Biomaterials toolkit

A toolkit for critical creative research on new material futures and collaboratively exploring material craftmanship

Side A accompanying booklet (8 sections, 2 rows)

|  |  |
| --- | --- |
| Header:  Name toolkit  Logo HvA  Logo Waag | Body: [max 50 words explaining how the toolkit helps users and in what it supports users]  www. samplemanagementtool.org  Funded by NWO/ Comenius fellowship |
| Header: Select and execute) | [Image]   * Front of the card and back of the card   [text]  Introduction   * The short description allows you to quickly assess whether the activity or method on the cards suits your needs.   Category   * Depending on what learners already know and depending on what topic you want to center your activities, the toolkit is divided in four categories. Cards can be about materials science, bio fabrication, diy-microbiology, or critical making.   Estimated Duration   * This is an estimate of how long it will take to execute   the activity.  Foundational vs Deepdive   * Foundational cards contain key activities and methods for learning, understanding, and critically engage with biomaterials. Deep Dive cards build on knowledge of the foundational cards and dive a bit deeper into the subject mentioned on the card.   Recommendations   * Depending on what learners already know and depending on what topic you want to center activities, the toolkit is divided in four categories. Cards can be about materials science, bio fabrication, diy-microbiology, or critical making.   Tasks   * The steps that need to be taken in order to execute the activity |
| Header:  Critical creative research on new material futures | Body [max 50 words: frame in what kind of situations this toolkit can support people, e.g. the design method kit supports a design process, what does this toolkit support?] Understanding biomaterials, fostering critical creative research, *what is the scope of this toolkit?*   * ...short detailed task-based descriptions help learners quickly undersantd the premises of DIY material fabrication. This makes [name toolkit] perfect for schools, institutions, etc, ?? To dive further into new materials and build new eco-systems to ??. Use [name toolkit] in combination with the materials archive [link] to collaboratively build an open-source archive.” |
| Header title:  Materials (Science + Experience) | body:  [±40words explanation about materials science + experience] |
| Header title:DIY Microbiology | body:  [±40words explanation about DIY microbiology and lab protocols] |
| Header title:  Critical Making | body:  [±40words explanation about critical making] |
| Header title:  Biofabrication | body:  [ ±40words explanation about biofabrication] |

Side B accompanying booklet

|  |  |
| --- | --- |
| Title | 3-5 woorden |
| Subtitle | Max 10 woorden |
| Short description | Max 30 woorden |
| tasks | Max 10 woorden per bullet (bold) Max 20 woorden uitleg (light) |
| recommendations | Max 10 woorden per item |
| Ideas for image |  |

DIY Microbiology (and lab protocols)

Introduction:

* Microbes/fungis/yeasts and other organisms (yeast vs fermentation?)
* (safety) levels of clean and dirty (read Butler’s Dirt)
* Lab protocols
* Kitchen Lab (filmpje/rondleiding)

Deep dive:

* Morphology of tools
* DIY biofilms
* DIY myco

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| --- | --- |
| title | Microbes, fungi, yeast and other organisms |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| --- | --- |
| title | (Safety) levels of clean and dirty |
| Short description | To make sure that microbiology experiments stay safe and that the work environment is healthy, by familiarizing yourself with biosafety levels. |
| tasks | Find out what biosafety level is allowed for your lab and/or experiments. Depending on where in the world you live, regulations can differ wildly regarding DNA, bacteria, or fungi.  Discussion prompt 1: Read the biosafety levels manuals and discuss the importance of biosafety levels.  Make a list of bacteria and fungi and find out together under which safety level each strain is classified and why. (*or we provide a list with some names*)  Discussion prompt 2: why is working in the lab with a grey Oyster strain different from growing grey oysters out in your garden and different from eating grey oyster?  Change the example of Grey Oyster to a strain or subject that applies to your lab.  Sources: Biosafety Levels Manuals; Good Microbiological Laboratory Practice (GMLP) |
| Recommendations | Recommendations: Consult your local biolab veiligheidsexpert when starting a biolab. |
| Ideas for image | Logo BSL1 |

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| --- | --- |
| title | Set up a basic biolab |
| Short description | Microbiology requires a designated space to work safely. Set up a basic biolab to prevent contamination and health hazards. |
| Tasks | Find suppliers of lab materials (e.g. Eurofysica)  Learn aseptic technique and Good Microbiological Laboratory Practice (GMLP)  (nog niet af) |
| Recommendations |  |
| Ideas for image |  |

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| --- | --- |
| title | Levels of clean and dirty |
| Short description | ‘Dirt is matter out of place’ -Mary Douglas (1966:44). |
| Tasks | Reappropriating waste materials for bioremediation asks us to reconsider our own and others’ ideas about dirt and cleanliness, and about waste and newness.  Collaboratively discuss and untangle what kind of ideas, beliefs, and value systems are in place regarding the materials you (want to) work with.  With your group, work out strategies to incorporate these beliefs and values in a positive way.  Sources: Mary Douglas, Purity and Danger, 1966 |
| Recommendations | The idea of ‘waste’ is not tied to the functionality or materiality of an object. Regarding the social, cultural, political, and economic dynamics allows for a more holistic perspective on waste, bioremediation, and sustainability. |
| Ideas for image | Melissa’s grey oyster on cigarette bud |

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| title | Lab protocol |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next | Source: where did we base our lab protocol on Good Microbiological Laboratory Practice (GMLP) |
| Ideas for image | Lab coat and bunsen burner |

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| --- | --- |
| title | Morphology of tools |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| title | DIY Biofilms |
| Short description | Biofilms are ? layers formed by microorganisms. They can help with water purification or nutrient cycling but can also be grown into a material that can be considered vegan leather. |
| tasks | **Choose a well-documented bacteria or yeast**  -Kombucha or kaasschimmels (of een aparte kaart over kombucha?) |
| when/why/note/output/next |  |
| Ideas for image | Tiago’s experiments or scoby |

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| --- | --- |
| title | DIY Applied mycology |
| Short description | 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. |
| tasks | **Set up a basic biolab (refer to card)**  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)** |
| \*ingredients  \*tools \*reference \*see also | **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)  **References**   * Peter McCoy (2016) *Radical Mycology* * Freshcap Mushrooms Blog and video channel <https://learn.freshcap.com/growing/> and <https://www.youtube.com/c/freshcapmushrooms>   **See also**  Mycelium-hemp composite |
| Ideas for image | Mycelium\_agar.JPG |

Biofabrication

Introduction:

* Glossary “bio-everything”
* Glossary Fabrication vs manufacturing vs production
* Morphology/functions of ingredients in biofabrication
* 24 basis recepten
* @HOME Materials kitchen

Deep dive:

* Be a 3Dprinter/ print paste
* DIY mallen maken
* Mono-material connections
* “Semi” fabrication (zelf kijken naar manieren van verwerking, dus manieren om vouwen/persen/rollen etc na de bootsen)

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| --- | --- |
| title | Glossary “bio-everything” (waarschijnlijk wel meer kaarten) |
| Short description | [±30 words, may be extended with an example]  Wij cureren± 30 woorden, opdracht is om voor alle woorden definities te zoeken om samen tot een glossary te komen  Biodesign  Bioart  Biology  Biofabrication  Biodegredable  Biorenewable  Biocompostable  Biomimicry  Biobased  Biomass  Biosynthesis  Bioremediation  Biohacking  Bioethics  Biotechnology  Bionics  Biomechanics  Biodesctructible |
| tasks |  |
| Recommendations |  |
| Ideas for image |  |

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| --- | --- |
| title | @HOME Materials kitchen |
| Short description | 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. |
| tasks | Give a small video tour in your kitchen: show us how you have converted your kitchen into a Biomaterials-fabrication site.   * Shopping & collecting list week 1 minor: * Silicone baking mat (heatproof) * Precision scale 0.01 g (e.g. bol.com for 5e) * Old pot you can dedicate to non-food experiments * Kitchen scale * Strainer * Glycerine, 1L (e.g. drogisterij.net) * Denatured alcohol 96%, 1L (e.g. drogisterij.net) * Gelatine powder (not sheets, look at online shops) * Agar agar powder * Sodium carbonate or cleaning soda (NL: kristalsoda) (supermarket) * White vinegar (supermarket) * Hand soap and dishwashing soap * Cutting mat (hobby stores) * Scalpel/hobby knife (hobby stores) * Clamps or clips to hang things * Ruler (min 30 mm) * Roll of painting tape * Roll of strong tape e.g. duct tape * Scissors and if possible: small scissors for precision work * Felt 1mm: 20 cm x 180 cm https://www.meervilt.nl/winkel/vilt/1-mm-wolvilt/ * Paper and card board (e.g. paper waste) * Textile swatches 20x30 cm minimum (e.g. cotton, denim, can be cut-up old clothing/sheet/towel) * Loose leaf green tea * Rubber bands (supermarket) * Cane sugar * Whole cloves (NL: hele kruidnagels) * Corn starch * Coconut oil OR vaseline OR purol * Fresh Kombucha Scoby (ekoplaza or https://yayakombucha.com/products/organic-kombucha-starter) > keep in the fridge until use * Acrylyc sheet PMMA 3 or 4 mm, minimum 50cm x 100cm e.g. https://kunststofplatenshop.nl/ * Roll of white paper (light gray/beige fine too), or a sheet of min 45 cm wide and 100cm long * Glass jars several sizes (e.g bean jar 250ml, big mayonaise jar 500ml, big yoghurt jar 1000ml) * Wide glass jar or plastic container (min 15 cm diameter or width) * Handful of old rusty metal scraps |
| recommendations | Collect old pans, pots and utensils for bioplastics and natural dye. Do not use them for cooking and store them separately. |
| Ideas for image | Collected Kitchen materials |

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| title | Fabrication vs manufacturing vs production |
| Short description | Fabrication, manufacturing and production are terms that are often used as though they are synonyms. Although the processes show similarities, there are some differences to keep in mind.  Source: <https://www.pacific-research.com/manufacturing-vs-fabrication-what-is-the-difference-prl/#:~:text=Fabrication%20is%20about%20the%20creation,process%20of%20assembling%20those%20parts>. |
| “Tasks" | Fabrication is about processing raw materials and making parts from these raw materials that are suitable for assembly. Common fabrication methods are welding, cutting, folding, machining, and extruding.  Manufacturing is when those parts are assembled into products intented for consumers. Semi-manufacturing is the making of components for products (think of companies specialised in making pcb’s for computers). A typical manufacturing process uses machines, assembly lines and skilled labor to assemble products.  Production is a term that simply denotes utility. As such, it can cover both fabrication and manufacturing and it is also applicable to the creation of intangible goods. |
| When/why/note/  output/  next | When making biomaterials, we talk about biofabrication. We fabricate materials that can be made into parts, or we directly make parts by casting biomaterials into molds.  Working with biomaterials may ask for |
| Ideas for image |  |

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| --- | --- |
| title | Morphology/functions of ingredients in biofabrication |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| --- | --- |
| title | Be a 3D printer/ print paste |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| --- | --- |
| title | DIY Mallen maken |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| title | Mono-material connections |
| Short description | [±30 words, may be extended with an example]  Opdracht van de minor: maak uit je biomateriaal een monoverbinding zonder gebruik te maken van extra verbindingsmaterialen |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| title | “Semi” fabrication (zelf kijken naar manieren van verwerking, dus manieren om vouwen/persen/rollen etc na de bootsen) |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

Materials science and experience

Introduction:

* What is a raw material? (Shit/Dust/Poo articles, materials and resources, waste streams)
* What is a material property? (develop a shared vocabulary)
* What is a material experience> (MDD)
* How do you test a material property? (DIY protocol material testing)

Deep dive:

* Material Objects (Zoe Laughkin)
* Better Together (combining polymers)

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| when/why/note/output/next | Max 10 woorden per item |
| Ideas for image |  |

**RECEPTKAARTEN**

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| --- | --- |
| Title | **Agar bioplastic** |
| Subtitle | Agar is a gum polysaccharide found in red algae |
| Short description | 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. |
| 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 |
| \*ingredients  \*tools \*reference \*see also | **Ingredients**  5 g Agar, 15 g Glycerine, 250 g Water  **Tools**  Scale, pot, stove, spoon, wide mold or casting surface  **Reference**  Biofabricating Materials lecture notes, by Cecilia Raspanti, Fabricademy 2019: https://class.textile-academy.org/classes/2019-20/week05A/  **See also**  Alginate bioplastic  Carrageenan bioplastic |
| Ideas for image | Agar.jpg |

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| Title | **Alginate bioplastic** |
| Subtitle | Alginate is a gum polysaccharide found in brown algae. |
| Short description | 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. |
| 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 |
| \*ingredients  \*tools \*reference \*see also | **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  **Reference**  Biofabricating Materials lecture notes, by Cecilia Raspanti, Fabricademy 2019: https://class.textile-academy.org/classes/2019-20/week05A/  **See also**  Agar bioplastic  Carrageenan bioplastic |
| Ideas for image | Alginate\_film.jpg |

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| Title | **Carrageenan bioplastic** |
| Subtitle | Carrageenan is a gum polysaccharide found in red seaweed. |
| Short description | 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. |
| 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 |
| \*ingredients  \*tools \*reference \*see also | **Ingredients**  16 g carrageenan kappa, 3 g glycerine, 350 g water  **Tools**  Scale, pot, cooker, spoon, casting surface  **Reference**  Lugae Valenti, Making Carrageenan 2021: https://vimeo.com/386012184  **See also**  Agar bioplastic  Carrageenan bioplastic |
| Ideas for image | Not yet |

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| Title | **Gelatin bioplastic** |
| Subtitle | Gelatin is hydrolized collagen: a polymer found in cartilage, bone and skin of animals. |
| Short description | 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. |
| 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 |
| \*ingredients  \*tools \*reference \*see also | **Ingredients**  50 g gelatine, 15 g glycerine, 250 g water  **Tools**  Scale, pot, cooker, spoon, casting surface  **Reference**  Biofabricating Materials lecture notes, by Cecilia Raspanti, Fabricademy 2019: https://class.textile-academy.org/classes/2019-20/week05A/  **See also**  Agar bioplastic  Carrageenan bioplastic |
| Ideas for image | Gelatine.jpg |

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| Title | **Mycelium-hemp composite** |
| Subtitle | Fungal composite of chitin and hemp fibres |
| Short description | Mycelium is the vegetative part of the mushroom, and consists of several biopolymers such as chitin, cellulose and proteins. |
| 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 |
| \*ingredients  \*tools \*reference \*see also | **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  **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 |
| Ideas for image | Mycelium\_composite.jpg |

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| Title | **Onion skin dye** |
| Subtitle | Plant-based pigment extracted from onion skins |
| Short description | The outer skins of onions contain a pigment called pelargonidin that can be used to create a medium light fast textile dye. |
| tasks |  |
| \*ingredients  \*tools \*reference \*see also | **Ingredients**  **Tools**  **Reference**  ​  **See also** |
| Ideas for image |  |

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| --- | --- |
| title | What is a raw material? |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| --- | --- |
| title | What is a material property? |
| Short description | [±30 words, may be extended with an example]  Develop a shared vocabulary (wij cureren woorden, opdracht is om hier voorbeelden bij te noemen zoeken, (noem een minimale en maximale > kijk in database die bij eindrapport minor staat) |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| --- | --- |
| title | What is a material experience? |
| Short description | [±30 words, may be extended with an example]  Source: material driven design method |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| title | Material Objects |
| Short description |  |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| --- | --- |
| title | Mono-material connections |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

|  |  |
| --- | --- |
| title | Mono-material connections |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

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| --- | --- |
| title | Mono-material connections |
| Short description | [±30 words, may be extended with an example] |
| tasks |  |
| when/why/note/output/next |  |
| Ideas for image |  |

Critical Making

Introduction:

* Reframing perfect/imperfection > (kintsugi etc)
* Reframijng expectations > good enough/good for whom/good for what
* Waste walk
* More than human collaboration

Deep dive:

* Define your eco-competitive principles
* Simultaan readings: 1 topic, 2-4 papers, 2-4 disciplines
* Bioremediation
* Open source – collaborative archiving