting surface

TASKS

Prepare the bioplastic mixture
- Weigh the ingredients
- Put the glycerine and half of the water in a blender
- Turn on the blender, sprinkle in the sodium alginate
- When the paste is homogenous, add the remaining water
- Leave the mixture overnight in a closed jar

Prepare the cross-linker
- Put the calcium chloride in a glass jar
- Add 100 g hot water and stir to dissolve
- Allow to cool and transfer to spray bottle

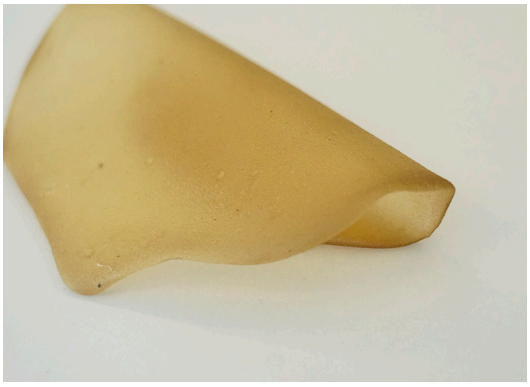
Cast the bioplastic
- Cast the bioplastic slowly in the center of the mold
- Spray generously with calcium chloride solution
- Allow to dry until no longer cold to the touch

Releasing the bioplastic
- Gently peel off the casting surface

REFERENCE: Biofabricating Materials lecture notes, by Cecilia Raspanti, Fa-bricademy 2019: https://class.textile-academy.org/classes/2019-20/week05A/

CARRAGEENAN BIOPLASTIC

GUM POLYSACCHARIDE FOUND IN RED SEAWEED



Agar, carrageenan, and alginate are gum polysaccharides. As food-safe biopolymers they are used widely in the food industry as thickeners and stabilizers but they also have good film-forming qualities.

SEE ALSO: Agar bioplastic, Alginate bioplastic

EST. TIME:

CARRAGEENAN BIOPLASTIC

INGREDIENTS
16 g carrageenan kappa, 3 g glycerine, 350 g water

TOOLS
Scale, pot, cooker, spoon, casting surface

TASKS

Weigh the ingredients
- Bring water up to 80 degrees C
- Add glycerine and carrageenan, stir gently to avoid bubbles

Allow mixture to thicken
- Keep the temperature around 80C
- Stir gently throughout for 30 mins
- Allow water to evaporate until liquid is like light syrup

Cast the bioplastic
- Cast the bioplastic slowly in the center of the mold
- Allow to dry for a week without touching

Release the bioplastic
- Check that the plastic no longer feels cold to the touch
- Gently peel it off the surface

REFERENCE: Lugae Valenti, Making Carrageenan 2021: https://vimeo.com/386012184

GELATINE BIOPLASTIC

GELATIN IS HYDROLIZED COLLAGEN: A POLYMER FOUND IN CARTILAGE, BONE AND SKIN OF ANIMALS

Gelatin or hydrolized collagen and is found in cartilage, bone and skin of animals. It is used as a gelling agent in food, medicine and microbiology, and is used in photography and paper sizing.

SEE ALSO: Agar bioplastic, Carrageenan bioplastic

EST. TIME:

GELATINE BIOPLASTIC

INGREDIENTS
50 g gelatine, 15 g glycerine, 250 g water

TOOLS
Scale, pot, cooker, spoon, casting surface

TASKS

Weigh the ingredients
- Bring water up to 80 degrees C
- Add glycerine and gelatine, stir gently to avoid bubbles

Allow mixture to thicken
- Keep the temperature around 80C
- Stir gently throughout for 10-20 mins
- Allow water to evaporate until liquid is like a thick syrup

Cast the bioplastic
- Cast the bioplastic slowly in the center of the mold
- When solidified: release from the mold
- Allow to dry fully for a week

REFERENCE: Biofabricating Materials lecture notes, by Cecilia Raspanti, Fabricademy 2019: https://class.textile-academy.org/classes/2019-20/week05A/

CHITOSAN

GFF

UU

SEE ALSO: Agar bioplastic, Carrageenan bioplastic

EST. TIME:

CHITOSAN

INGREDIENTS
JJ

TOOLS
JJ

TASKS

Weigh the ingredients
- Bring water up to 80 degrees C
- Add glycerine and gelatine, stir gently to avoid bubbles

Allow mixture to thicken
- Keep the temperature around 80C
- Stir gently throughout for 10-20 mins
- Allow water to evaporate until liquid is like a thick syrup

Cast the bioplastic
- Cast the bioplastic slowly in the center of the mold
- When solidified: release from the mold
- Allow to dry fully for a week

REFERENCE:

MYCELIUM-HEMP COMPOSITE

COMPOSITE OF HEMP FIBRES, CHITIN, AND OTHER POLYMERS

MYCELIUM IS THE VEGETATIVE PART OF THE MUSHROOM, AND CONSISTS OF SEVERAL BIOPOLYMERS SUCH AS CHITIN, CELLULOSE AND PROTEINS.

SEE ALSO:vv

EST. TIME:

MYCELIUM-HEMP COMPOSITE

INGREDIENTS
GIY kit from grown.bio, plain flour (30g per kg grow kit)

TOOLS
Scale, 70% alcohol, scissors, large bowl, scalpel, cling film, latex or nitrile gloves, molds

TASKS

Clean all tools and surfaces with 70% alcohol
Prepare the composite mix
- Wear gloves and open the bag with clean scissors
- Add the GIY mix to the bowl and mix in the flour
- Crumble up all the lumps with your hands until even

Prepare the mold:
- Desinfect the mold with alcohol
- Distribute the mycelium-hemp mix
- Cover the mold with cling film
- Punch small holes every 3 cm with a clean scalpel

Let it grow:
- Put the mix in a dark place at 20-25 degrees C
- Allow the mycelium to colonize the substrate for 3-5 days
- When it is completely white, carefully take it out

Dry the composite:
- Dry the composite for 2-3 hours at 40 degrees C
- Keep the door of the oven open to allow moisture to escape
- Bake for another 2 hours at 80 degrees until light and firm

REFERENCE: Grow-It-Yourself kit via Grown.bio https://www.grown.bio

SEE ALSO:
- Kick-start your Mycoculture by Fabtextiles https://issuu.com/nat_arc/docs/myceliumfabtextiles

ONION SKIN PIGMENT EXTRACTION

PLANT-BASED PIGMENT EXTRACTED FROM ONION SKINS

THE OUTER SKINS OF ONIONS CONTAIN A PIGMENT CALLED PELARGONIDIN THAT CAN BE USED TO CREATE A MEDIUM LIGHT FAST TEXTILE DYE.

SEE ALSO:vv

EST. TIME:

ONION SKIN PIGMENT EXTRACTION

INGREDIENTS
10-20 g Onion skins (red and yellow onions separated), 20g mordanted natural fibres, water, PH modifiers (soda solution, vinegar), iron modifier, cloves or clove oil.

TOOLS
Cooker, pot, spoon, scale, strainer, glass jar

TASKS

Separate yellow and red onion skins
- Yellow onion skins create a yellow/gold/orange hue
- Red onion skins create a greens and greenish yellow
- Pre-wet the mordanted fibre by putting them in water

Cover the onion skins with water and bring to the boil
- Extract the pigment by letting it simmer for 30-60 minutes
- Allow to cool to 30 degrees C

Dyeing
- Add the pre-wetted mordanted fibres
- Slowly reheat, keep temperature below 80 degrees C
- Dye for 1 hour, turn off the heat and leave overnight

Rinsing and modifying
- Rinse the fibres until the water runs clear, squeeze out excess
- Cut the fibre into 4 parts. Dip one in a jar of vinegar, dip one in a soda solution (PH9-10), and dip the last one in an iron sulphate solution to shift the colors.

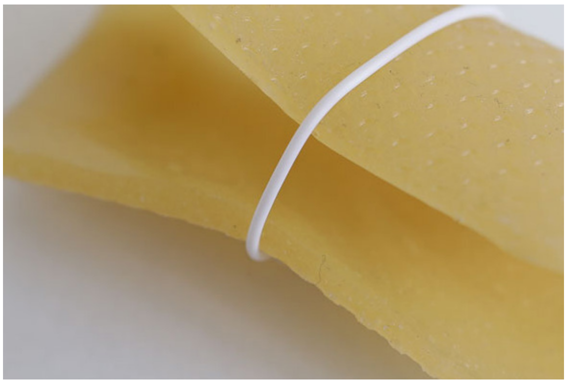
Re-use or store the dye
- add new fibres to the exhaust bath, evaporate more water and add a binder such as Arabic gum to create an ink, or create a lake pigment (e.g. https://rebeccadesnos.com/blogs/journal/making-lake-pigments)

REFERENCE:https://class.textile-academy.org/classes/2019-20/week04/

SEE ALSO:
- Joy Boutrup & Catherine Ellis (2019) The Art & Science of Natural Dyes: Principles, Experiments.
- Jason Logan (2018) Make Ink: A Forager's Guide to Natural Inkmaking.

STARCH BIOPLASTIC

POLYSACCHARIDE (OR POLYMERIC CARBOHYDRATE) PRODUCED BY PLANTS FOR ENERGY STORAGE



In industry, (modified) starches are used to manufacture bioplastics, alcohol and biofuel, as thickener for e.g. sauces. Non-food applications include stiffening textiles, adhesives and papermaking. Because native starch has poor processing and mechanical properties, gelatin is added here.

SEE ALSO: BBBBB

EST. TIME:

STARCH BIOPLASTIC

INGREDIENTS
50 g potato starch, 50 g gelatin powder,
100 g glycerine, 100 g water, 15 g vinegar

TOOLS
Cooker, pot, scale,
spoon, casting surface

TASKS

Prepare the gelatine mix
- Weigh the ingredients
- Bring water to the boil, add the glycerine and gelatine
- Keep temperature below 80 degrees C
- Stir slowly until gelatine is fully dissolved

Prepare the starch mix
- Put starch in a bowl and dissolve with 2 tbsp hot water
- Add the mixture to the gelatine mix and stir slowly

Casting and drying
- When it thickens but is still liquid, cast on surface
- Quickly spread out with spatula if needed
- Allow to dry at room temperature near an open window

REFERENCE: Starch-based rubber by Loes Bogers (2020) https://class.textile-academy.org/2020/loes.bogers/files/recipes/biorubber/

SEE ALSO:
- The Bioplastics Cookbook: A Catalogue of Bioplastics Recipes by Margaret Dunne for Fabtextiles (2018) https://issuu.com/nat_arc/docs/bioplastic_cook_book_3

MILK COMPOSITE // CONCRETE

MAMMAL MILK CONTAINS A PROTEIN CALLED ***CASEIN***, WHICH IS A POLYMER

Casein was first patented in 1899 and was used to copy horn. It was commonly used for small items such as buttons, cutlery handles and knitting needles.

SEE ALSO: BBB

EST. TIME:

MILK COMPOSITE

INGREDIENTS
65 g calcium carbonate or finely ground egg shells, 25 g calcium hydroxide, 8 g glycerine, 800 g low fat milk, 30 g white vinegar

TOOLS
Face mask, scale, bowls, grater, oven, cooker, pots, blender

TASKS

Preparing the casein
- Heat up the milk and add the vinegar, stir
- After 1 minute: strain the casein curd from the liquid
- Put in the blender and blend with glycerine
- Press into mould and dehydrate fully

Making the composite
- Wear a mask to protect airways from small particles
- Grate the dried casein plastic into a fine powder
- Dissolve the calcium hydroxide in hot water
- Dissolve the calcium carbonate in the vinegar
- Mix both with the calcium carbonate

Casting and drying
- Cast into a mould and press for 1 hour
- Dehydrate at 50 degrees C in the oven for at least 4 hrs
- Allow to air dry until fully dehydrated.

REFERENCE
- William Christmas (1924) Casein Plastic Composite patent https://bit.ly/3C7rdYF

SEE ALSO
- Tessa Silva (2016) Chalk & Cheese, and Protein project: https://www.tessasilva.com/chalk-cheese

FRUIT LEATHER

MOST FRUITS CONTAIN THE BIOPOLYMER ***PECTIN***, A POLYSACCHARIDE

Fruit leather was originally conceived of as a way to preserve fruit to be eaten as a snack. To make fruit leather, overripe fruit is best, used with skin and all. Unsold market fruits are a big waste stream in the Netherlands.

SEE ALSO: BBB

EST. TIME:

FRUIT LEATHER

INGREDIENTS
1 overripe mango with skin, 10 g potato starch, 8 g vinegar

TOOLS
Blender, walled mould, cooker, pan, spoon, scale, oven

TASKS

Prepare the mixture
• Cut the mango in smaller pieces and puree with blender
• Put the puree in a pot with some water
• Keep at low heat for 30 minutes while stirring to kill bacteria

Cook the mixture
• Dissolve the starch in a dash of cold water
• Add to the hot mango mixture and stir
• Cast the paste into the mould

Drying
• Heat the oven to 40-50 degrees C
• Dry the sheet for 16 hours in the oven
• Peel off the sheet and flip to dry the other side
• Allow to airdry for another 5-7 days

REFERENCE
• Beatriz Sandini (2018) Ephemeral Fashion Lab: https://class.textile-academy.org/2020/beatriz.sandini/projects/final-project/

SEE ALSO
• Fruit Leather, Rotterdam: https://fruitleather.nl/

MICROBIAL LEATHER

KOMBUCHA CULTURE CONTAINS ***ACETOBACTER XYLINUM***, A BACTERIA THAT PRODUCES PURE NANOCELLULOSE AS IT FERMENTS SUGARS.

KOMBUCHA IS A FERMENTED TEA DRINK THAT CAN BE MADE WITH LIVING CULTURE CALLED A SCOBY: SYMBIOTIC CULTURE OF BACTERIA AND YEAST. BY BUILDING UP THIS CULTURE, YOU CAN CREATE A SMALL CELLULOSE FACTORY.

REFERENCE
• Suzanne Lee (2011) Grow Your Own Clothes TedTalk: https://www.ted.com/talks/suzanne_lee_grow_your_own_clothes

SEE ALSO
• Kombucha Mold! How to Identify Mold vs. No Mold and What to Do Next (n.d.) Kombucha Kamp: https://www.kombuchakamp.com/kombucha-mold-information-and-pictures

EST. TIME:

MICROBIAL LEATHER

INGREDIENTS
1x Yaya Kombucha starter pack (contains SCOBY), 4 g green or black tea, 40 g sugar, vinegar, 400 ml water, citric acid

TOOLS
Clean glass 1000 ml jar, dishwashing soap, PH strips, large round coffee filter or old t-shirt, rubber band

TASKS

Prepare your work area
- Clean and disinfect your work area and wash all tools with very hot water and soap. Rinse off the soap well

Brew the sugary tea
- Brew 400 ml of tea, add the sugar and stir to dissolve
- Allow to cool to 30 degrees C
- Strain the tea and catch the liquid in the clean glass jar

Add the living culture
- Add the kombucha culture form the starter pack (both the liquid SCOBY and the pellicle).
- Add white vinegar until pH of the liquid reaches pH6
- Cover the jar with a coffee filter or piece of clean t-shirt, and wrap a rubber band around it. The filter allows for oxygen to come through but keeps bugs out.
- Allow the culture to go in a warm spot away from sunlight

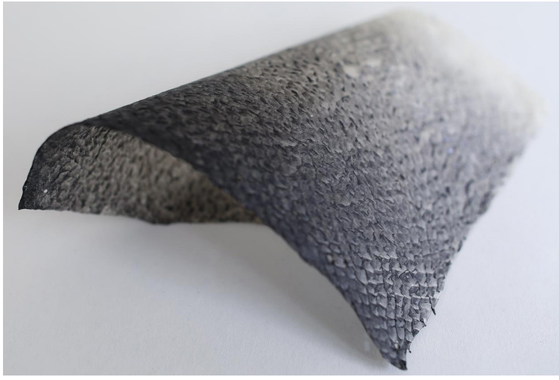
Wait 3-4 weeks
- Check for every few days for contami nation, without moving the pot or the filter.
- If the culture is contaminated (see link), discard!
- You should see a white or translucent pellicle growing on the top of the surface after a few weeks.
- Wait until the pellicle is 10 mm thick

Harvesting
- Wash your hands and tools well, take out the pellicle
- Prepare a citric acid solution with pH2-3 and soak the pellicle in it over night, this will make it more supple
- Allow it to dry until fully dehydrated (e.g. oven at 50 degrees C)

Continuous culturing
- Repeat the process by adding more cold sugary tea to the liquid SCOBY in the jar and wait another few weeks.
- Your culture will get stronger and grow faster over time.

FISH LEATHER

FISH SKIN IS RICH IN THE PROTEIN ***COLLAGEN***, A BIOPOLYMER



THIS TREATMENT WITH ALCOHOL ***DENATURES*** OR DAMAGES THE LIVING CELLS OF THE FISH SKIN, TO PREVENT DECOMPOSITION. GLYCERINE RE-HYDRATES AND PLASTICIZES THE SKIN, MAKING IT PLIABLE AND STABLE.

SEE ALSO: BBB

EST. TIME:

FISH LEATHER

INGREDIENTS
Fresh uncooked fish skins, 250 ml denatured 96% alcohol, 250 ml glycerine

TOOLS
Blunt scraping tool, 1000 ml glass jar, dishwashing soap, wooden board, nails, hammer

TASKS

Clean the skins
- Scrape off fat, meat and membrane with a blunt scraping tool
- Wash the skins with cold soapy water and rinse

Prepare the tanning liquid
- Put the glycerine and alcohol in the jar
- Submerge the skins in it and shake vigourously for 1 min
- Put a little weight (like a marble) on the skin to keep it down

Tanning process
- Keep the skins in the jar for 3 days, shake daily for 1 min
- Take out the skins, massage and stretch them for 1 hr
- Nail them to the wooden board and leave outside to dry

REFERENCE
- Fish Skin Tanning from the 6-8th grade Heritage Kit Curriculum, by Chugachmiut Heritage Preservation, Anchorage USA:https://chugachheritageak.org/pdf/CLO_6-12%20_FISH_SKIN_TANNING_Final.pdf
- Cecilia Raspanti (2019) Fish skin leather: https://class.textile-academy.org/classes/2019-20/week05A/

SEE ALSO:
- Nienke Hoogvliet (n.d.) Re-Sea Me https://www.nienkehoogvliet.nl/portfolio/re-seame/

FLOWER PAPER

PLANT CELLS IN FLOWER PETALS – AND OTHER PARTS OF GREEN PLANTS - CONTAIN ***CELLULOSE***, A BIOPOLYMER

WITH THIS SIMPLE TECHNIQUE YOU CAN MAKE YOUR OWN PAPER. STEMS CAN ALSO BE USED, BUT NEED LONGER COOKING TIME AND RESULT IN ROUGHER AND THICKER PAPER.

SEE ALSO: BBB

EST. TIME:

FLOWER PAPER

INGREDIENTS
Bouquet of withered flowers, sodium carbonate (soda ash), water

TOOLS
Mortar and pestle, cooker, pot, mould & deckle or a picture frame lined with a fine mesh, strainer

TASKS

Prepare the paper slurry
- Pick the flower petals from the bouquet
- Cover them with water, add a tsp of soda ash
- Bring to the boil and cook for 30 mins or until soft
- Strain the flower leaves and pound them in the mortar
- Optional: blend them with a blender, but this cuts the fibres and results in a more brittle paper.

Distribute the slurry
- Scoop the slurry onto the mesh or mould & deckle
- Spread out evenly, about 2 mm thick
- Carefully submerge in water to help distribute the slurry

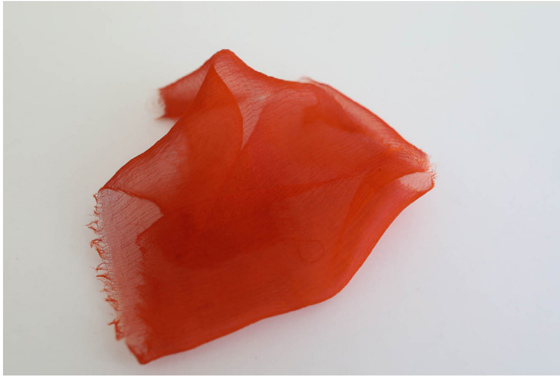
Allow to dry
- Leave to dry for about 2 days
- Carefully peel the paper off the mesh

REFERENCE
- May Babcock for Paper Slurry (2014) Hand-papermaking With Plants: https://www.paperslurry.com/2014/08/20/hand-papermaking-with-plants-illustrated-infographic/

SEE ALSO:
- https://class.textile-academy.org/2020/loes.bogers/files/recipes/flowerpaper

MADDER PIGMENT EXTRACTION

LIKE INDIGO (BLUE) AND WELD (YELLOW), MADDER IS A ***GRAND TEINT***: A CLASSIC DYEPLANT THAT IS COLOR FAST AND LIGHT-FAST. MADDER PRODUCES REDS, ORANGES AND BROWNS.



MADDER CAME FROM THE ROOTS OF ***RUBIA TINCTORUM*** PLANTS FOUND IN SOUTHERN EUROPE AND WEST-ASIA. MADDER WAS BROUGHT TO THE SOUTH OF THE NETHERLANDS AND FLANDERS AROUND 1300 WHERE THE CLAY SOIL WAS OPTIMAL FOR MADDER CULTIVATION. COMPARED TO RED PIGMENTS COMING FROM THE SYNTHETIC GARANCINE, MADDER IS LESS ECOLOGICALLY TAXING.

SEE ALSO: Onion pigment extraction

EST. TIME:

MADDER PIGMENT EXTRACTION

INGREDIENTS	TOOLS
50 g dried madder roots, water	Pot, thermometer, cooker, spoon, old pantyhose, blender

TASKS

Soak the roots
- Soak the dried madder roots in water overnight
- Blend them with a blender

Extract the pigment
- Put the roots in the pantyhose and make a knot to close
- Put the madder in a pot and cover with water
- Optional: adding a tbsp of soda ash and/or calcium carbonate brings out the red tones
- Bring up to 60 degrees C, and keep there for 2 hours
- Overheating causes pigment to shift to brown
- Allow to cool, keep the madder roots for a 2nd extraction

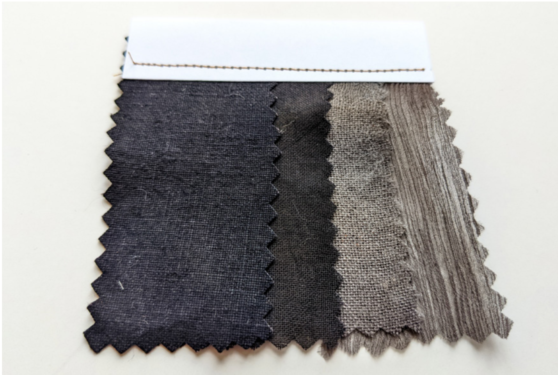
Use or store the pigment
- Use the pigment solution as a textile dye, or evaporate water on low heat to create a water-based ink, or create a lake pigment for DIY crayons and paints.

REFERENCE

- Joy Boutrup & Catherine Ellis (2019) The Art & Science of Natural Dyes: Principles, Experiments.

OAK GALL TANNIN EXTRACTION

OAK GALL EXTRACTIONS CAN BE USED AS TANNIN MORDANT TO PREPARE TEXTILES FOR DYEING, AND WHEN COMBINED WITH FERROUS ACETATE CREATES DARK IRON GALL INK.



Oak galls form when gall wasps inject their larvae into developing buds of the oak tree. An oak gall forms as the larvae undergo metamorphosis into adults.

SEE ALSO: DIY Iron Acetate

EST. TIME:

OAK GALL TANNIN EXTRACTION

INGREDIENTS
100 g oak galls, water, DIY iron acetate

TOOLS
Plastic bag, hammer, cooker, pot,

TASKS

Extracting the tannins
- Put the galls in a plastic bag and smash with a hammer
- Cover with water and bring to the boil
- Simmer for at least an hour to extract the tannins, strain

Modifying the color
- When tannins are exposed to iron ions (such as DIY iron acetate) the pale yellow/beige color will turn dark gray/ purple.

Uses
- Use the extraction to dye textiles, or use a diluted extraction as tannin mordant to prepare textiles for dyeing. Or evaporate more water to turn it into a water-based ink.

REFERENCE
- Joy Boutrup & Catherine Ellis (2019) The Art & Science of Natural Dyes: Principles, Experiments.
- Catherine Ellis (2018) Are All Oak Galls Equal? https://blog.ellistextiles.com/2018/08/06/are-all-oak-galls-equal/

FUNGAL DYE

PIGMENT FROM THE TOXIC SULPHUR TUFT MUSHROOM OR ***HYPHOLOMA FASCICULARE*** CAN BE USED AS WOOL DYE (AND GLOWS UNDER A BLACKLIGHT!)

THIS MUSHROOM (NL: ZWAVELKOP) IS HIGHLY ABUNDANT IN THE NETHERLANDS AND CAN BE FOUND IN GROUPS AT THE FOOT OF DECI-DUOUS AND CONIFER TREES IN PARKS AND FORESTS.

SEE ALSO: DIY Iron Acetate

EST. TIME:

FUNGAL DYE

INGREDIENTS
250 g fresh sulphur tuft mushrooms, 25 g mordanted wool, DIY iron acetate

TOOLS
Large pot (non-food only), cooker, wash bag, spoon

TASKS

Find a mycologist to help you identify the right mushrooms

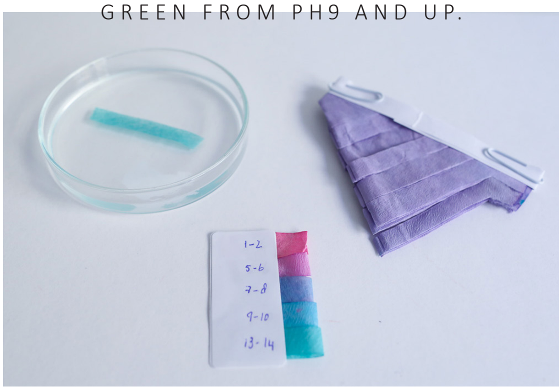
Preparing the dye bath
- Clean the mushrooms and break them into smaller pieces
- Put the pieces in a wash bag
- Put the wash bag in the pot and cover with water
- Bring to 80 degrees C and extract the pigment for 1 hr
- Allow to cool, then add the wet mordanted wool
- Dye the wool at 80 degrees C for 30-60 minutes

Rinsing and modifying
- Take half the wool out, rinse with warm water
- Add a splash of DIY iron acetate to the dye bath and modify the color of the remaining wool.
- Take out the wool, rinse with warm water

REFERENCE
- Miriam Rice (1974) Mushrooms for Color
- That Which Sustains Us: Lessons from the Forest Natural Dyeing with Mushrooms (2020) Museum of Vancouver: https://youtu.be/o-IXeTI7AwY

DIY pH PAPER

EXTRACT OF RED CABBAGE JUICE CHANGES COLOR WHEN EXPOSED TO SOLUTIONS OF VARYING ACIDITY (OR PH): IT IS PURPLE WHEN NEUTRAL (PH 7-8), TURNS PINK BELOW PH 6, AND BLUE/ GREEN FROM PH9 AND UP.



The purple color in red cabbage comes from a class of pigment molecules called anthocyanins. The level of acid or alkali (i.e., lower or higher than pH 7) around the molecule changes the color of the anthocyanin.

SEE ALSO: DIY Iron Acetate

EST. TIME:

DIY pH PAPER

INGREDIENTS
Half a red cabbage, water, citric acid, soda ash

TOOLS
Food grater, pot, cooker, a clean spray bottle, filter paper or white coffee filters, 4 bowls

TASKS

Prepare the ink
- Grate the red cabbage
- Put in the pot and cover with water
- Bring to the boil and simmer for 30 mins
- Strain the liquid and put in a spray bottle
- Spray the purple liquid to cover the entire filter paper
- Allow to dry

Make a legend
- Boil some water and put in the bowls
- Add a pinch of citric acid to one bowl, stir to dissolve
- Add a pinch of soda ash to another bowl, stir to dissolve
- Dip a piece of paper in each and tweak until you get the following colors: fuchsia pink (pH3-4), pink/purple (pH5-6), blue/purple (pH7-8), blue/green (pH9-10), green (pH 13-14)
- Write up a legend and glue the papers to it

REFERENCE
- Anne Marie Helmenstine (2020) Make Red Cabbage pH paper: https://www.thoughtco.com/make-red-cabbage-ph-paper-605993

SEE ALSO
- https://class.textile-academy.org/2020/loes.bogers/files/recipes/phmodifiers

DIY IRON ACETATE

DIY IRON ACETATE IS ALSO CALLED IRON VINEGAR OR IRON LIQUOR AND CAN BY MADE BY LETTING WHITE VINEGAR CORRODE IRON SCRAPS.

IT IS HIGH IN IRON IONS, WHICH REACT WITH TANNINS FOUND IN SEVERAL NATURAL DYES AND FOODSTUFFS. DIY IRON ACETATE SHIFTS COLORS OF TANNIN RICH DYES TO GREENS AND GRAYS AND INCREASES COLOR FASTNESS OF DYES WHEN USED AS A MORDANT.

SEE ALSO:Oak gall tannin extraction, Fungal dye

EST. TIME:

DIY IRON ACETATE

INGREDIENTS	TOOLS
White vinegar, rusty iron nails or a fine steel wool sponge	Large glass jar, household gloves

TASKS

Make the iron acetate
- Put the rusty iron nails or the steel wool in the jar
- Cover with vinegar
- Leave for 1-3 weeks

Use the iron acetate
- Wear household gloves before using
- Can be used as mordant, dye modifier or wood stain.
- Use only small – diluted - amounts, the iron is corrosive to fibres and irritant to eyes and skin.

REFERENCE
• Make Wood Stain (n.d.) https://www.apieceofrainbow.com/make-wood-stain/

SCOURING AND MORDANTING WOOL FIBRES

SCOURING AND MORDANTING WOOL (PROTEIN FIBRE) TO PREPARE IT FOR TEXTILE DYEING WITH NATURAL DYES.

It is high in iron ions, which react with tannins found in several natural dyes and foodstuffs. DIY iron acetate shifts colors of tannin rich dyes to greens and grays and increases color fastness of dyes when used as a mordant.

SEE ALSO:Scouring and mordanting silk fibres, Scouring and mordanting cellulose

EST. TIME:

SCOURING AND MORDANTING WOOL FIBRES

INGREDIENTS
100 g wool (dry weight), 1 g eucalan detergent, 15 g alum, 5 g cream of tartar, water

TOOLS
Large pot, cooker, glass jar, scale, spoon, bucket, thermometer

TASKS

Scouring
- Soak the fibres in water overnight
- Dissolve the Eucalan detergent in hot water
- Put the wool in a large pot, add the solution
- Cover with water until the wool can float freely
- Bring up to 80 degrees C and keep there for 30 mins
- Allow to cool a little and rinse with warm water

Mordanting
- Measure the alum and cream of tartar, and put in the jar
- Add some boiling water and stir to dissolve
- Put the fibres in a large pot, add the solution
- Cover the fibres with additional water so they float freely
- Bring the fibres to 80 degrees C, slowly
- Turn off the heat and leave overnight
- Squeeze out excess water, rinse lightly
- Replenish the mordant bath by adding 50% to re-use

REFERENCE
- How to Scour (n.d.) Botanical Colors: https://botanicalcolors.com/how-to-scour/
- Joy Boutrup Catherine Ellis (2018) The Art & Science of Natrual Dyes: p. 120-121.

SCOURING AND MORDANTING SILK FIBRES

SCOURING AND MORDANTING SILK (PROTEIN FIBRE) TO PREPARE IT FOR TEXTILE DYEING WITH NATURAL DYES.

It is high in iron ions, which react with tannins found in several natural dyes and foodstuffs. DIY iron acetate shifts colors of tannin rich dyes to greens and grays and increases color fastness of dyes when used as a mordant.

SEE ALSO:Scouring and mordanting wool fibres, Scouring and mordanting cellulose

EST. TIME:

SCOURING AND MORDANTING SILK FIBRES

INGREDIENTS
100 g silk (dry weight), 1 g sodium carbonate (soda ash), 1 g neutral detergent, 15 g alum, water, vinegar

TOOLS
Large pot, cooker, glass jar, scale, spoon, bucket, thermometer

TASKS

Scouring
- Soak the silk in water overnight
- Dissolve the detergent in hot water
- Put the wool in a large pot, add the solution
- Cover with water until the silk can float freely
- Bring up to 80 degrees C and keep there for 30 mins
- Allow to cool a little and rinse with warm water
- Add vinegar to the rinse water and leave for 20 mins
- Rinse again, squeeze out excess water

Mordanting
- Measure the alum, and put in the jar
- Add some boiling water and stir to dissolve
- Put the fibres in a large pot, add the solution
- Cover the fibres with additional water so they float freely
- Bring the fibres to 80 degrees C, slowly
- Turn off the heat and leave overnight
- Squeeze out excess water, rinse in hot water
- Replenish the mordant bath by adding 50% to re-use

REFERENCE

- How to Scour (n.d.) Botanical Colors: https://botanicalcolors.com/how-to-scour/
- Joy Boutrup Catherine Ellis (2018) The Art & Science of Natrual Dyes: p. 124.

DYEING CELLULOSE FIBRES

SCOURING, MORDANTING AND DEYING CELLULOSE FIBRES (LINEN, COTTON, HEMP, RAMIE)

IT IS HIGH IN IRON IONS, WHICH REACT WITH TANNINS FOUND IN SEVERAL NATURAL DYES AND FOODSTUFFS. DIY IRON ACETATE SHIFTS COLORS OF TANNIN RICH DYES TO GREENS AND GRAYS AND INCREASES COLOR FASTNESS OF DYES WHEN USED AS A MORDANT.

SEE ALSO:Scouring and mordanting silk fibres, Scouring and mordanting wool fibres

EST. TIME:

DYEING CELLULOSE FIBRES

INGREDIENTS
100 g cellulose fibres, 1 g soda ash and 1 g detergent for scouring, 10 g oak gall extract OR: 30 g ground oak galls, 12 g alum and 1.5 g soda ash for mordanting.

TOOLS
Large pot, cooker, glass jar, scale, spoon, bucket, pH paper, rubber gloves

TASKS

Scouring
- Fill a large pot with warm water
- Add and dissolve 1 g detergent and 1 g soda ash
- Measure pH, add soda until it reaches pH8-9
- Add fibres and cover with water, fibres should move freely
- Heat to 100 degrees C (boil), keep there for 1-2 hours
- Move the textiles regularly
- Allow to cool in the mordant bath, then rinse well

Application of tannins
- Fill a large (30L) pot with hot water (50 degrees C)
- Add the tannin powder and stir until dissolved.
- Add the fibres and soak for 2 hrs. Do not heat the bath.
- Remove fibre, squeeze out wearing gloves
- While still damp: proceed to alum mordant

Alum mordanting
- Dissolve the alum in boiling water, allow to cool
- Dissolve the soda in boiling water, allow to cool
- Combine the alum and soda solution, while stirring
- Add enough warm water (50 degrees C) to immerse fibres
- Place moist tannin-treated fibres in mordant, soak for 2 hours
- Stir occasionally, then take out wearing gloves
- Squeeze our excess mordant and rinse well.

REFERENCE
- How to Scour (n.d.) Botanical Colors: https://botanicalcolors.com/how-to-scour/
- Joy Boutrup Catherine Ellis (2018) The Art & Science of Natrual Dyes: p. 117, 127, 132.

MATTER/MATERIAL/MATERIALITY

VVV

BBBB

SEE ALSO: BBB

EST. TIME:

MATTER/MATERIAL/MATERIALITY

INGREDIENTS
VV

TOOLS
VV

TASKS

Scouring
- Fill a large pot with warm water
- Add and dissolve 1 g detergent and 1 g soda ash
- Measure pH, add soda until it reaches pH8-9
- Ad

REFERENCE
- sdsf

WHAT IS A MATERIAL PROPERTY?

VVV

MATERIAL SCIENCES HAVE DEVELOPED SHARED VOCABULARIES TO DESCRIBE MATERIAL PROPERTIES BUT ARE OFTEN UNDERPINNED BY TECHNICAL MATERIAL TESTS AND MATHEMATICAL FORMULAS. DEVELOP A SHARED VOCABULARY UNDERPINNED BY EXAMPLE MATERIALS AND TACTILE EXPERIENCES.

REFERENCE

• Properties of Materials Introduction (2018) Science Learning Hub https://www.sciencelearn.org.nz/resources/2659-properties-of-materials-introduction

SEE ALSO:

• List of materials properties, Wikipedia: https://en.wikipedia.org/wiki/List_of_materials_properties

• Open Source Universal Test Machine (2019) CNC Kitchen Youtube: https://youtu.be/uvn-18Cbt-zM

EST. TIME:

WHAT IS A MATERIAL PROPERTY?

WHY

When we document material experiments, it is useful to have words to describe their properties and be specific about the differences between those words (e.g. hardness vs. elasticity vs. stiffness). Calculating a modulus however is demystifying for those without a background in material science. Finding a shared vocabulary based on tactile experience and discussion offers a contextual and embodied approach to defining and comparing materials and their properties within a community of practice.

TASKS

Make duos and assign all property keywords
• Formulate a one-sentence definition per property in your own words
• Find an object that represents a material that would score very low on the scale, and one that represents a high score or even maximum of the scale for that property and one in the middle
• Determine words that can express the minimum and maximum of the scale for each property (e.g. for strength: weak to strong)
• List interactions with the material that help determine its score on the scale of that property

Property keywords
Strength, hardness, transparency, glossiness, weight, structure, texture, temperature, shape memory, odor, stickiness, weather resistance, acoustic properties, scratch resistance, surface friction, weight, elasticity, ductility, wear resistance, water resistance, heat conductivity, creep, density

Class discussion
• Bring your objects to class and reflect on each other's definitions and "testing" methods.
• Assess how well the presented samples represent the range (min/max) of the scale for that property
• Suggest better examples of the min/max/middle

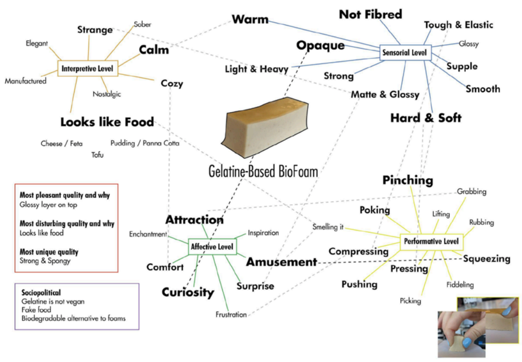
Visualize your shared vocabulary
• Together, make a visual overview of your shared vocabulary of material properties, words used to describe the range, and images of the sample materials that represent different points on the scale for each property.

NEXT

Formalize your vocabulary further by developing DIY testing methods using simple tools that allow for numerical comparison, e.g. https://www.education.com/science-fair/article/tensile-stregth-fishing-line/

WHAT IS A MATERIAL EXPERIENCE?

VVV



THE NOTION OF ***MATERIALS EXPERIENCE*** EMPHASIZES THE ROLE OF MATERIALS AS BEING SIMULTANEOUSLY TECHNICAL AND EXPERIENTIAL. PEOPLE EXPERIENCE MATERIALS IN PRODUCTS AT FOUR EXPERIENTIAL LEVELS, NAMELY SENSORIAL, INTERPRETIVE, AFFECTIVE AND PERFORMATIVE.

SEE ALSO: BBB

EST. TIME:

WHAT IS A MATERIAL EXPERIENCE?

WHY
Developing an *experiential characterization* of a material entails investigating of how a material is received, what it makes people think, feel and do. It helps designers mobilize unique material qualities in design processes.

WHEN
When you've developed one or more interesting materials and want to systematically explore their possible application in real products/objects.

TASKS

Understand the material: technical
tinker with the material (e.g. make variations on the recipe)| test material's properties, compare to similar materials | describe opportunities and constraints | explore and describe possible manufacturing processes

Understand the material: experiential
Explore how the material is experienced by people using the MA2E4 toolkit. Inquire about their experiences on the *performative*, *sensorial*, *affective* and *interpretive* level.

Create a materials experience vision & patterns
Express how you envision the material's role in creating functional applications and unique user experiences, in relation to other products, people and wider contexts. See also reference below.

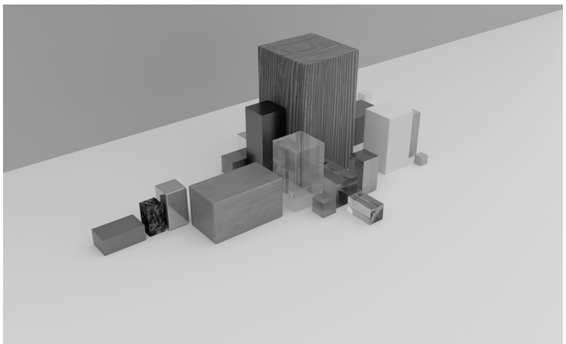
Designing material/product concepts
Integrate all findings into 3 product concepts that mobilize the material's unique properties in a meaningful way.

REFERENCE
- Elvin Karana, Bahareh Barati, Valentina Rognoli & Anouk Zeeuw van der Laan (2015) Material Driven Design (MDD): A Method to Design for Material Experiences. International Journal of Design.

SEE ALSO:
- Serena Camere & Elvin Karana (2018) MA2E4 Toolkit: Experiential Characterization of Materials: https://materialsexperiencelab.com/ma2e4-toolkit-experiential-characterization-of-materials

MATERIAL OBJECTS

VVV



MAKING, DISPLAYING AND USING SERIES OF ***MATERIAL-OBJECTS*** CAN REVEAL SPECIFIC ASPECTS OF MATERIAL SCIENCE IN AN EXPERIENTIAL WAY. THEY COMMUNICATE ASPECTS OF THE RELATIONSHIP BETWEEN FORM, FUNCTIONALITY AND MATERIALITY.

REFERENCE
• Zoe Laughlin (2010) How can the Science of Materials be Represented by the Materials Themselves in a Materials Library? https://doi.org/10.13140/RG.2.2.16034.94405

SEE ALSO:
• Shttp://zoelaughlin.com/research-papers

EST. TIME:

MATERIAL OBJECTS

WHY
The strategy of creating *material-objects* has been proposed by Zoe Laughlin (2010) as a way to express the relationship between form, function and materialty by letting the material itself represents the science behind materials in the context of a material library [24]. Laughlin demonstrated this by creating a series of cubes, spoons, bells, and tuning forks identical in form but made of different materials, whose properties can then be experienced and compared.

TASKS

Select
- Choose a form or object you are interested in exploring (e.g. a spoon, a sheet material)
- Choose one or more material recipes you are interested in exploring further

Make
- Create a series of objects that have the same form, but are made with a different material recipe.
- Variations between the recipes can be very small and incremental (e.g. from no glycerine to a lot of glycerine), or substantial (e.g. using to entirely different recipes with different biopolymers).
- Document each recipe in detail: weigh the ingredients, record cooking and drying times, measure temperatures etcetera.

Share
- Allow others to explore the material series and documentation and explore what they're able to understand about the materials by interacting with the series and comparing the samples.
- Contribute the set to your material archive.

WHEN
Designing a set of material-objects is a method to systematically understand and expand upon a material recipe by making variations on a theme.

OUTPUT
A set of material samples that are identical in form (the thing), but different in terms of the material (the stuff).
Can be contributed to a shared material archive when documented together with recipes.

TACTILITY VIDEO

VVV

Making a tactility video is a way to explore and document the sensory qualities of a material, by capturing the "feel" and sound of it in a video.

SEE ALSO: BBB

EST. TIME:

TACTILITY VIDEO

WHY
This method provides a way to convey material properties in an accessible, non-textual way.

WHEN
1) To spend time with your material experiments, and get to know their unique features
2) when you cannot provide access to the physical sample you can use this format to convey the feel and sound of a material.

NEXT
Asking others to manipulate the materials while you film them is also a way to research materials experience described in the card ***What is a materials experience?***

TASKS

- Select one or more materials to explore
- Watch the tutorial video https://bit.ly/3bIQHQh
- Lasercut a phonestand with the design file provided
- Find a quiet place with even natural lighting
- Set up your phone in landscape format
- Shoot your tactility video(s)
- Optional: include a link to the video in your archiving template

REFERENCE:
- Loes Bogers (2020) Tutorial for a tactility video: https://class.textile-academy.org/2020/loes.bogers/projects/outcomes/tools_and_templates/tactilityvideo/

WHAT IS CRITICAL MAKING?

VVV

BBBB

SEE ALSO: BBB

EST. TIME:

WHAT IS CRITICAL MAKING?

INGREDIENTS
VV

TOOLS
VV

TASKS

Scouring
- Fill a large pot with warm water
- Add and dissolve 1 g detergent and 1 g soda ash
- Measure pH, add soda until it reaches pH8-9
- Ad

REFERENCE
- sdsf

A HISTORY OF DESIGN & NATURE

VVV

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: BBB

EST. TIME:

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 to work with nature and position their 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. Clair’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.

INVASIVE SPECIES

VVV

BBBB

SEE ALSO: BBB

EST. TIME:

INVASIVE SPECIES

INGREDIENTS
VV

TOOLS
VV

TASKS

Scouring

- Fill a large pot with warm water
- Add and dissolve 1 g detergent and 1 g soda ash
- Measure pH, add soda until it reaches pH8-9
- Ad

REFERENCE

- sdsf

DESIGN TO DISAPPEAR

VVV

BBBB

SEE ALSO: BBB

EST. TIME:

DESIGN TO DISAPPEAR

INGREDIENTS
VV

TOOLS
VV

TASKS

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REFERENCE

- sdsf

SHIT, HAIR, D(ISG)UST

VVV

BBBB

SEE ALSO: BBB

EST. TIME:

SHIT, HAIR, D(ISG)UST

INGREDIENTS
VV

TOOLS
VV

TASKS

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REFERENCE
- sdsf

REFRAMING: WHO BENEFITS?

VVV

BBBB

SEE ALSO: BBB

EST. TIME:

REFRAMING: WHO BENEFITS?

INGREDIENTS
VV

TOOLS
VV

TASKS

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REFERENCE
- sdsf

OPEN DESIGN

VVV

BBBB

SEE ALSO: BBB

EST. TIME:

OPEN DESIGN

INGREDIENTS
VV

TOOLS
VV

TASKS

Scouring

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REFERENCE
- sdsf

IMPERFECTION / KINTSUGI

VVV

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SEE ALSO: BBB

EST. TIME:

IMPERFECTION / KINTSUGI

INGREDIENTS
VV

TOOLS
VV

TASKS

Scouring

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REFERENCE
- sdsf

CLASS READINGS AND REFLECTION

VVV

BBBB

SEE ALSO: BBB

EST. TIME:

CLASS READINGS AND REFLECTION

INGREDIENTS
VV

TOOLS
VV

TASKS

Scouring
- Fill a large pot with warm water
- Add and dissolve 1 g detergent and 1 g soda ash
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- Ad

REFERENCE
- sdsf

WASTE WALK

LEARN TO IDENTIFY UNUSED SOURCES OF BIOMATERIALS THAT CAN BE TURNED INTO MATERIALS OF VALUE FOR ARTMAKING AND DESIGN.

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: BBB

EST. TIME:

WASTE WALK

WHEN	OUTPUT
Autumn is typically a good season to do waste walks	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)

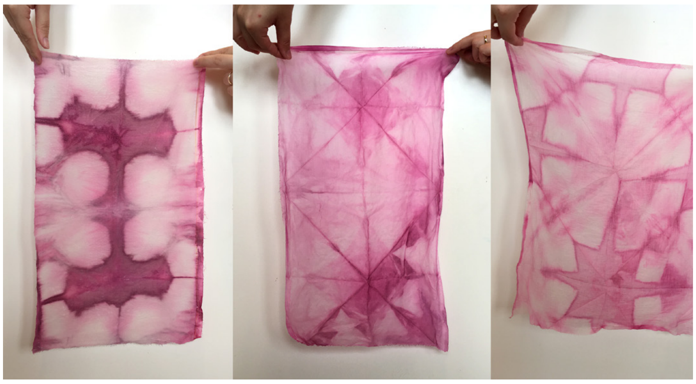
Make a catalogue of all the potentially useful waste streams you identified, and research historical crafts techniques that make use of them. Think of: basket weaving branches, paper-making, fish leather tanning or combining materials into composites. Use the references below for inspiration.

Optional: try out some of the techniques you found if you can

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.

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: BBB

EST. TIME:

MORE-THAN-HUMAN-COLLABORATIONS

WHY
Colloborating 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?

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?

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/

COLLABORATIVE OPEN-SOURCE ARCHIVING

VVV

DOCUMENTING, ARCHIVING AND PRESENTING YOUR MATERIAL EXPLORATIONS TOGETHER OPENS UP ACCESS TO A WEALTH OF OPTIONS YOU COULD NEVER EXPLORE ALONE.

REFERENCE
- OS Material Archive developed at Textile Lab Amsterdam (2016-ongoing): https://tcbl.eu/project/os-material-archive

SEE ALSO:
- Labels designed by Maria Viftrup for Textile Lab Amsterdam can be downloaded here: https://bit.ly/3wdJkdb

SEE ALSO: BBB

EST. TIME:

COLLABORATIVE OPEN-SOURCE ARCHIVING

WHY
Having a large collection of small variations gives you a good feeling for how material recipes can be tweaked to achieve very different results. By having a sample available with a recipe attached, you get a better idea than from a picture or piece of text alone.

WHEN
When you find yourself in a group of people who are interested in experimenting with natural design materials, and believe you could learn more from each other than alone.

TASKS

Discuss the idea of *open-source*
What does it mean?
Where does it come from?
Could it be applied to making materials?
What could be pitfalls?
What are the benefits?
Do you have any hesitations?

Decide what system you will use
- Design, or choose a template all materials will be archived with
- Make sure there's a template for small, medium and large samples
- Find a place where you can display everyone's samples safely
- Decide on the paper stock (something that fits an office printer)

Do material experiments
Keep notes on all material experiments you do: write down details on ingredients, cooking and drying time, references, etc.

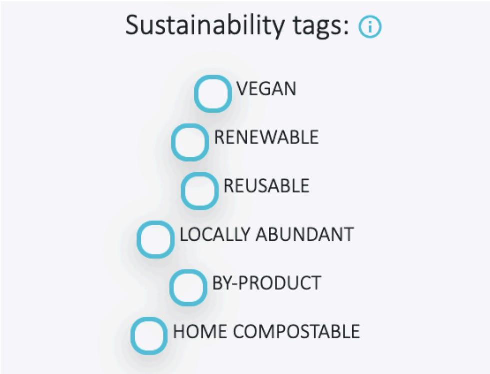
Document and archive
- Collect all your notes and fill out the labels for your samples.
- Make sure to list a main reference and state which changes you made to create a new variation (your "contribution to the field").

Display
- Trim your materials if needed, and mount them onto the labels
- Attach a hang tab or other system to hang them up
- Put them in your material archive.

NEXT
If you want to formalize the process, consider installing software to build your own online/offline archive and sample management tool: https://samplemanagementtool.org/

DEFINE YOUR ECO-COMPATIBILITY PRINCIPLES

VVV



SUSTAINABILITY IS NOT SOMETHING ABSOLUTE THAT CAN BE MEASURED: IT DEPENDS ON THE CONTEXT A MATERIAL IS APPLIED IN, AND THE LIFE CYCLE OF THE OBJECT. SHARED GUIDELINES HELP TO SYSTEMATICALLY CLASSIFY AND COMPARE DIFFERENT OPTIONS.

REFERENCE

• Beatrice Lerma, Claudia diGiorgi & Cristina Allione (2013) Design & Materials: Sensory perception sustainability project: p. 103: https://bit.ly/3BHM9nZ

SEE ALSO: Here's an adaptation used for a material archive: https://samplemanagementtool.org/#/about

SEE ALSO: BBB

EST. TIME:

DEFINE YOUR ECO-COMPATIBILITY PRINCIPLES

WHY

If a product is to be truly eco-compatible during its life cycle it must minimise, if not eliminate, resource consumption (energy and materials) and emissions (air, water, and solid waste). Lerma, diGiorgi & Allione developed a multi-criteria interpretation system top help designers interpret the environmental performance of design materials in a context-aware way.

OUTPUT

Shared definitions that work as a yardstick to help you assess when you can make certain claims about a material (e.g. say it is biodegradable).

TASKS

1. Research & define

Research these terms and define them in 1 or 2 sentences. Try to come to an agreement with your peers on what definition you agree on, so you have a yardstick to assess when these terms apply to a particular material.

2. Suggest ways to research the parameters

Describe methods to look into each of these for a given material or feedstock.

Low environmental impact in use:

- Eco-efficiency (relates to embodied energy & emissions)
- Short distribution chain (relates to sourcing of feedstock)
- Non-toxicity (relates to toxicity of material when in use)
- Renewable resources (relates to time required for resource to replenish itself, e.g. regrow in nature)

Extension of the useful life of materials:

- Durability (is the lifespan of material in proportion to lifetime of use of the product it is used for?)
- Recyclability (homogeneity of material, and quality of recycled output)
- Biodegradability (time and conditions required)

Ethical production:

- Is the feedstock or semi-finished product or ingredient manufactured in a responsible way?

NEXT

Select and - if necessary - simplify some of the parameters to use them as guidelines in your projects.

CROSS-DISCIPLINARY READING

VVV

Wikimedia, Tobi Kellner 2012.

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: BBB

EST. TIME:

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 under stand 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.

BIOREMEDIATION

VVV

BBBB

SEE ALSO: BBB

EST. TIME:

BIOREMEDIATION

INGREDIENTS
VV

TOOLS
VV

TASKS

Scouring
- Fill a large pot with warm water
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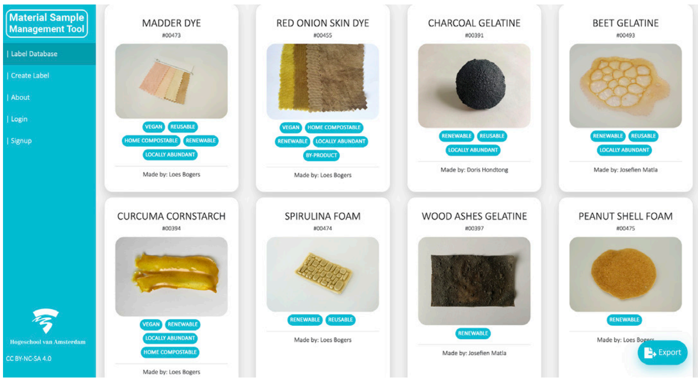
- Ad

REFERENCE
- sdsf

INSTALL A SAMPLE MANAGEMENT TOOL

VVV



WHEN YOU WANT TO MAINTAIN A MATERIAL ARCHIVE FOR LONGER, IT CAN HELP TO INVEST ENERGY IN SETTING UP SAMPLE MANAGEMENT

SEE ALSO: BBB

EST. TIME:

INSTALL A SAMPLE MANAGEMENT TOOL

WHY
The Sample Management Tool is a label generator and database to support creative communities in documenting and sharing material experiments. It was designed around the idea of collaboratively building an archive of alternative design materials with an emphasis on materials that are easily renewable, reusable, (home) compostable within 90 days, locally abundant and make use of local waste streams.

WHEN
After you have done some experimenting and want to commit to material experimentation for a bit longer. Is designed for use in university and art school courses to help teachers and students showcase material experiments in shared studios, to learn from and get inspiration.

TASKS

- Contact your systems administrator (or find one)
- Ask them if they are able to install the software below on your server
- Decide who you want to make admins
- Update the logo to your organisation’s logo
- Add users and explore together how the tool works
- Negotiate things that are unclear or unusful to you
- Read the about page for more info: https://samplemanagementtool.org/#/about
- Start archiving your material samples!

REFERENCE
- sotware
- Example of tool in use: https://samplemanagementtool.org

This tool was developed based on the OS Material Archive, a project developed at Textile Lab Amsterdam by Cecilia Raspanti: https://tcbl.eu/project/os-material-archive