

Designing with (bio)materials



A collection of approximately 15 petri dishes arranged on a white surface. Each dish contains a different colored agar medium, ranging from bright yellow and orange to various shades of blue, purple, and pink. Some dishes show distinct bacterial growth patterns, such as colonies or streaks, while others appear mostly clear or have subtle textures. The dishes are overlapping and scattered across the frame.

BIO-TERMINOLOGY

(BIO)DESIGN IN CIRCULAR ECONOMY

TIPS: HOW TO FOLLOW (BIO)MATERIAL DEVELOPMENT



BIO...?



- **BIOMATERIALS** *BIOMATERIAALIT*
- **BIO-BASED MATERIALS** *BIOPOHJAISET MATERIAALIT*
- **RENEWABLE MATERIAL SOURCE** *UUSIUTUVA RAAKA-AINE*
- **BIODEGRADABLE MATERIAL** *BIOHAJOAVA MATERIAALI*
- **COMPOSTABLE MATERIAL** *KOMPOSTOITUVA MATERIAALI*
- **RECYCLABLE MATERIAL** *KIERRÄTETTÄVÄ MATERIAALI*
- **BIOLOGICALLY PRODUCED** *TUOTETTU BIOLOGISESTI*
Biology/synthetic biology *biologia/synteettinen biologia*

BIOMATERIALS *BIOMATERIAALIT*: MEANING DEPENDS ON THE CONTEXT

IN MEDICINE: Biomaterials are synthetic or natural origin materials that are used in repairs, regeneration and replacement of tissues.

Source: <https://www.utu.fi/en/>



LÄÄKETIETEESSÄ: Biomateriaaliksi voidaan kutsua mitä tahansa vierasta, synteettistä tai luonnollista, materiaalia jota käytetään biolääketieteessä elävän kudoksen hoitoon tai korjaamiseen. Biomateriaalit voivat olla lasia, teflonia, titaania, erilaisia biopolymeerejä ja geelejä tai jauheita.

Lähde: <https://tieteentermipankki.fi/>

BIO-BASED MATERIALS are produced for example of ligno-cellulosic raw materials

Cellulose is the most abundant organic polymer in the earth
- it is in wood, plants, algae.

Cellulose can have very different formats.

Renewable
Recyclable
Functional



Photos: Eeva Suorilampi

Trees and plants contain also lignin, hemicellulose, bark, long bast fibres, extractives for colours and natural 'chemicals'...

BIO-BASED MATERIALS FROM RENEWABLE MATERIAL SOURCES

- but how wisely are we using our precious renewable raw materials today?



Example of RENEWABLE MATERIAL SOURCE: algae



Photo Esa Kapila

*Experimental materials from polluting algae
(Cladophora glomerata), Laura Rusanen 2020, ChemArts*



Harnessing the power of the ocean to create materials.

Example: RENEWABLE MATERIAL SOURCES for textiles: flax (linen), nettle/ramie, hemp...



Ecologically Efficient Agri-Food Systems for Development of Advanced Textiles Supply Chain - Production of nettle (*Urtica dioica*) for regenerative fashion

By doctoral researcher Samica Sadik

Photo Anne Kinnunen



FF FIBRE@FASHION

Business Market Intelligence News Services - More -

Hemp fibre for high quality textile

Hemp fabric is a sustainable textile made of fibres of a very high-yielding crop in the cannabis sativa plant family. Historically used for industrial purposes, like rope and sails, hemp is known as one of the most versatile and durable natural fibres. Growing and processing of hemp fibre does not involve use of pesticides and other chemicals.



Hemp fabric is a sustainable textile made of fibres of a very high-yielding crop in the cannabis sativa plant family. Historically used for industrial purposes, like rope and sails, hemp is known as one of the most versatile and durable natural fibres.

Growing and processing of hemp fibre does not involve use of pesticides and other chemicals. This makes hemp fibre a natural and environmentally friendly product. Its main properties are:

BIODEGRADABLE MATERIAL / BIOHAJOAVA MATERIAALI OR COMPOSTABLE MATERIAL / KOMPOSTOITUVA MATERIAALI



Wood pulp



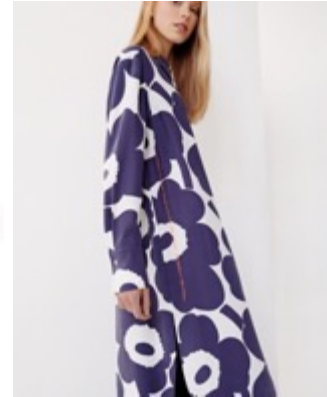
Thermoformable packaging material
by Huhtamäki



Sulapac packaging material



Timberfill
3D printing filament



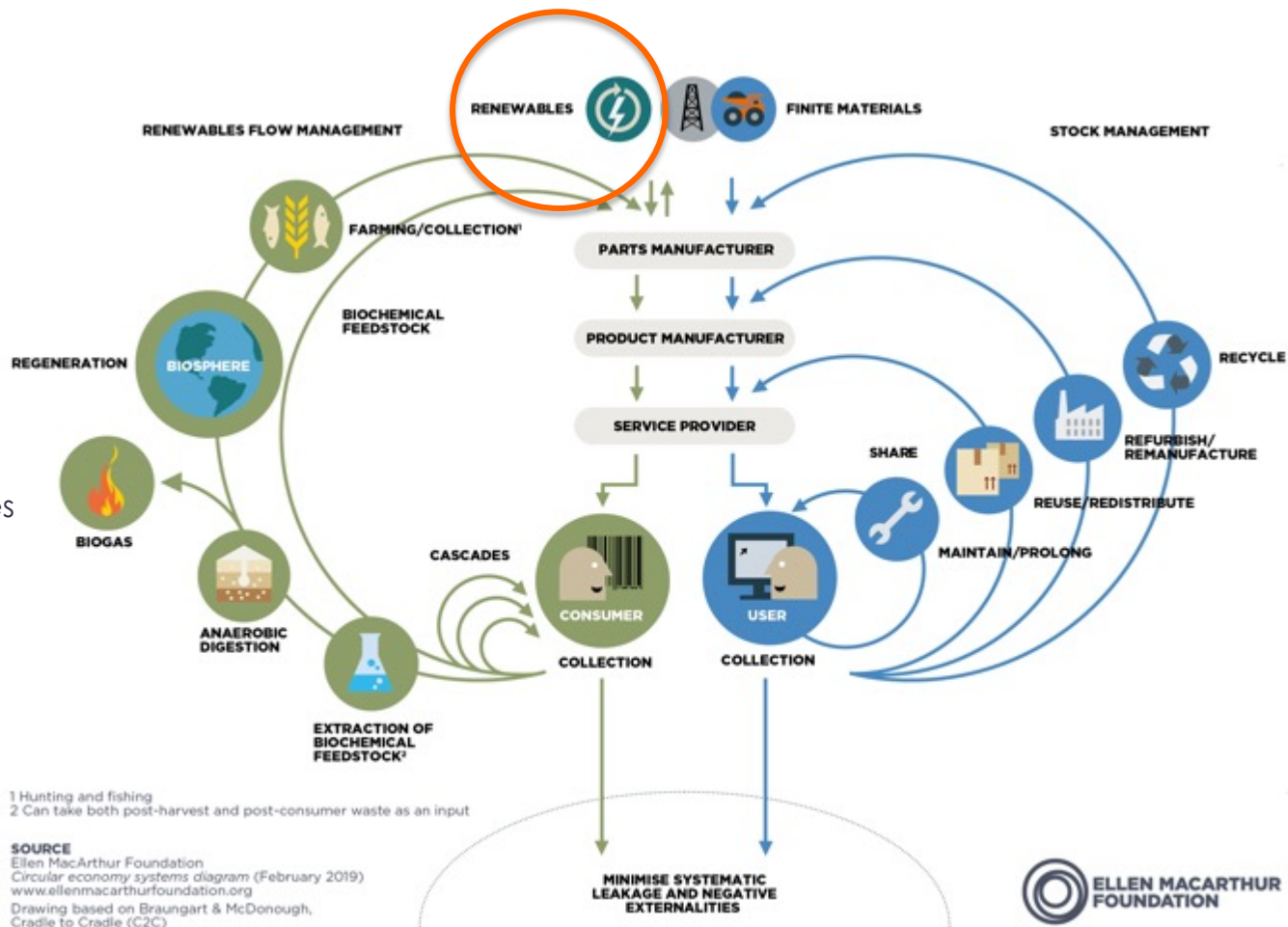
loncell textile fibres
@Marimekko

Examples: Biodegradable, bio-based materials made of cellulose
(and some other ingredients)

RECYCLABLE MATERIALS KIERRÄTETTÄVÄT MATERIAALIT

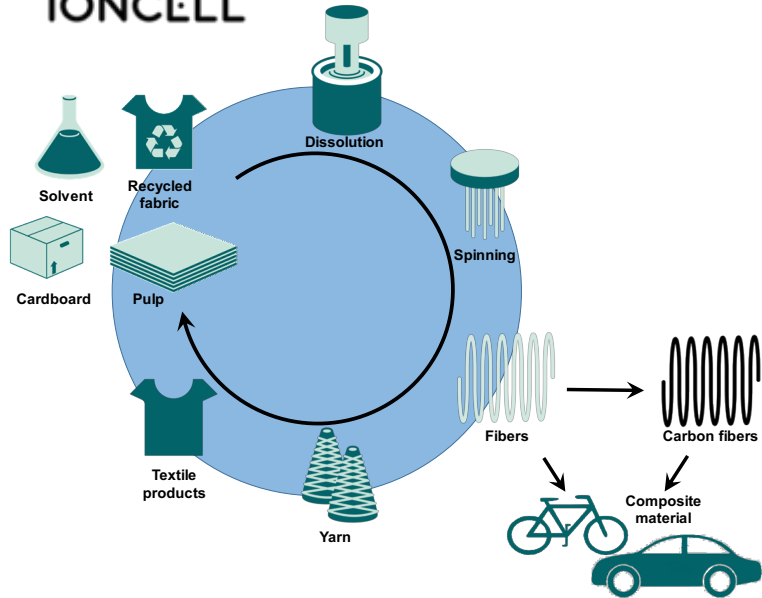
FOR CIRCULAR ECONOMY

The circular economy is a systems solution framework that tackles global challenges like climate change, biodiversity loss, waste, and pollution.



Example of RECYCLABLE MATERIALS: Recycling textiles mechanically, chemically or with enzymes

IONCELL



Mechanically recycled textiles
Khanittha Nuattaranee 2022
Photo Rainer Paananen

Example of RECYCLABLE MATERIALS: From flower waste to materials



irenepurasachit.com

BIOLOGICALLY PRODUCED *TUOTETTU BIOLOGISESTI*

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zenaholloway.com



dianascherer.nl



biofabricate.co

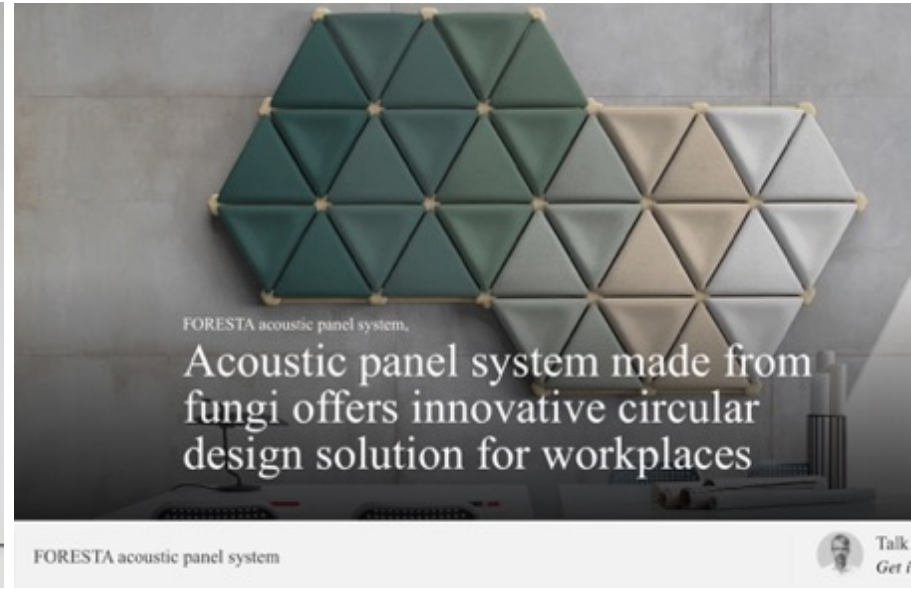
Example of BIOLOGICALLY PRODUCED MATERIALS: Fungi (mycelium)



thegrowingpavilion.com



caracaracollective.com



arup.com

HOW?

**How to be a designer in the world of new materials:
Design for Circularity**



The circular economy is based on main three principles, driven by design

- Eliminate waste and pollution
- Circulate products and materials (at their highest values)
- Regenerate nature

'In circular economy materials are not only reused or recycled; they are merely stored in products, and used again and again'

Prof. Mark Hughes Aalto CHEM

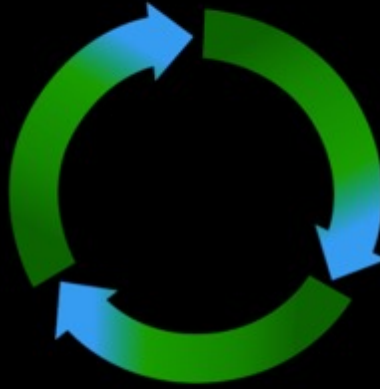


Adidas Futurecraft shoes made of monomaterial to enable recycling

Sustainability

Circularity

Regeneration



Do
less harm

Design
out waste

Replenish
and restore



Do less harm

Example: Replacing fossile-based raw materials with renewable ones



*Bubbles with benefits
Material experiments by Satu Paavonsalo & Valentin Schwarz 2022, photo Esa Kapila*



Foamed pulp, photo Eeva Suorlahti

Cellulose-based materials can be soft, hard, transparent...
In most cases these materials react with moisture - and biodegrade.



*By Pia Johansson in collaboration
with Biocolour research project
2021-22*



*Dyeing with coffee waste
Natural Indigo Finland + Paulig 2023*



*Natural Indigo Finland & Marimekko 2021
Photo Mikko Raskinen.*

Do less harm Example: Alternative materials for art practices



*Greta Salonen 2024
Photo Esa Kapila*



*Spruce cone panels by lines Jakovlev 2023
Photo Anne Kinnunen*

Design out of Waste

Example: Upcycling plastic waste



Business Insider
14 Companies Using Recycled ...



Trend Hunter
Natural Recycled Plastic Products ...



Plastic Collective
Reusing and Recycling - Plastic Colle...



Passions Of Paradise
Recycled Plastic: Coming to a Shop N...



EuroPlas
from recycled plastic bottles ...

Halla Hallan pirteät bikinit ja uikkarit ovat olleet pinnalla jo muutaman vuoden ajan. Perustajat Salla Valkonen ja Hanna Chalvet saivat idean uikkarimerkkiin huomatessaan matkoillaan, miten paljon meressä kelluu muovijätettä. Halla Hallan uima-asut tehdäänkin merten jätteistä valmistetusta Econyl-kankaasta, ja myös nämä uikkarit ommellaan Balilla.



Dinamica
Recycled Plastics ...



Precious Plastic Melbourne
Recycled Products - Preci...



RecycleNation
Recycled Plastic ...



Spruce Refillable Cleaning P...
4 Upcycled Plastic Product...



Maine gov
What Your Recyclables Become



Science Learning H...
Plastics and recycl...



Plastic Waste into Inspiring Products



Wikifab



Recycle Coach



Alamy



Martin's Plastics

...but how to solve the original problem?

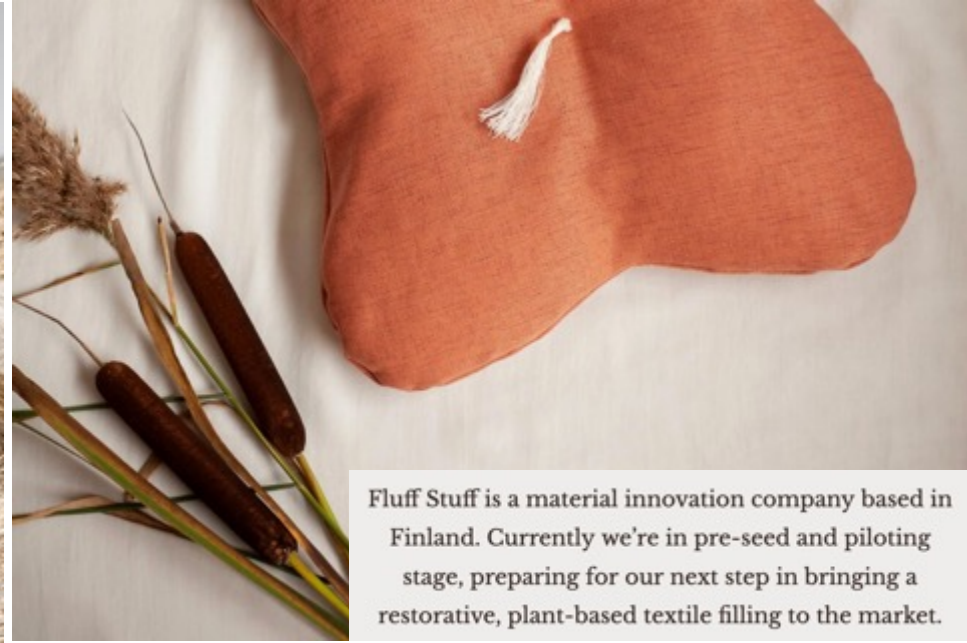
Replenish and restore

Example: fibers from lupine, filling from cattails.



*Textiles from invasive species: Lupine
Maija Vaara and Mithila Mohan, 2023*

Photo Anne Kinnunen



Fluff Stuff is a material innovation company based in Finland. Currently we're in pre-seed and piloting stage, preparing for our next step in bringing a restorative, plant-based textile filling to the market.

fluffstuff.fi

TIPS: How to follow material development?

Curiosity

Creativity

Collaboration

Communication

Critical thinking

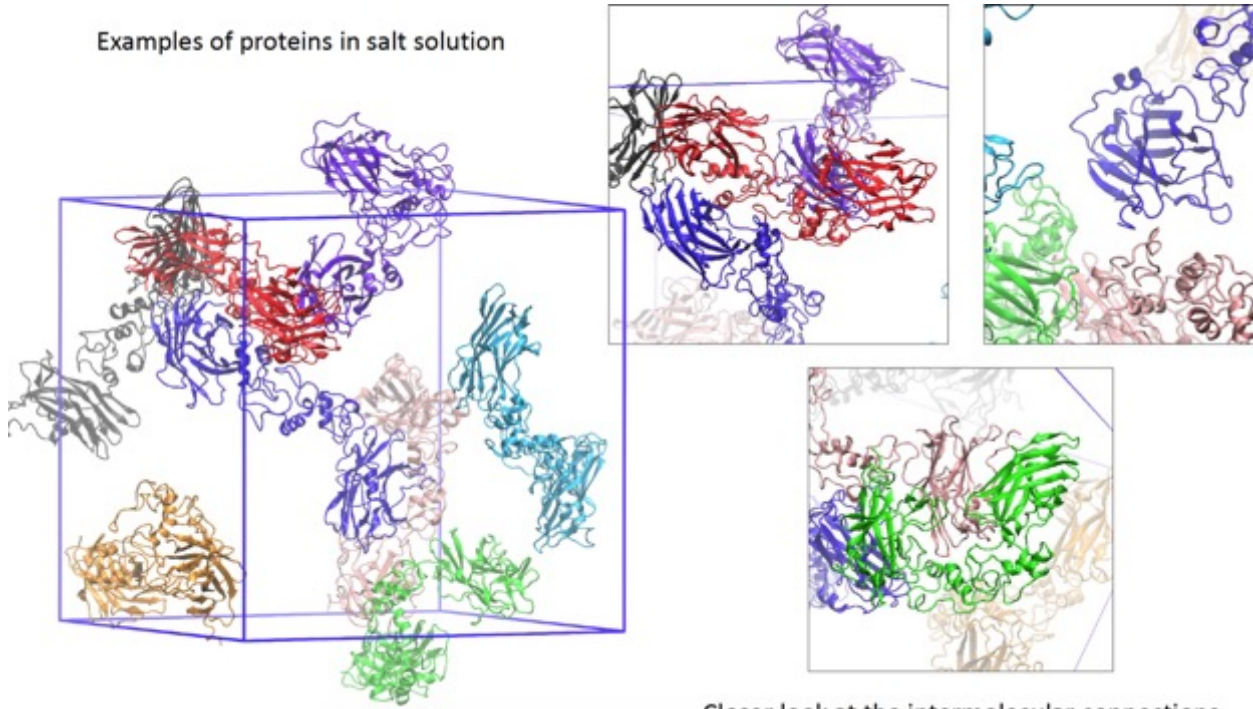
Complexity > Persistence



CURIOSITY

Follow material development
and new technologies from
various sources

Examples of proteins in salt solution



Closer look at the intermolecular connections



WHEAT STRAW

WHEAT STRAW

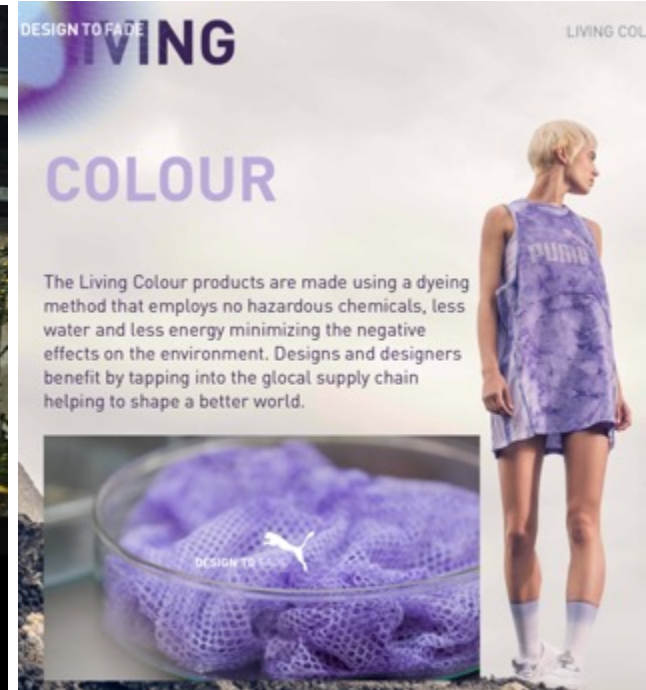
SPRUCE CONES

LUPINE

WOOD



Design to Fade - PUMA x Streamateria biodesign project explores sustainable ways of producing and dyeing textiles



Source: streamateria.com

CREATIVITY

Change perspective: problems might be possibilities

A!

Aalto University

COLLABORATION

'The challenges to our planet are so complex that they cannot be solved by one discipline. Design is a bridge. It translates scientific ideas and discoveries into real-world applications.'

*- Matilda McQuaid, Curator at Cooper-Hewitt Smithsonian Design Museum, NYC
in the exhibition catalogue: 'Nature: Collaborations in Design', 2019*

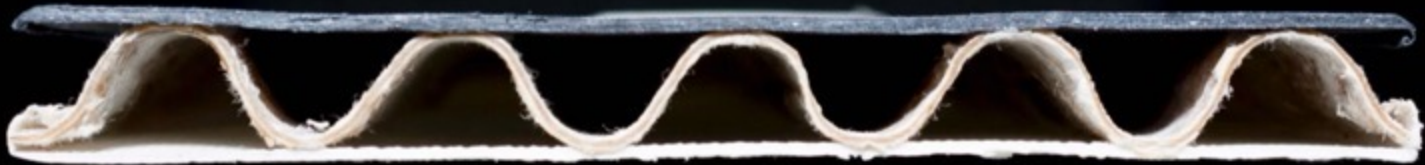




Photo: Esa Kapila

Dress by Anna Semi 2023. Structural colour by Noora Yau & Konrad Klockars, structuralcolourstudio.com

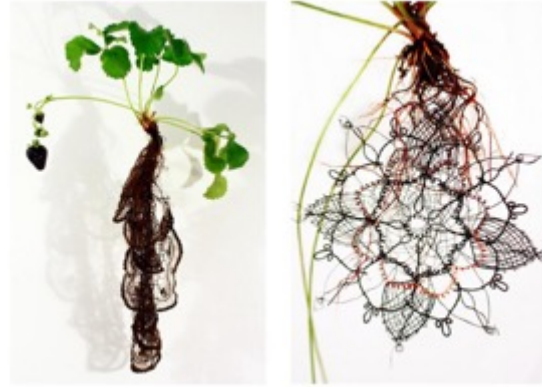
COMMUNICATION



Biocouture jackets made of cellulose material

Suzanne Lee

https://www.ted.com/speakers/suzanne_lee



Biolace by Carole Collet

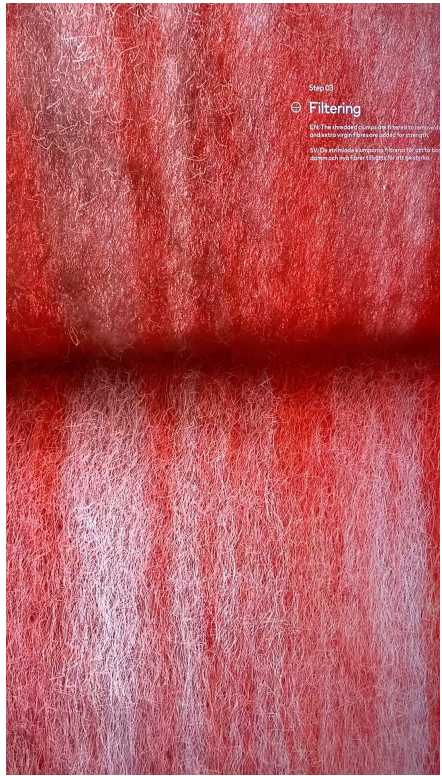


https://www2.hm.com/fi_fi/life/culture/inside-h-m/meet-the-machine-turning-old-into-new.html

A!

Aalto University

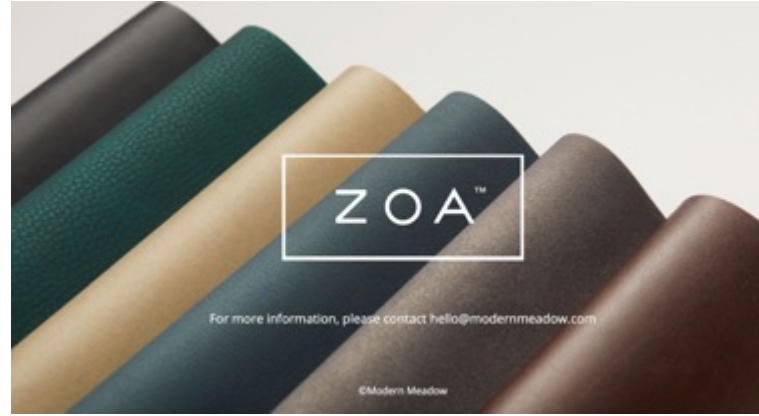
Example: H&M Communication





/ #MadeFromPiñatex

Piñatex® is a versatile natural textile, suitable for use as a leather alternative from fashion to furnishing.



Replacing leather – but what about material sustainability?

MEET MYLO™

Made from mycelium, the underground root-like system of fungi, Mylo™ is a bio-based leather alternative that is soft, supple and less harmful to the environment.

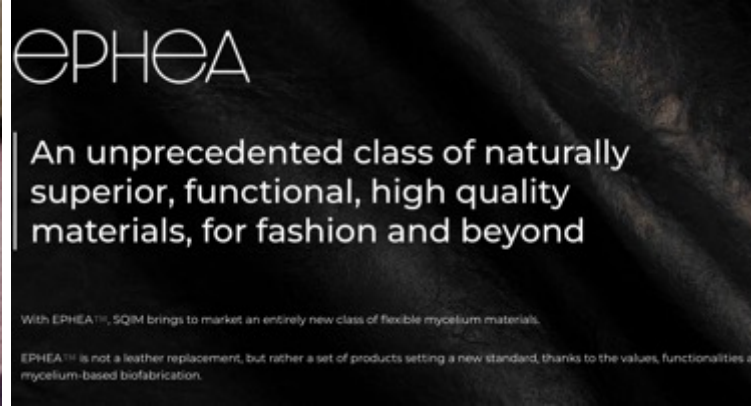
The material that sparked a "mushroom leather" movement, Mylo is made possible by the world-class scientists and engineers at Bolt Threads and is backed by pioneering brands like adidas, lululemon, Stella McCartney, and more.

VEGEA



COMPANY

Biomaterials for fashion, furniture, packaging, automotive & transportation



EPHEA

An unprecedented class of naturally superior, functional, high quality materials, for fashion and beyond

With EPHEA™, SQIM brings to market an entirely new class of flexible mycelium materials.

EPHEA™ is not a leather replacement, but rather a set of products setting a new standard, thanks to the values, functionalities and mycelium-based biofabrication.

COMPLEXITY > PERSISTENCE

Long journey
from idea to innovation
and products:
material development
takes 5-15 years



TRL - Technology Readiness Levels



Methods mapped against the spiral showing the seven stages of innovation

BIOLOGICALLY PRODUCED

Example: Designing new materials with synthetic biology and genetic engineering



<https://www.biofabricate.co/summit>

THANK YOU!
Kiitos!



Some design approaches

- Social aspects and communication to raise people's awareness of materials and their sustainable consumption habits
- Sustainable use of raw materials and natural resources and transparency of the whole production chain
- Designing for circularity: efficient product and material recycling and creating new value for waste in circular economy
- Ideas for novel, ecologically sustainable services, processes or products
 - no more green washing
 - For example for interior architecture, packaging, construction and building, textiles and fashion, edible products, cosmetics and beauty, healthcare etc.*
- Exploring bio-based options for packaging, replacing fossil-based products, functional materials with non toxic finishings etc.
- Localized production - when it makes sense
- Learning from past (in good and in bad)
- Concepts for use of biological processes and synthetic biology