CHEM-E0165

Nordic Biomaterials by CHEMARTS 6 cr

On Aalto University campus 9.8.-20.8.2021

Welcome!

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Tomato stem project by Chiao-wen Hsu & Yu Chen 2019. Photo: Eeva Suorlahti

Short presentations:

Your name, background and main interest at this course

Write your name and main interest also in a post-it note (to be attached at the board)

Photo: Eeva Suorlahti

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1st Day 9.8.2021

10 - 11 Presentations and course details - *All*

Break

11.15 - 12 CHEMARTS and material insights - *Pirjo Kääriäinen*

Lunch break

13-14 Lecture on materials - *Tapani Vuorinen*

14-14.25 Working at the laboratories - *Janika Lehtonen*

Short break

14.30-16 Guided tours at CHEM (2 groups)

Questions are welcome anytime!

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Photo: Eeva Suorlahti

Learning outcomes

After the course students

- **have familiarized with materials that are processed either chemically or mechanically from trees or other plants, such as cellulose fibres, fibrils (micro- or nano-structured), lignin, bark extractives and novel combinations of these**

- **have ability to develop innovative ideas through hands-on prototyping and experimenting with materials**

- **are aware of the main sustainability issues related to this field**

- **understand the principles of scaling the ideas towards innovations and even commercialization**

- **have an experience of an interdisciplinary working environment in practice**

Photo: Eeva Suorlahti

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Assignments and course report

In the laboratories you will be working mainly in pairs. However, you need to document your working process in a personal learning diary on daily basis. To learn of the materials, you should observe, systematically document and analyse the material behavior when experimenting and afterwards.

You can take your samples with you so consider that when working in pairs.

On the last day of the course, 20th August, you will share your most interesting experiment or a potential material concept (in pairs or alone).

The course report is due to 31st August, to be submitted through MyCourses. It should consist of documentation (text, photos), reflection and argued conclusions of your working and learning process. The length is 15-20 pages.

Photo: Eeva Suorlahti

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CHEMARTS and some material insights

9.8.2021
Pirjo Kääriäinen
pirjo.kaariainen@aalto.fi
aalto.chemarts.fi

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Carbon Capturing Images by Aman Asif &Valentina Guccini CHEMARTS 2020
Photo Esa Naukkarinen

CHEMARTS at Aalto University since 2011

CHEMARTS *is a strategic collaboration in interdisciplinary education and materials research at Aalto University between the School of Arts, Design and Architecture (ARTS) and the School of Chemical Engineering (CHEM).*

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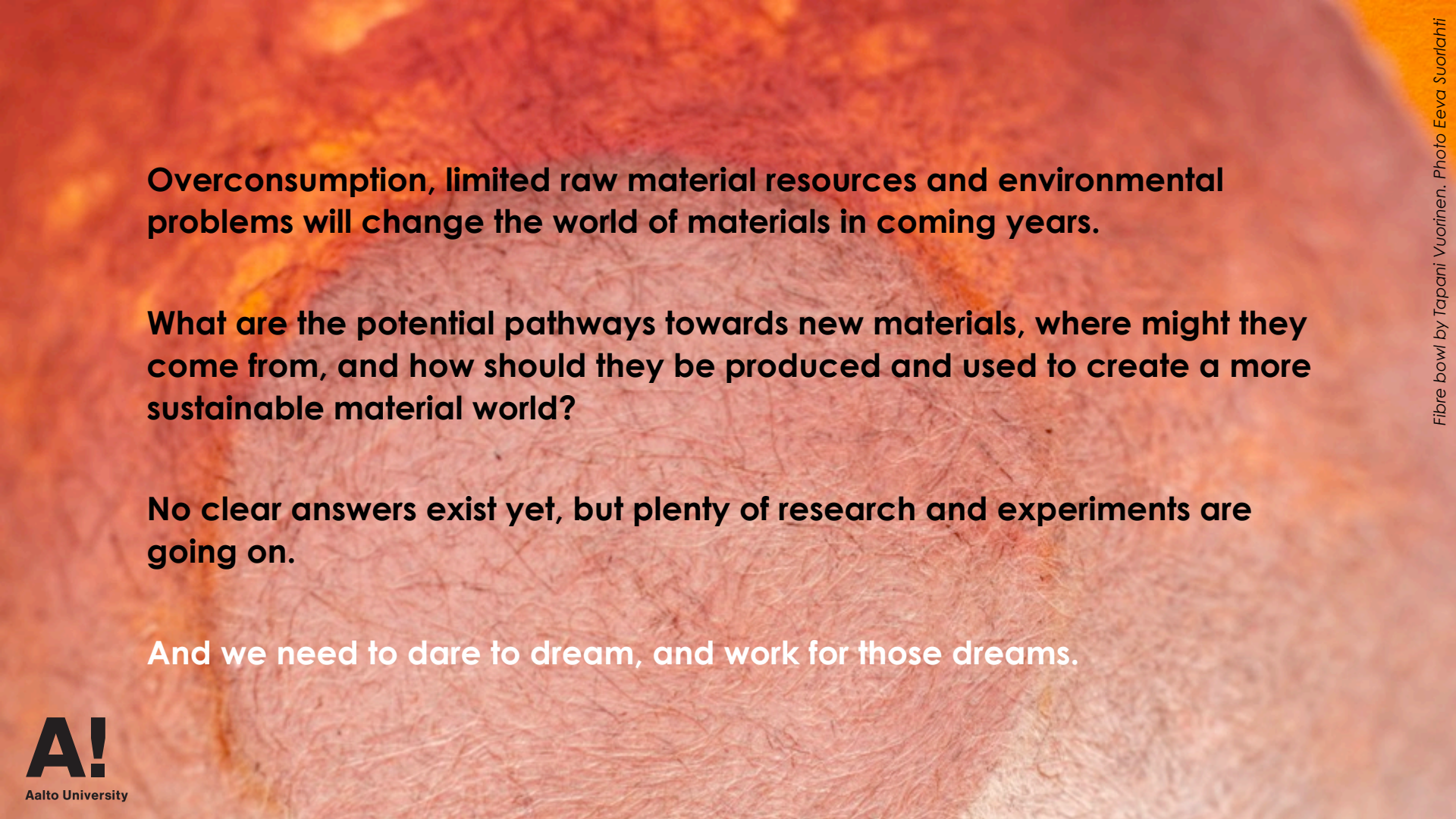

Overconsumption, limited raw material resources and environmental problems will change the world of materials in coming years.

What are the potential pathways towards new materials, where might they come from, and how should they be produced and used to create a more sustainable material world?

No clear answers exist yet, but plenty of research and experiments are going on.

And we need to dare to dream, and work for those dreams.

Fibre bowl by Tapani Vuorinen. Photo Eeva Suorlahti

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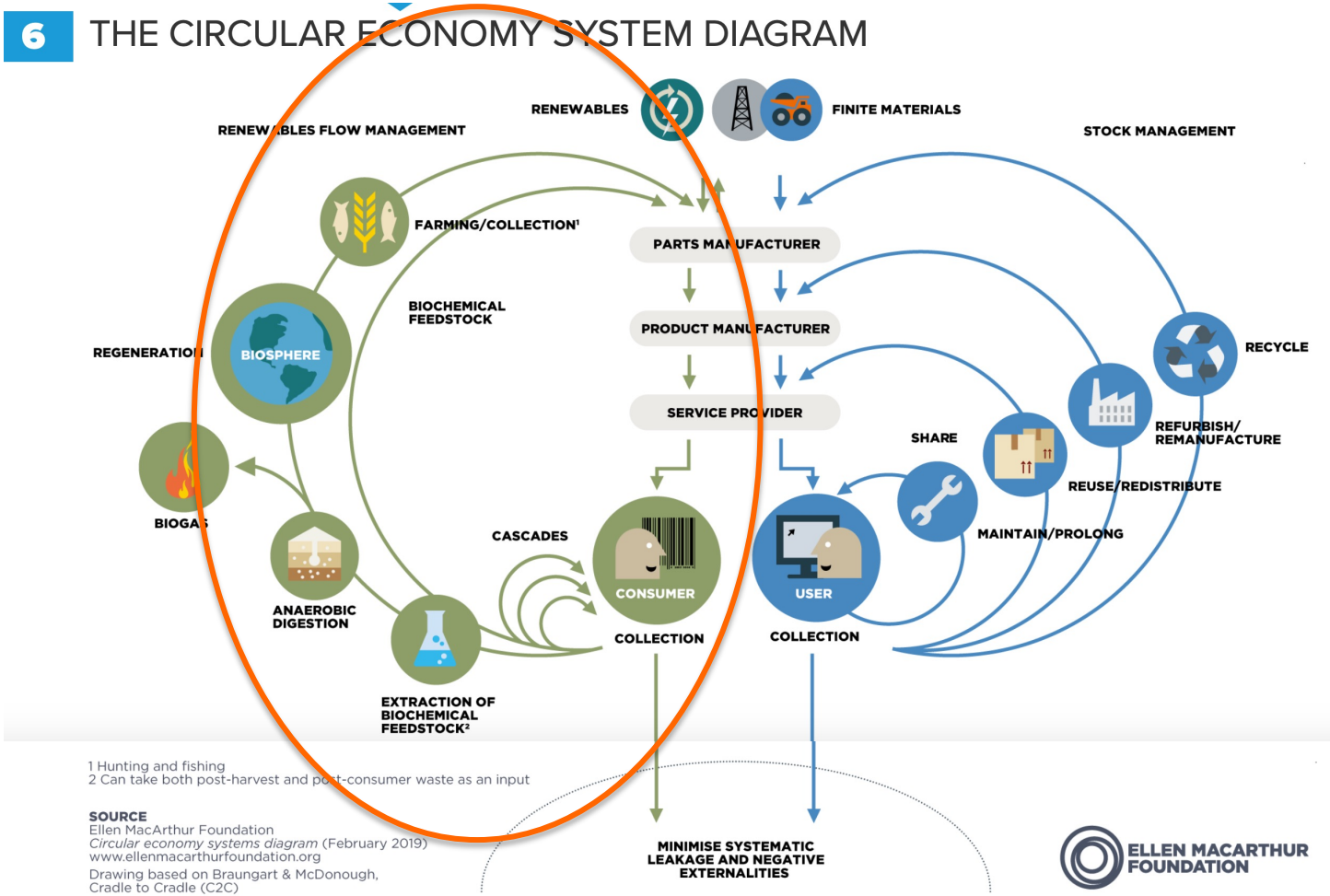
Materials are part of United Nation Sustainable Development Goals

6 THE CIRCULAR ECONOMY SYSTEM DIAGRAM



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https://www.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail

Four phenomenas changing the world of materials

Transforming new and old (renewable) raw materials

Reuse, **recycling**

Biology -biofabrication

Synthetic biology

Alder bowl by Saara Kantele 2019 Photo Eeva Suorlahti

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Transforming new and old renewable raw materials

Photos Eeva Suorlahti

Cellulose is the most abundant organic polymer in the earth - it is in wood, plants, algae.
Cellulose can have very different formats, it is recyclable and can be functionalised – with limitations.

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Industrial scale production processes are long and often complicated

Example: From wood to pulp and nanocellulose

Forest

Picture: Eeva Suorlahti

Pulp bales

Wood pulp

Mechanical grinding

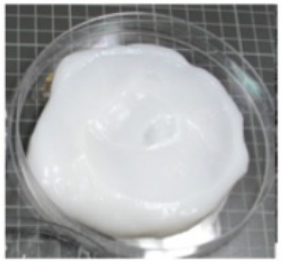
/

Chemical

/

Enzymatic

Treatment



Picture: Tiina Pöhler

Wet CNF
Cellulose nanofibrils

Credits: Heidi Turunen, Aalto University

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How wisely are we using our precious raw materials today?

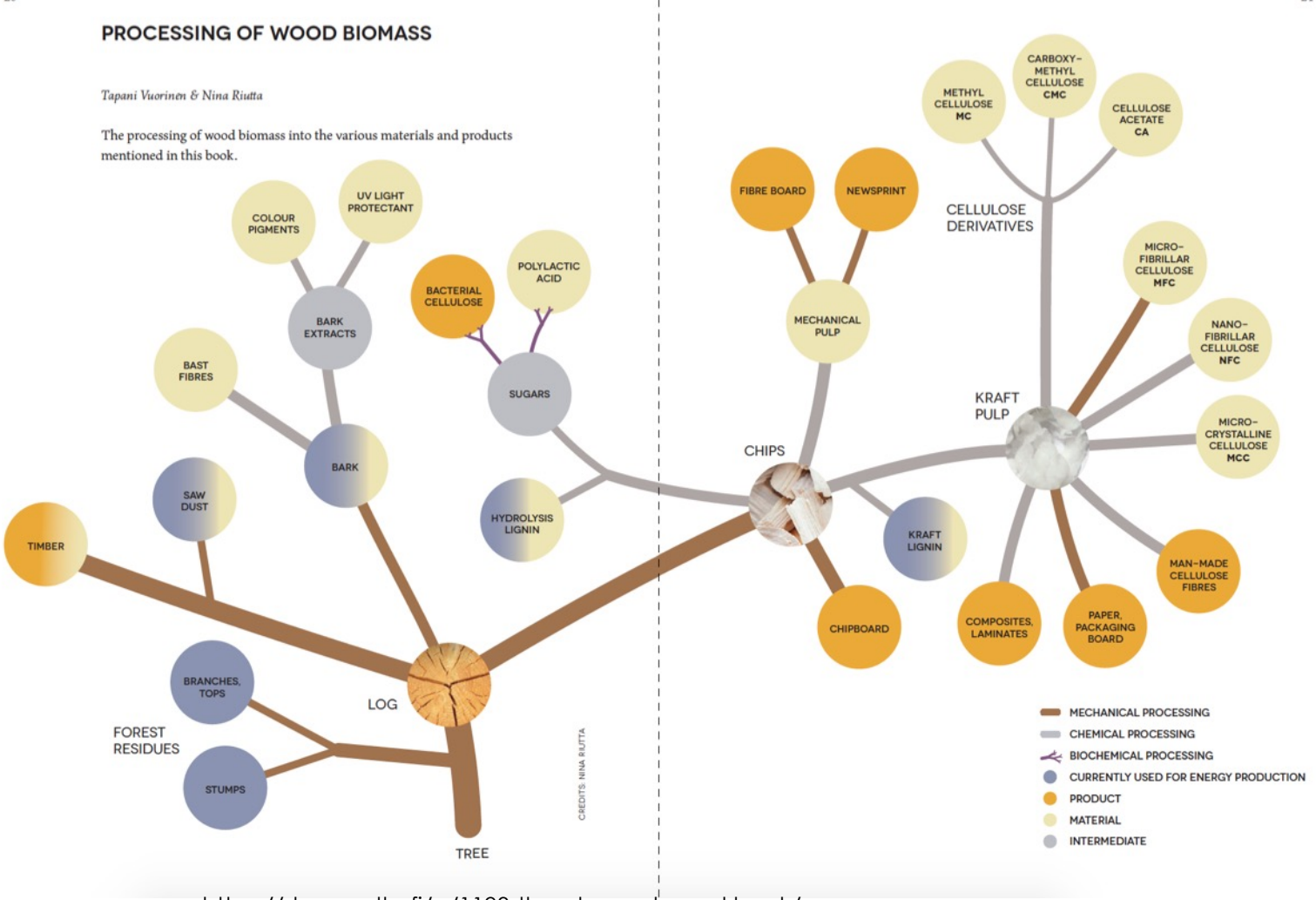
or

Light and durable nanocellulose tubes by Tiina Härkäsalmi. Bicycle by Kim-Niklas Antin & team. DWoC project 2017, photo Eeva Suorlahti

Trees & plants:
not only cellulose, also lignin, hemicellulose, bark, long bast fibres, extractives for colours and natural ‘chemicals’…

The CHEMARTS Cookbook:

Wood-based materials



https://shop.aalto.fi/p/1193-the-chemarts-cookbook/

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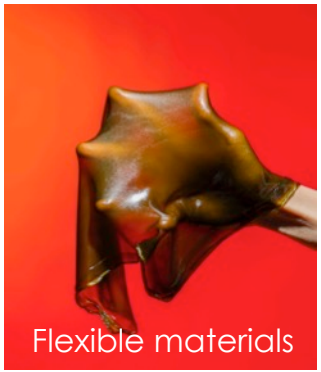
Examples of student projects

CHEMARTS



chemarts.aalto.fi

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Examples of student projects

Willow bark project by Eveliina Juuri, Sanna-Liisa Järvelä and Jinze Dou CHEMARTS 2017-18

Photo Eeva Suorlahti

Natural dyes by Aleksandra Hellberg and Jenny Hytönen CHEMARTS 2019

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Examples of student projects

Birch polypore experiments Sonja Dallyn & Linh Tong Aalto CHEMARTS 2020

Photos: Esa Naukkarinen

Algea-based materials Laura Rusanen CHEMARTS Aalto 2020

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Examples of experimental material projects

Hard and soft hybrid textiles dyed with dyer's Woad
by Anna-Mari Leppisaari & Anna van der Lei 2019
Prof. Tatiana Budtova's team at Aalto CHEM (Dissolution)
Prof. Kirsi Niinimäki's team at Aalto ARTS (Dyer's Woad)

PLA and nanocellulose by
Megan McGlynn CHEMARTS 2019

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Examples of experimental material projects

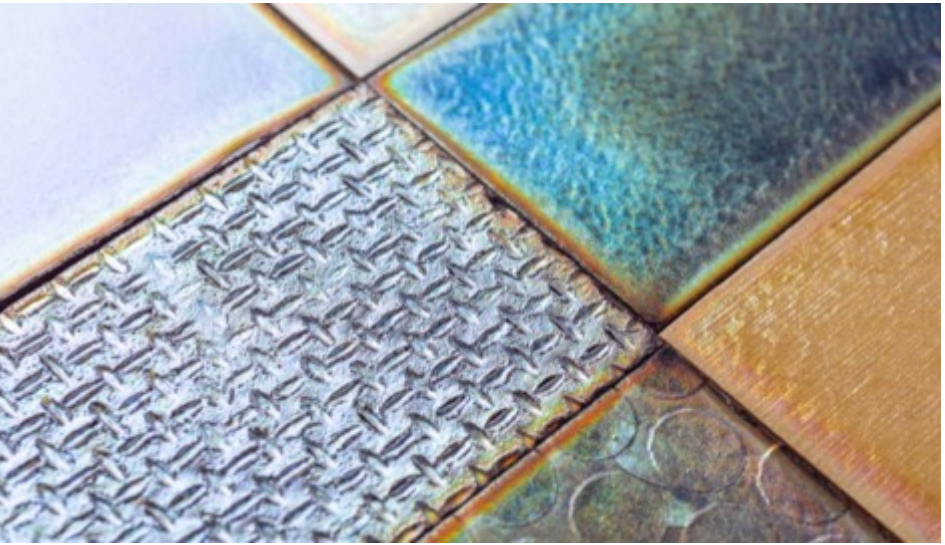

Photo Eeva Suorlahti

Shimmering Wood – Sructural colour from nanocellulose by Noora Yau & Konrad Klockars and Prof. Orlando Rojas's team at Aalto CHEM

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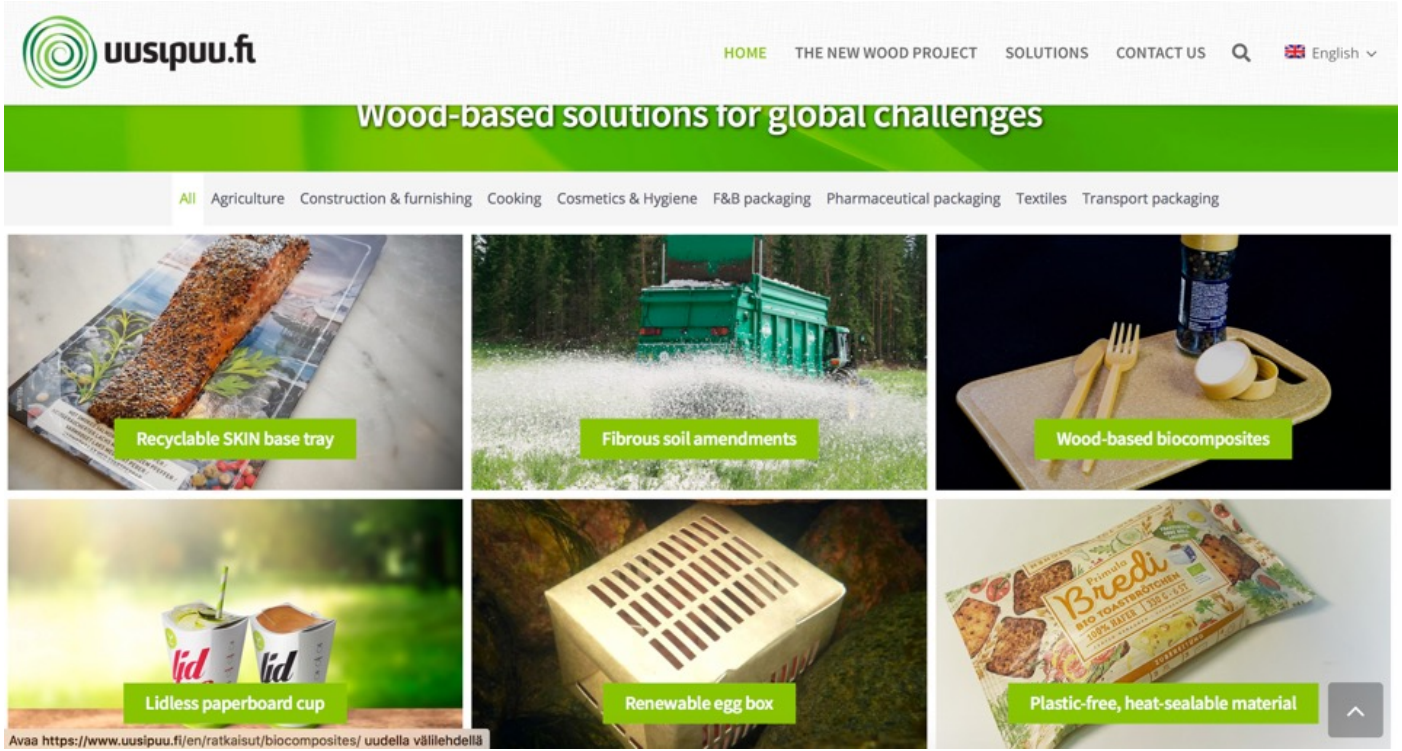
Examples of commercialized material development



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Example of commercialized material development: Sulapac


Sulapac, photo Katri Kapanen

Bio-based material, Sulapac is a fully biodegrable and micro plastic free material.

-made of wood chips and natural binders
-compostable and non toxic
-suitable for **extrusion and injection moulding**
-for cosmetics, personal care, accessories etc.
-commercially available in large amount (TRL9)

sulapac.com

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Recycling materials (e.g. mechanically, chemically -or with enzymes)

Recycling material and colour with Ioncell technology by Eugenia Smirnova & Ioncell team CHEMARTS 2015

'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

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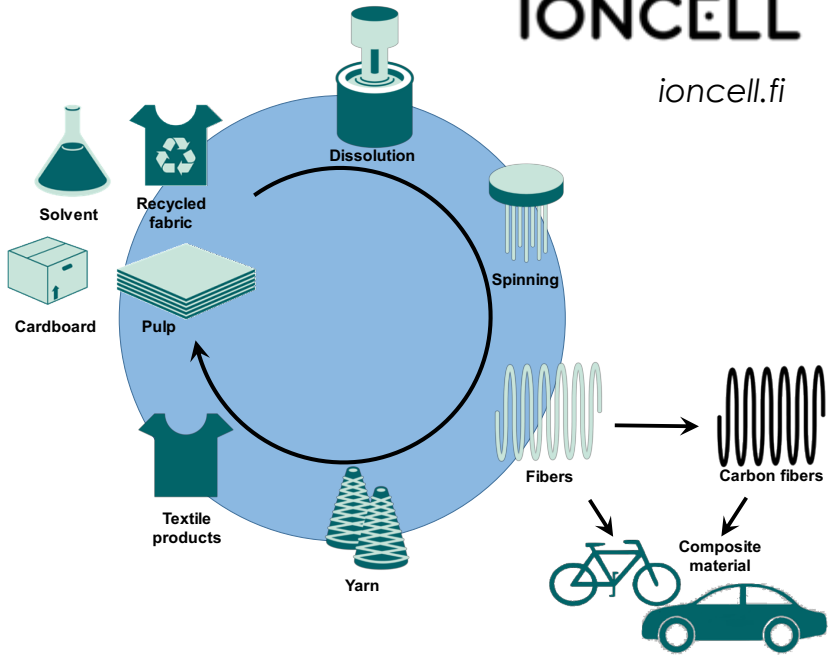
Ioncell, new sustainable technology to produce high quality textile fibres from wood or cellulosic waste (cotton, cardboard, paper waste) by Prof. Sixta's team, in collaboration with the University of Helsinki.

IONCELL

ioncell.fi



Circular processes enabling circular economy

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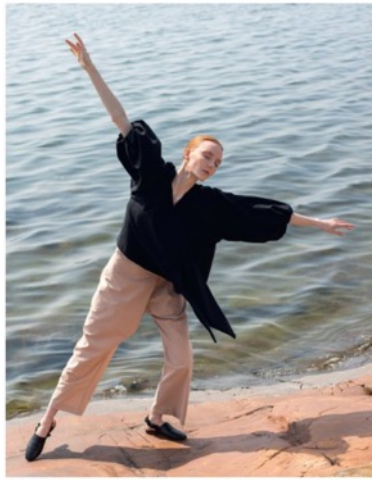
‘It was a bedsheet, became my summer pants, and now the material is to be recycled’



TAUKO

Fashion from locally sourced industrial textiles https://taukodesign.com

H&M

NEWSROOM IMAGE GALLERY PRESS CONTACTS

RECYCLING SYSTEM 'LOOOP' HELPS H&M TRANSFORM UNWANTED GARMENTS INTO NEW FASHION FAVOURITES

We are thrilled to soon offer customers in Sweden the possibility to transform unwanted garments into new fashion favourites with the help from our new garment-to-garment recycling system 'Looop'. We are committed to closing the loop on fashion and this machine visualizes to customers that old textiles hold a value and should never go to waste.

From textile waste to paddings. Recycling experiments by fashion designer Elina Onkinen, Aalto University CHEMARTS 2020. Photo Esa Kapila.

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Circular economy . Repairing . Reuse . Mechanical recycling . Chemical recycling

Rediscovering traditional materials

Hemp, flax (linen), nettle and other traditional textile fibers

Research by Julie-Anne Gandier 2020, Department of Bioproducts and Biosystems, Aalto University. Photo Valeria Azovskaya

Natural indigo for textile dyeing, Crops4luxury project 2019 Photo Eeva Suorlahti

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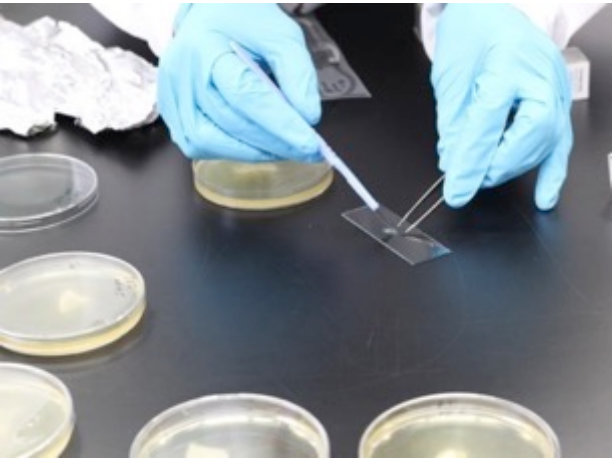
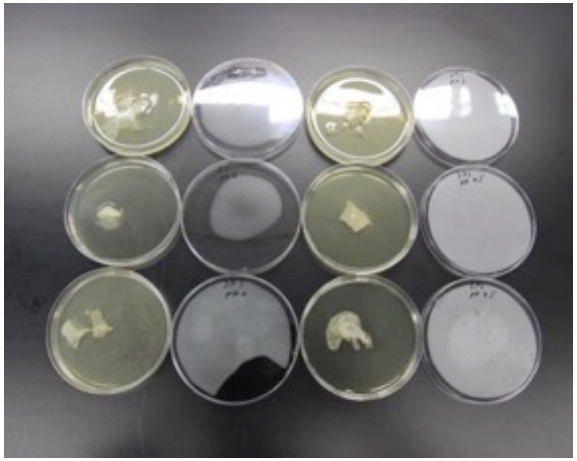
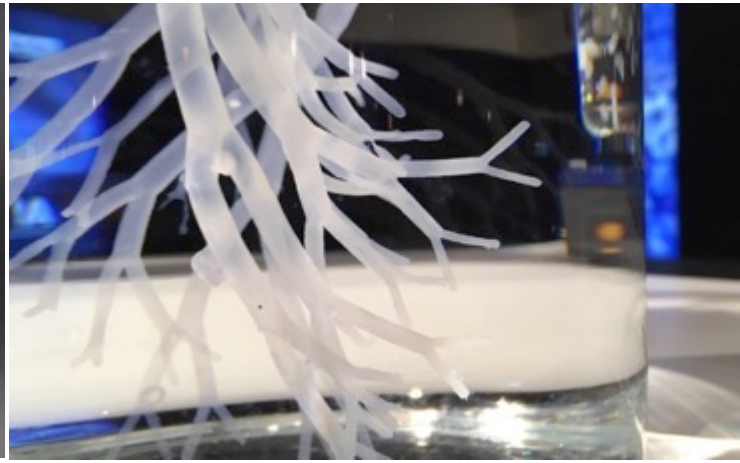
Biofabricating materials with **biology** (with the help of microbe, yeast or fungi)







Complex structures of microbial cellulose grown by Prof. Orlando Rojas's team 2018, Aalto University

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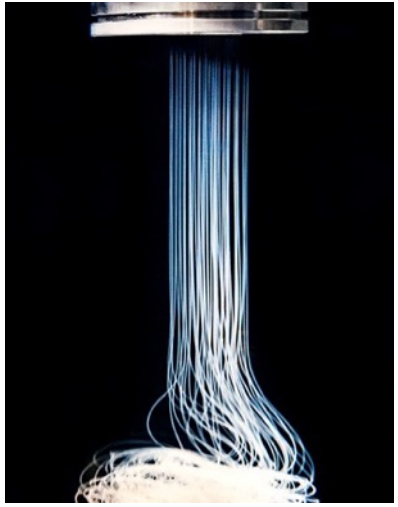
'Let's brew for a pullover!'



Microsilk by Bolt Threads, U.S

Stella Mc Cartney x Bolt Threads

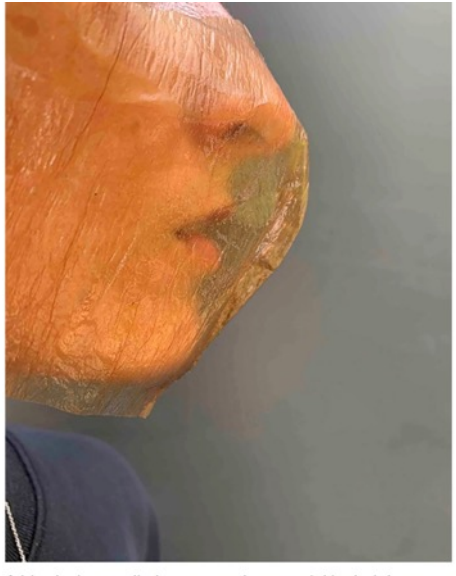
Brewed Protein by Spiber

New kind of textile factory: Brewed Protein by Spiber

Source: 'Understanding 'Bio'material Innovations' report 2020, https://www.biofabricate.co

Aalto University

'Have you seen this recipe to grow your jacket?'



A bio-design studio has grown the material in their home kitchen for a protective mask made of xylinum. Photo: Elizabeth Bridges and Garrett Benisch, Sum Studio.

Textile-like materials from microbial cellulose and other bio-based materials. Julia Strandman, Aalto University CHEMARTS 2018. Photo Esa Eeva Suorlahti

Experimental mycelium jacket By Aniela Hoitnik https://neffa.nl/portfolio/

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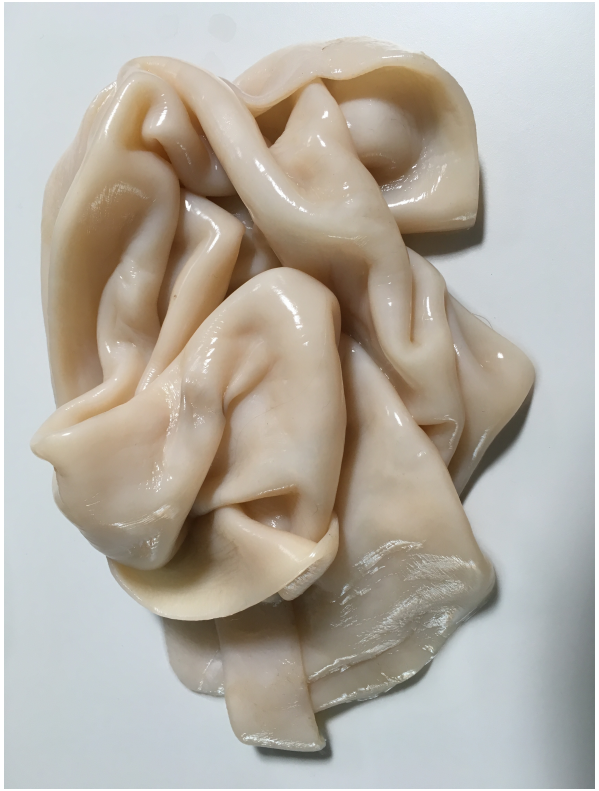
Biodesign . Biofabrication . Biology . Biodegradability . DIY . Locality



Ingvill Fossheim, CHEMARTS 2018

dezeen Next story

Image by Oscar Vinck

Pavilion grown from mycelium acts as pop-up performance space at Dutch Design Week

Augusta Pownall | 29 October 2019 | Leave a comment

The Growing Pavilion is a temporary events space at Dutch Design Week constructed with panels grown from mushroom mycelium supported on a timber frame.

Designed by set designer and artist Pascal Leboucq in collaboration with Erik Klarenbeek's studio Krown Design, the temporary pavilion is made entirely from bio-based materials.

bioMASON®
building with nature

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Biocement™ Masonry, 2017–ongoing

Installation, Building with Nature, 2019; Designed by Thomas Hill; bioLITH tiles; Courtesy of bioMASON, Inc.

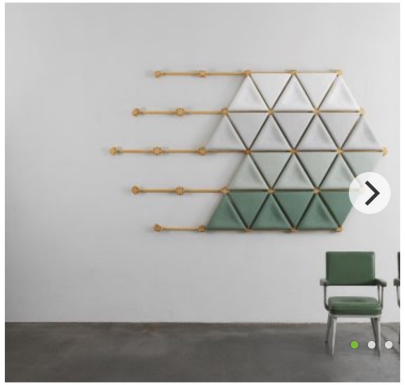
Ginger Krieg Dosier (American, born 1977), bioMASON (Durham, North Carolina, USA, founded 2012)

Biocement bricks are made by mixing sand with nutrients and microorganisms. The bricks harden in a few days at room temperature, an ecologically sensitive solution to the intensive firing and carbon emissions released in traditional brick production. The biocement bricks are grown in molds in various shapes, textures, and colors, and perform like traditional bricks. bioMASON developed the process based on research into how seashells and coral grow underwater into hard, durable organisms.

MATERIAL DISTRICT.

MATERIALS ARTICLES EVENTS BOOKS Search SIGN IN

ACOUSTIC DESIGN MYCELIUM PANELS



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22 July 2021

Architectural firm Arup and Italian biodesign company Mogu teamed up to

The Foresta panel system consists of a

MATERIALDISTRICT BOOKSTORE

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’Dyeing with microbi, colours by photosynthesis, glowing dresses – what’s next ?’

Pigments of Microorganisms, Master's thesis on microbial colours by Eveliina Juuri, Aalto University 2020. Photo by Eveliina Juuri

Carbon capturing images (colours by photosynthetis) by Aman Asif and researcher Valentina Guccini Aalto CHEMARTS 2020

Transgenic glowing silk dress. Fantasma by Another Farm et al. Japan. Cooper-Hewitt museum 2019, New York

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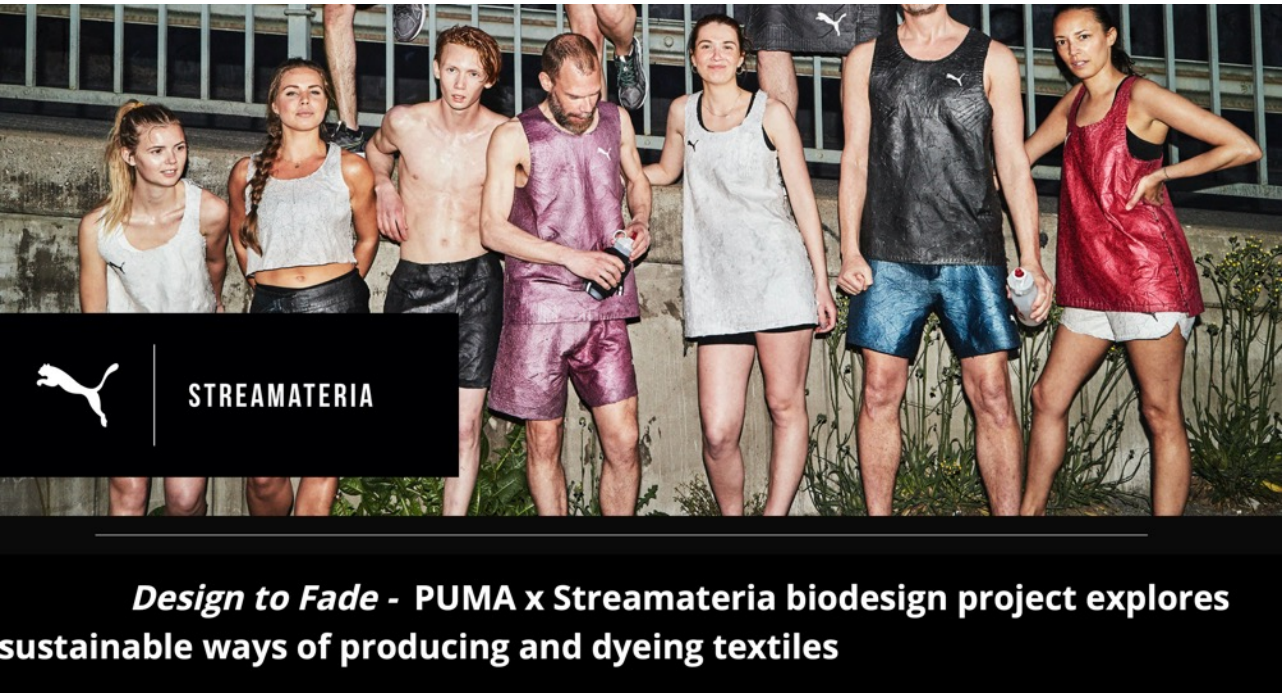
Non-toxic functionality. Biofabrication . Biology . Synthetic biology . Ethics

New approaches to materials are needed



Source: streamateria.com

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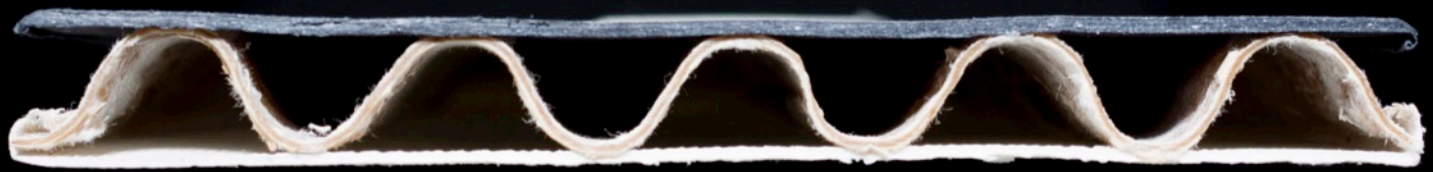
‘The challenges to our planet are so complex that they cannot be solved by one discipline. Design is a bridge. It translates scientific ideas and discoveries into real-world applications.’

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



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Multilayered nanocellulose sheet / Maker Tiina Härkäsalmi, DWoC project 2017, photo Eeva Suorlahti

Needed for collaboration:

Curiosity and listening

Willingness to collaborate and to learn each other's 'language'

Shared values & responsibility

Co-working, co-learning

Mutual interest and benefit

Funding, agreement of IPR and crediting

Photos Eeva Suorlahti

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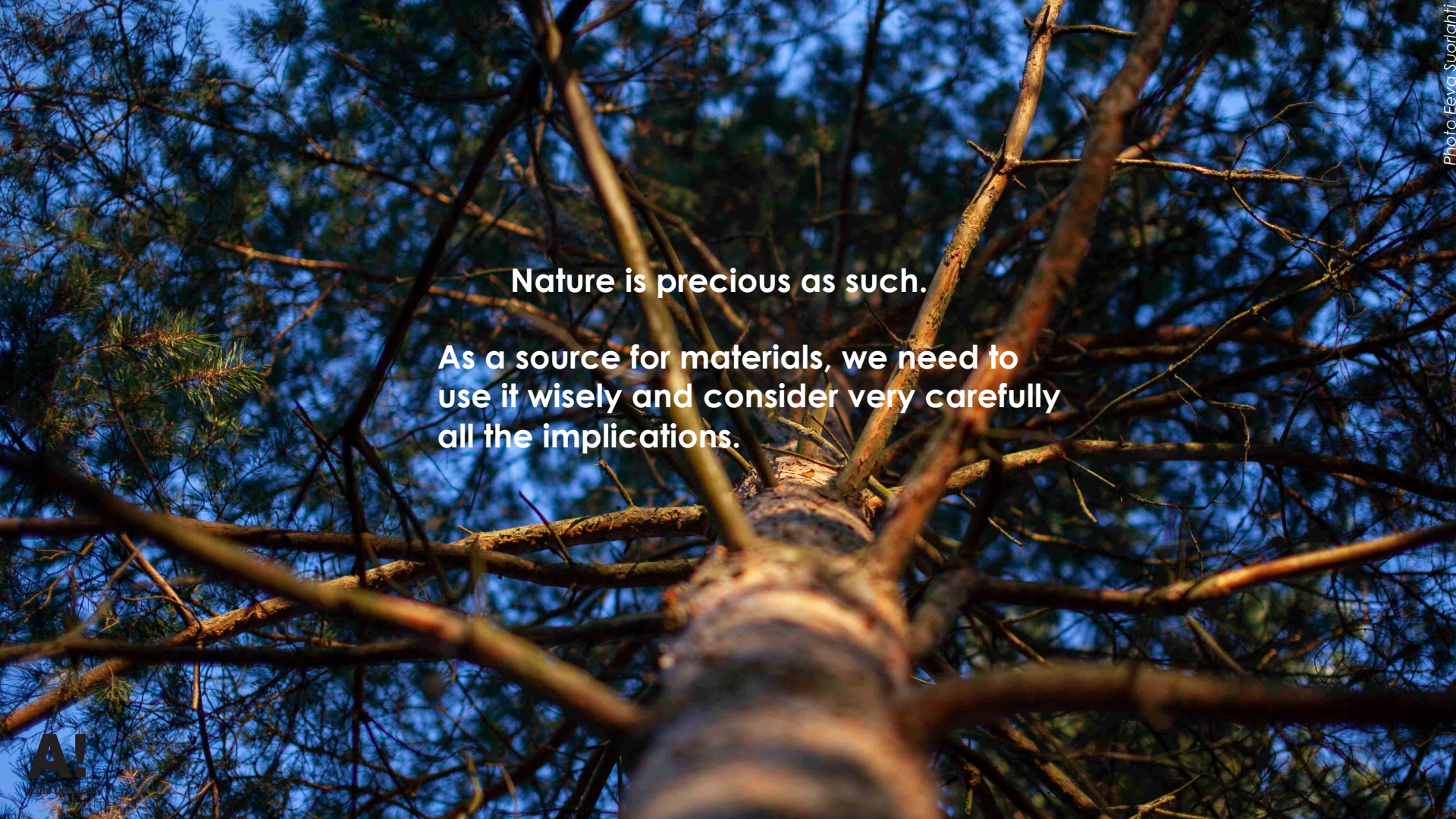
Nature is precious as such.
As a source for materials, we need to use it wisely and consider very carefully all the implications.
Photo Eeva Suorlahti

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Photo: Eeva Suorlahti