

WEARABLES: MATERIAL FUTURES

SPRING 2020

CHAPTER 1: CIRCULAR ECONOMY

CIRCULAR ECONOMY

Circular economy looks to explore a change in how we think about the economy by designing products that can be “made to be made again” powering the system with renewable energy. This concept reduces negative impacts of linear economy:

- Promotes a shift in long-term resilience
- Generates business / economic opportunities
- Provides environmental + societal benefits.

Circular economy helps rethink how we manufacture through 3 basic principles of:

- Design out waste + pollution
- Keeping products + materials in use
- Regenerating natural systems



TECHNICAL CYCLE

Materials not used up during use in the product can be reprocessed to allow them to be used in a new product. Recovery + restoration of products, components and materials:

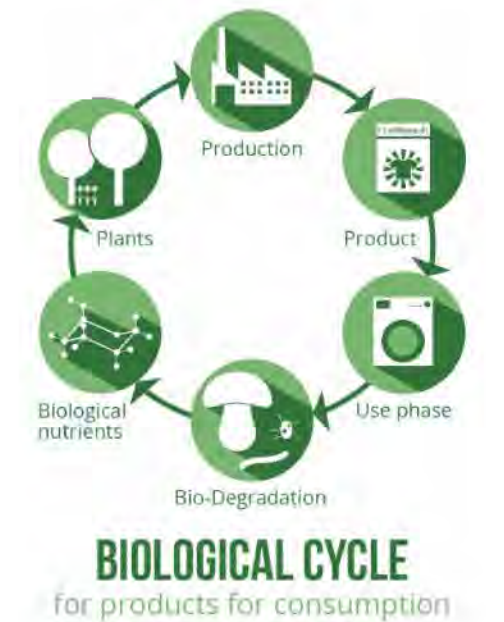
Reuse
Repair
Remanufacture
Recycle



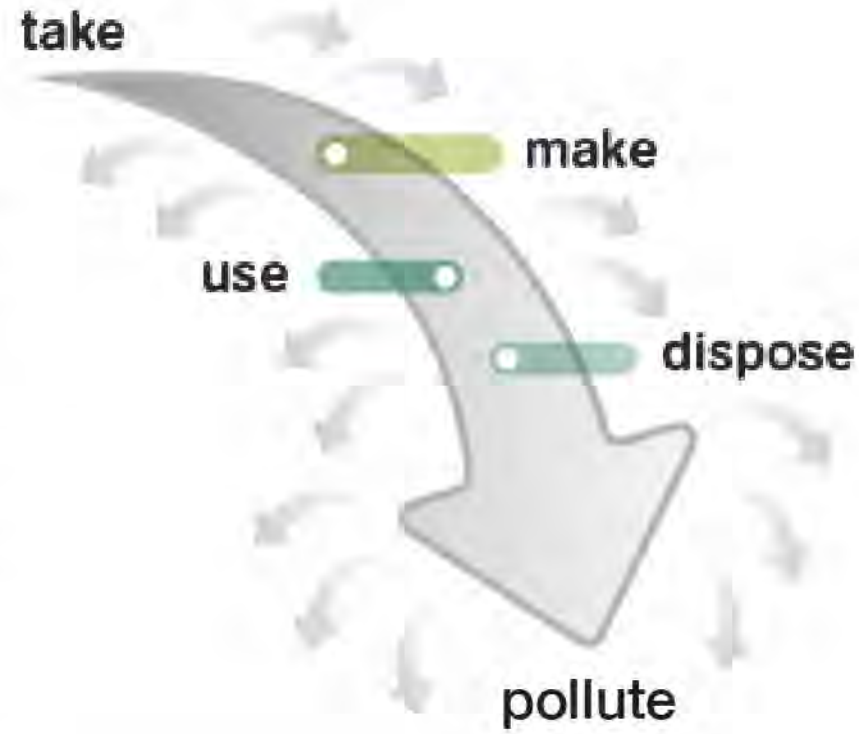
BIOLOGICAL CYCLE

Materials returned to the biosphere in the form of compost, from which new materials can be created. Food + biologically-based materials [cotton + wood] are designed to feed back into the system through:

Composting
Anaerobic digestion.



LINEAR ECONOMY



The mining of raw materials that we process into a product that is thrown away after use. Linear economy follows the idea of “take-make-dispose” step-by-step plan; this is also called down cycling.

Raw materials are collected
Transformed into products
Used and discarded as waste

FAST FASHION

Defined as cheap, trendy clothing taken from the catwalk turning them into garments in highly popular street stores at breakneck speed. To illustrate fast fashion has 52 seasons a year [micro seasons of one season a week] in comparison to the traditional 4 season a year model.

Fast fashion brings inexpensive styles to the public through:

Trend replication

Rapid production

Low quality materials

This results in:

Harmful environmental impact

**Disregard of human capital
& the psyche of consumption.**



FAST FASHION

According to Elizabeth Crane, Zara started the trend shifting to bi-weekly deliveries of new merchandise back in the 2000's becoming the norm to have endless supply of stock at all times.

There isn't enough time for proper quality control when there is urgency from brand to get product to the customers. Low quality goods is not built to last going through an "easy come, easy go" process

H&M are concerned with the bottom line banking on an abundance of clothing they churn out for profits.

SLOW FASHION



Conscious fashion means brands, communities & individuals are gifting for the safety of our earth and fellow humans. Buying a garment from a responsible brand ensures control of personal style, quality product, and protecting the rights of workers manufacturing the product. [all held by human hands]

A movement in the fashion industry towards:

Mindful manufacturing

Fair labor rights

Natural materials / last garments

Slow fashion encourages:

Buy less garment at higher quality

More sustainable process

Less often.

CRADLE TO CRADLE

Created by William McDonough, cradle to cradle is a concept inspired by nature in which products are created according the principles of an ideal circular economy.

Companies become less dependent on price fluctuations in raw material markets. Economy of the whole value creation cycle is improved.

Eco-effectiveness
Sustainability tools / approach

THE TRUE COST

Fast Fashion has caused nightmare situations of collapsed buildings because of the ignored capacity regulations. This is significant because as Americans feed into the capitalist model of constant consumption, working conditions to produce are intensified, human rights are disregarded & so are natural resources.

The more people worry about self-image, the higher depression increases as the clothing does not solve life's problems. Expectations from advertisements do not live up to the perfection, which in my opinion leaves people feeling empty.

You are sold to think that your problems will be solved. When you don't look good in it, it affects your psyche.

A 3-trillion dollar market has caused 1,000+ deaths in manufacturing end of the industry. Human capital is not calculated in the true cost of fast-fashion.

International:

To improve the quality of material production I would continue to protest as safely as I can to provide awareness on a governmental level. I would leverage social media & marketing to press the issue to governmental powers of primary manufacturing nations like Bangladesh, India, Cambodia & China.

Local:

Press the issues of these human rights through larger brands. Advertise sponsored celebrities to speak to the brand followers of how brand strives to create equality & agricultural alternatives to creating clothes. Small slow-fashion brands can share information of local manufacturing + production. Sponsor more celebrities / athletes that can boost awareness on a global level.

Sustainability:

To me sustainability is the action of abstaining the amount of natural resources used to create longevity for ecological balance.

BODEN

UK based clothing brand supporting eco-friendly practices, ethical supply chain and women's rights.

HERproject - Women make up the majority of workforce as well as customer base. HERproject empowers educates and supports woman working in supply chains through enabling women workers to access advice about health nutrition and family planning.



EVERLANE

California based-brand supporting ethical production processes.

Everlane creates relationships specifically with ethical factories. Each factory is given a compliance audit to evaluate fair wages, reasonable hours, & environment. Everyone strives to continue dealings with factories that have an evaluation score of 90 or a above.



TRADLANDS

Ethical production approach & use recycle remnants.

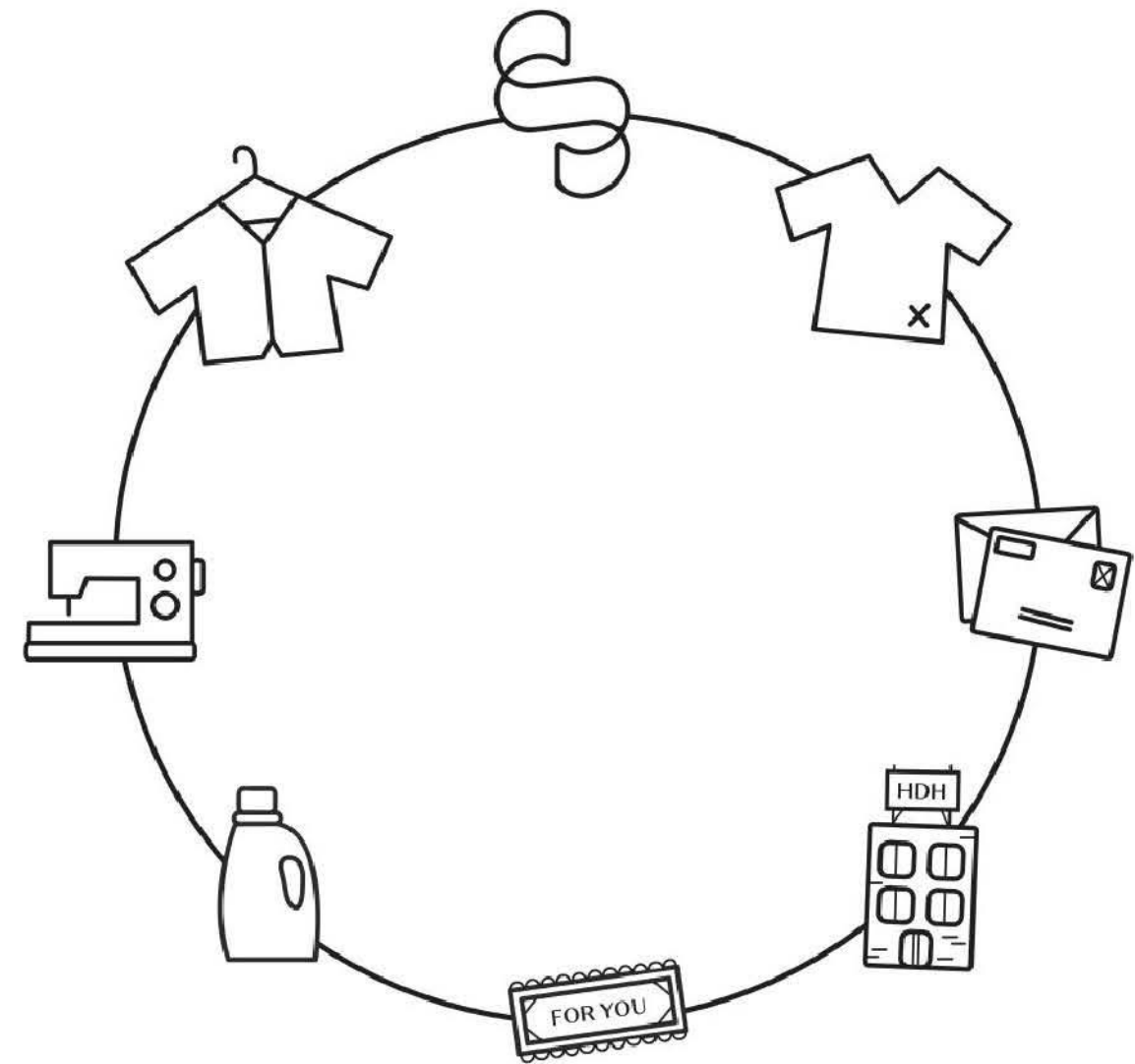
Tradlands employ upon US-based standards of working hours, paying overtime, & never allowing triple shifts. Yearly audits to evaluate satisfaction and environmental conditions. They strive to use 98% of their materials and recycle any remnants in order to keep their waste to a minimum.



HACKWITH DESIGN HOUSE -

Made to order / Made in the USA.

Focuses on local family owned fabric stores specializing in run-off and second-hand fabrics. Use of biodegradable + natural fiber fabrics.



OUTDOOR VOICES

Use of recycled materials & ethical production.

Built with materials for a lifetime of use keeping gym bags out of landfills. Use of circularity process with materials to repurpose, repair, recirculate used product.



Process of conveying false impression or providing misleading information about a company's products being environmentally sound.

1 BYPASS PACKAGING + READ LABELS

Create awareness as a consumer. Understand there are no regulations on images a company can use on their products.

2 BEWARE OF BRANDING

Be aware of earthy tone color palettes to put off an "all-natural vibe"

3 LOOK FOR HIDDEN TRADE OFFS

Claims sustainable materials while being developed in exploitative conditions also known as justice washing.



Process of conveying false impression or providing misleading information about a company's products being environmentally sound.

4 IRRELEVANT SKEWED CLAIMS

"Cruelty free"

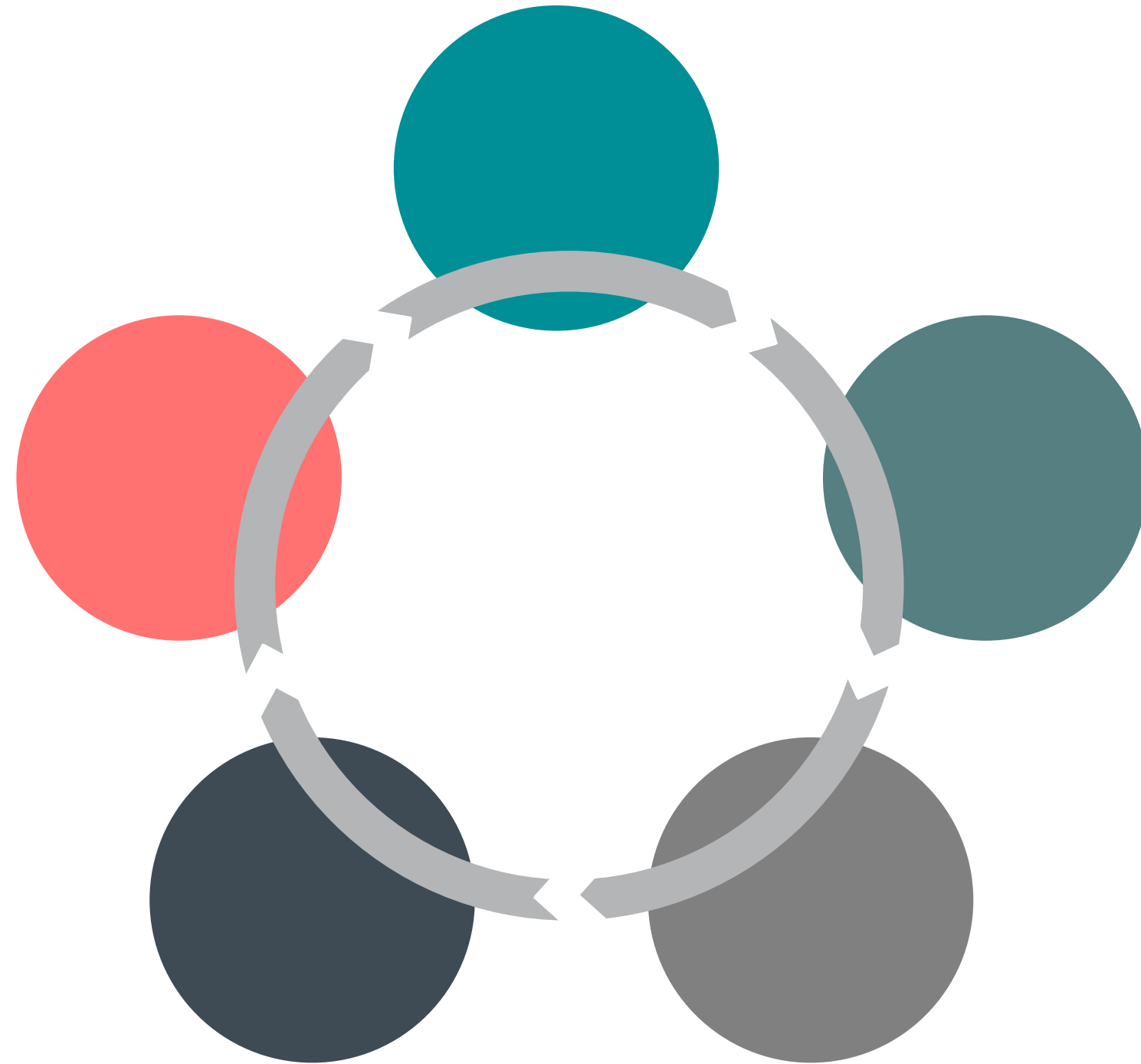
"Not tested on animals"

Claims can be confirmed to be truthful through choosecrueltyfree.com which provides a list of accredited cruelty free companies that do not test on animals.

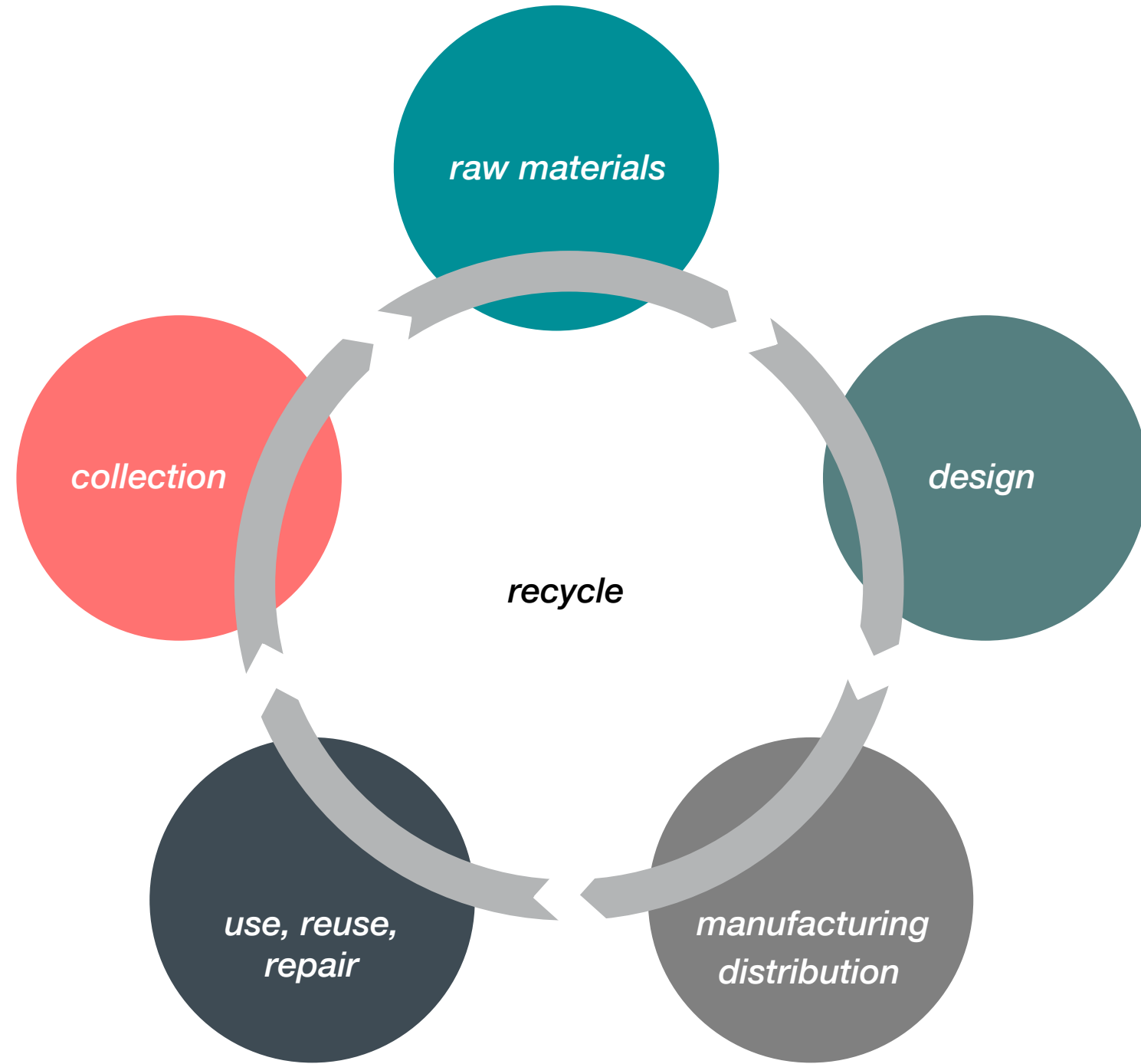
5 MISLEADING JARGON

Creating overly complex jargon so customers will not understand.





CIRCULAR MODEL



CIRCULAR MODEL

Synthetic materials

Source Synthetic fibers / fabrics is the fossil fuel crude oil.

98% of future fibre growth is expected to be in synthetic fibers

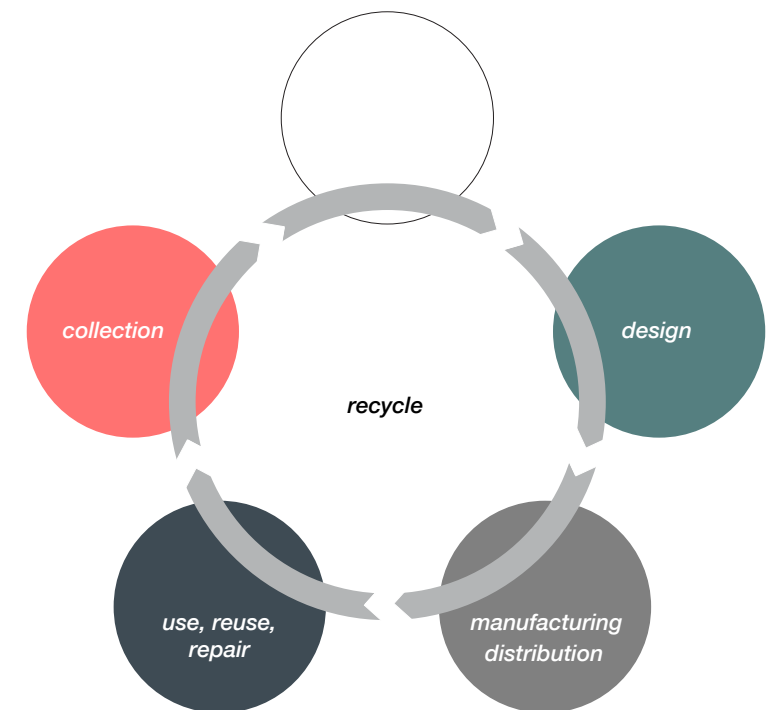
95% is expected to be polyester.

Cotton

oldest non-food crop

21% of all fibre used globally - 21 million tonnes.

Important in low-income nations - 350 million people involved in cultivation + processing.



CIRCULAR MODEL

Cellulosic fibres / viscose

Cellulose extracted from a natural resource [bamboo / trees] then crushed and transformed into fibers.

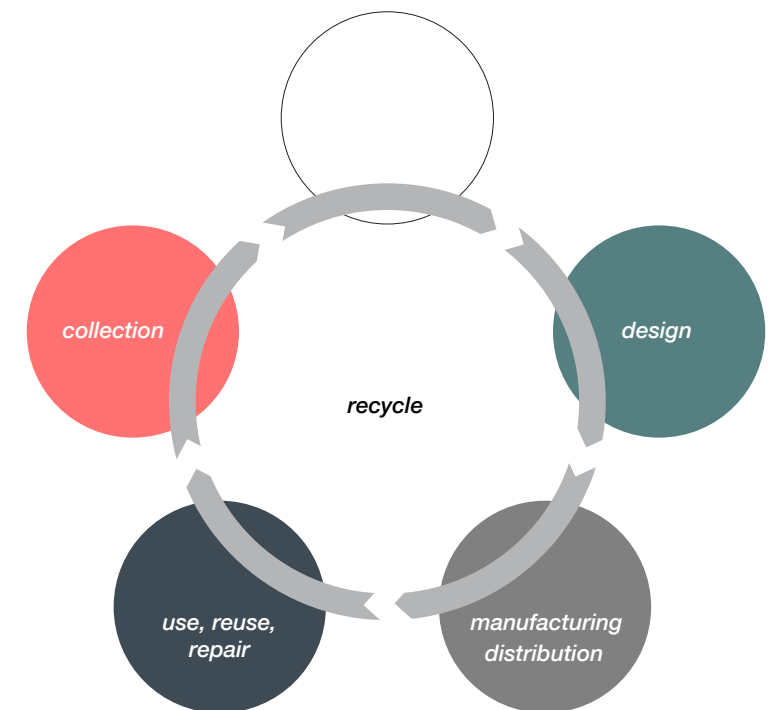
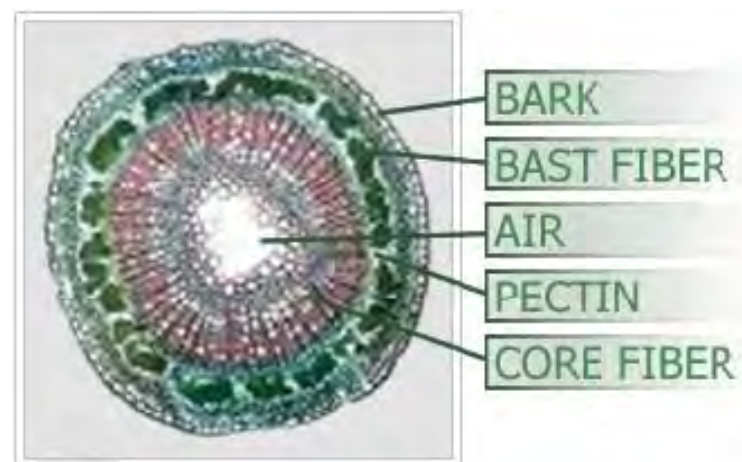
Most popular cellulosic fabric is viscose, prized for its silk-like qualities.

Rayon is material made to mimic silk.

Bast fibres

Hemp + nettle are traditional source that has been used by humans for thousands of years.

These fibers are found in inner bark layer [phloem]



CRADLE TO CRADLE

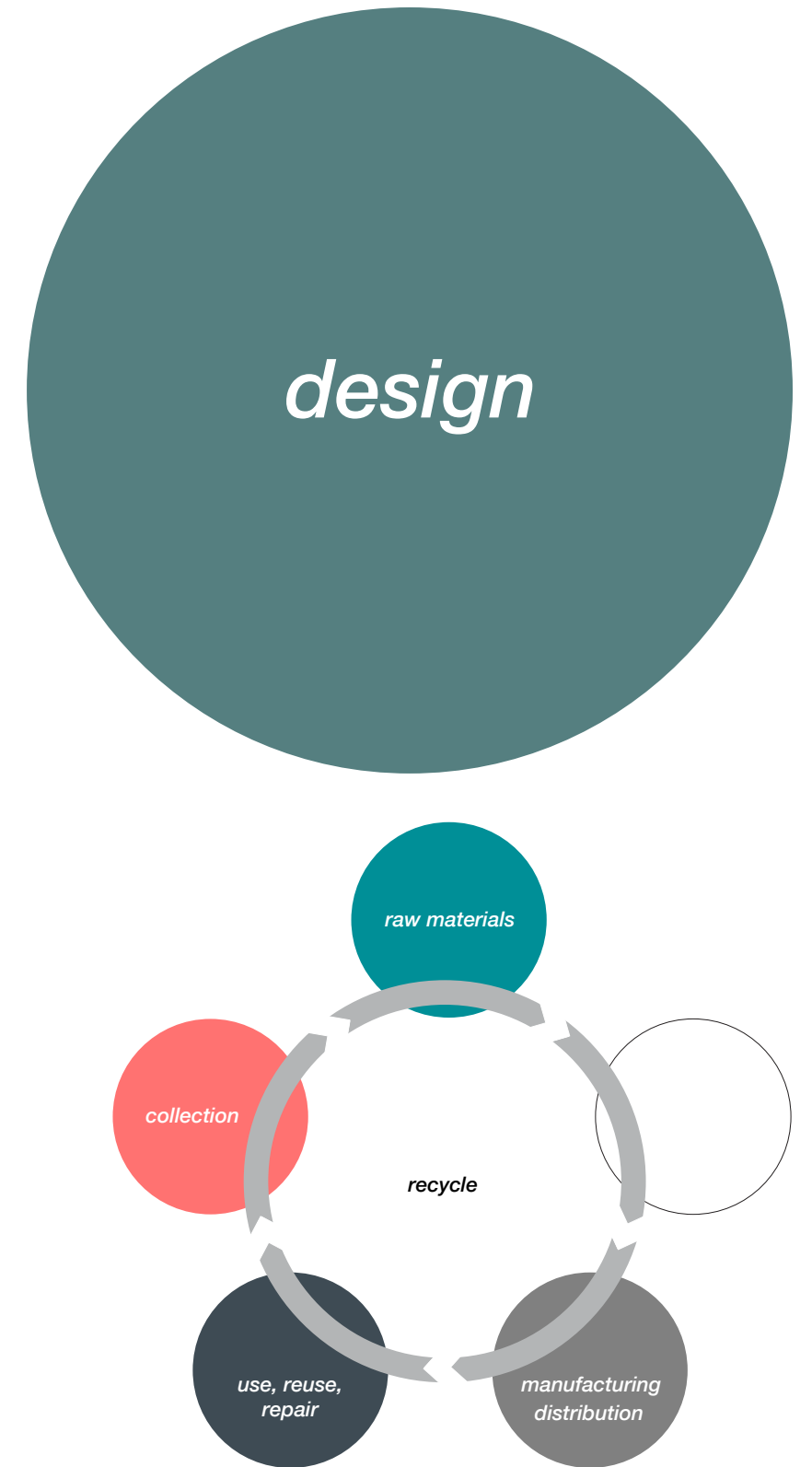
Biological cycle should wear out in environment Is biodegradable.

Technical cycle suggests everything not biodegradable & should be prevented from going into the environment.

The new products should not be harmful and help humans in a positive ecological way.

keep materials in cycles.
stimulating renewable energy only.
celebrating diversity.

Collectively, too, many initiatives have been launched with the goals of educating consumers, striving for substantial improvements, building broad industry networks dedicated to environmental, social and ethical objectives, and more.



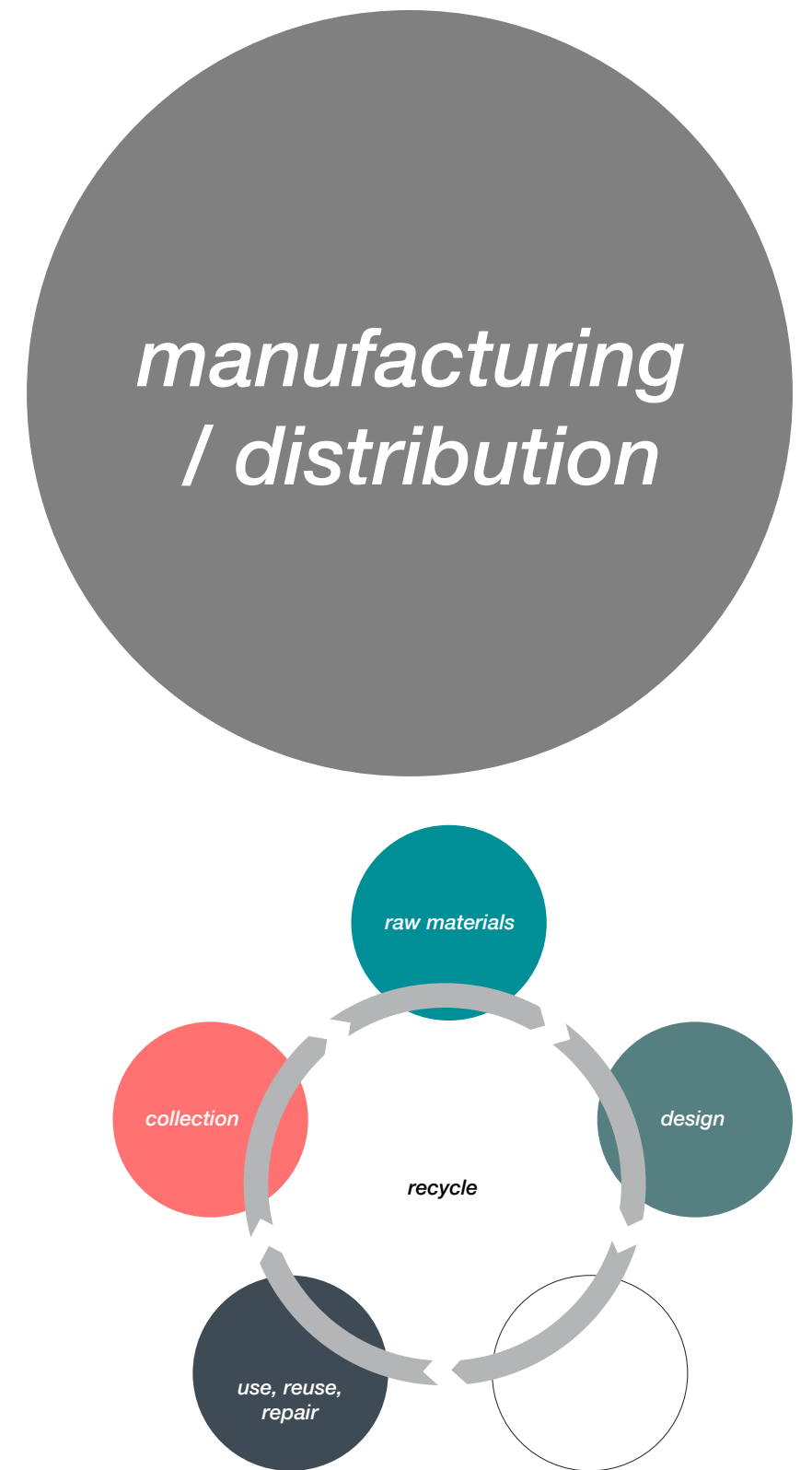
CIRCULAR MODEL

Much effort has gone to develop transparency indexes as standard supply chain measurement tools, such as the Sustainable Apparel Coalition's (SAC) Higg Index that is already in use by many companies.

High transparency on 1st tier suppliers; only exceptions not covered. Majority of suppliers visited by brand or third party auditors.

Full visibility on 1st tier suppliers. Suppliers visited by brand or third party auditors

Publish full list of contracted manufacturing facilities and system in place to monitor sub-contracting

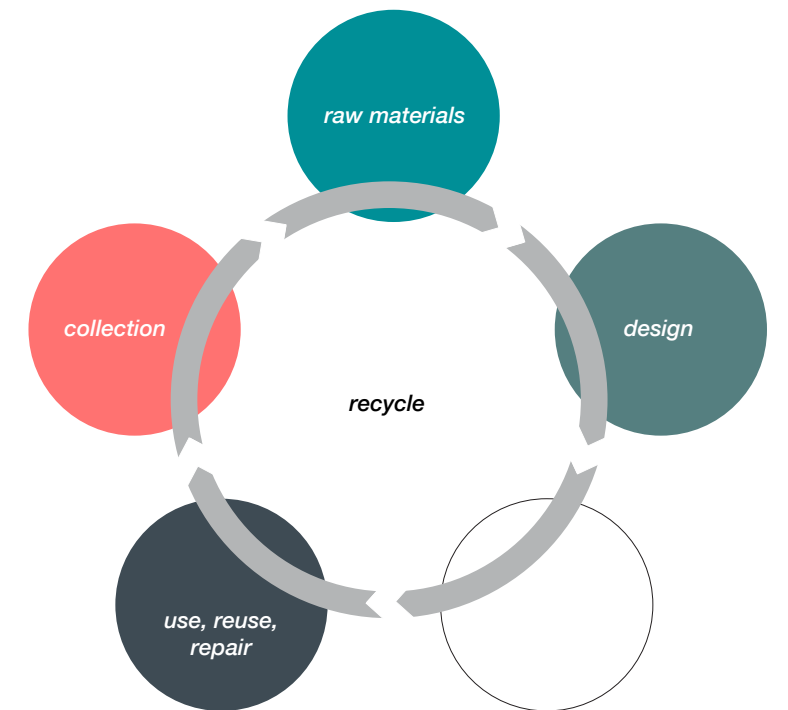


CIRCULAR MODEL

Distribute knowledge across the industry through collaborations

Cooperation or sharing of guidelines on machine standards

Investment support for facilities to upgrade technology, improvements in production methods, packaging and energy efficiency with clear impact reduction targets



CIRCULAR MODEL

Borrowing materials instead of using them.

Return and renew design

Products are disassembled and reproduce.

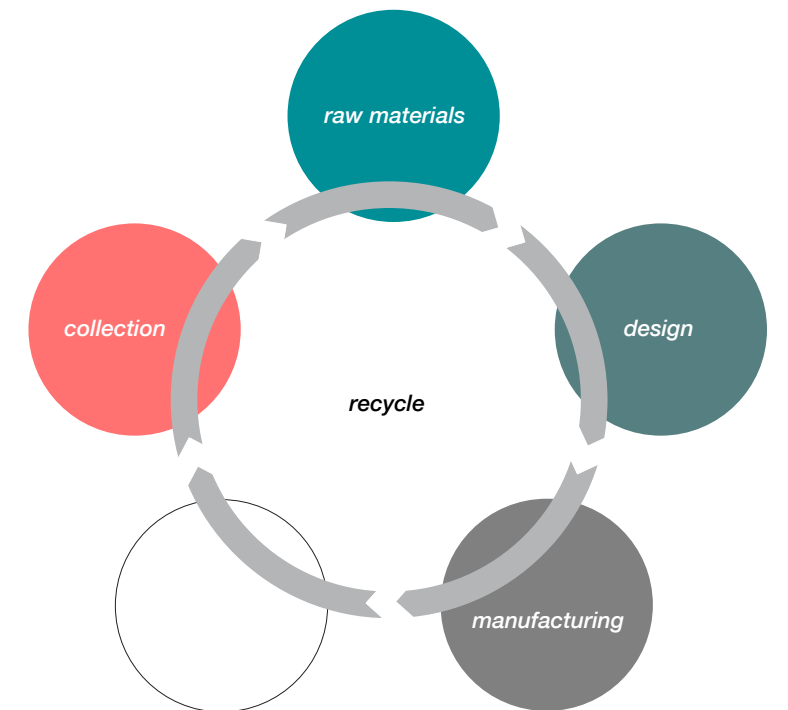
Brands won't own product

but license from manufacture.

The are remade by renewable energy.

All interconnecting companies that form our infrastructure come together.

This will open new perspectives and new horizons.



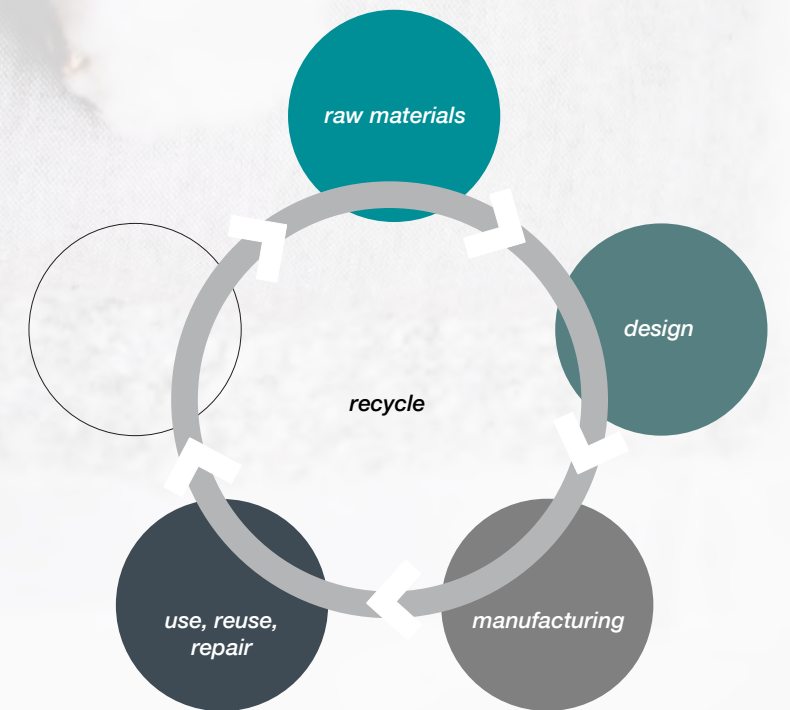
CIRCULAR MODEL

Cotton Blossom

Carton boxes made from recycled materials.

Paperless offices reduce more than 15,000+ A4 papers per year.

2/3% micro dust (cotton waste) used as natural manure for garden trees.



amazon prime
repurposed

amazon repurposed

Using Amazon packaging, I wanted to re-use it's plastic as a wearable product.

Amazon Prime has reached 100+ million buyers.

Implementing packaging in a circular production model can add a new platform to their 'Second Chance' recycle program.

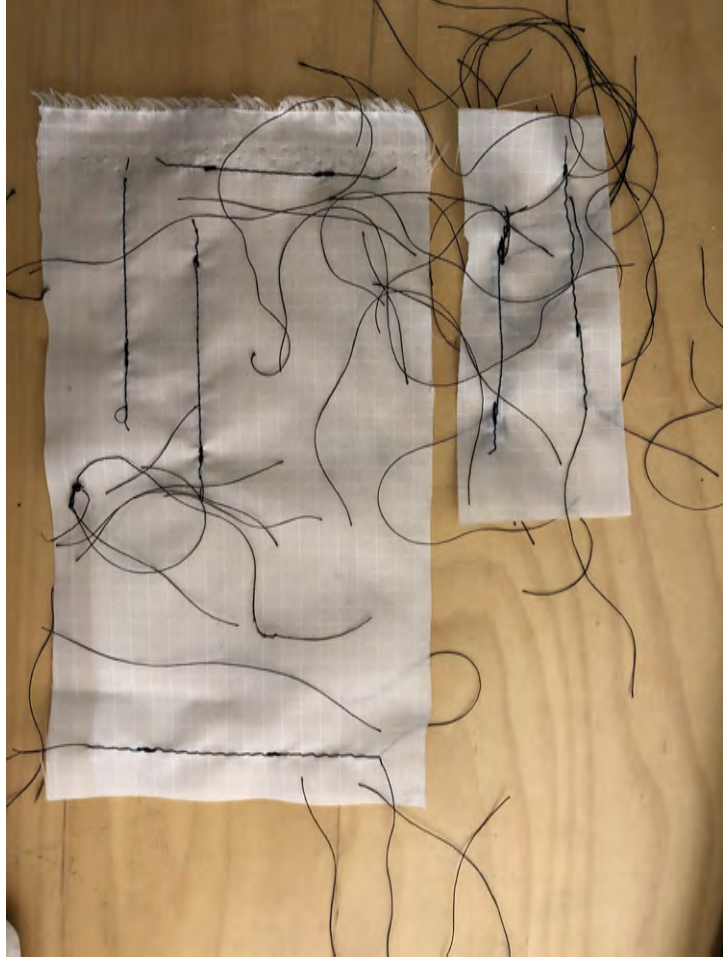
process



process



process





RECYCLING PLASTIC

BENEFITS

Repurposing plastics in soft goods is beneficial because it reduces toxins released into air while burning plastic.

The plastic bottles are turned into fabrics are recycled and generate less pollution in the environment.

We are understanding repurposed plastic caters to people's needs & eliminates waste from environment.

Recycling materials consumes much less energy than making a new one.

When 1 plastic bottle is recycled, a person can save enough energy to light a 60 watt light bulb for 6 hours.

As we become more eco-conscious, we see the rise of usage of recycled plastic fabrics for everyday needs.



BENEFITS

The development of recycling technology, plastic bottles can be now transformed into soft & breathable textiles used for wearable clothing.

Plastics are woven into textiles such as nylon, polyester, spandex, acrylic rayon, faux fur, faux leather, vinyl, polyurethane etc.

The versatility of the recycled plastic is such that it can be made into different weights and textures.



DOWNSIDE

When plastics are heated, they leach. These leached chemicals enter our bodies daily, absorbed through our skin & in items we eat + drink.

When plastics are heated they release toxins, when they are in a water bottle form, we drink the toxins. In relation to clothing, **having the plastic against warmskin could have the same effect.**

Although we found use for non-reusable plastic we consume, it means there are many polyester garments out there, in landfills around the world which are not biodegradable.

Man made fabrics like recycled polyester releases microplastics into the ocean.



ALTERNATIVE OPTIONS

Shop consciously, shop with brands who are clear about environmental impact, checking the label before we buy to ensure there is no plastic.

Preventing microplastics from entering the water system through A Guppy Friend Washing Bag. **Place the clothes containing plastic in the guppy bag and the bag collects the microfibers removed in the washing process.**

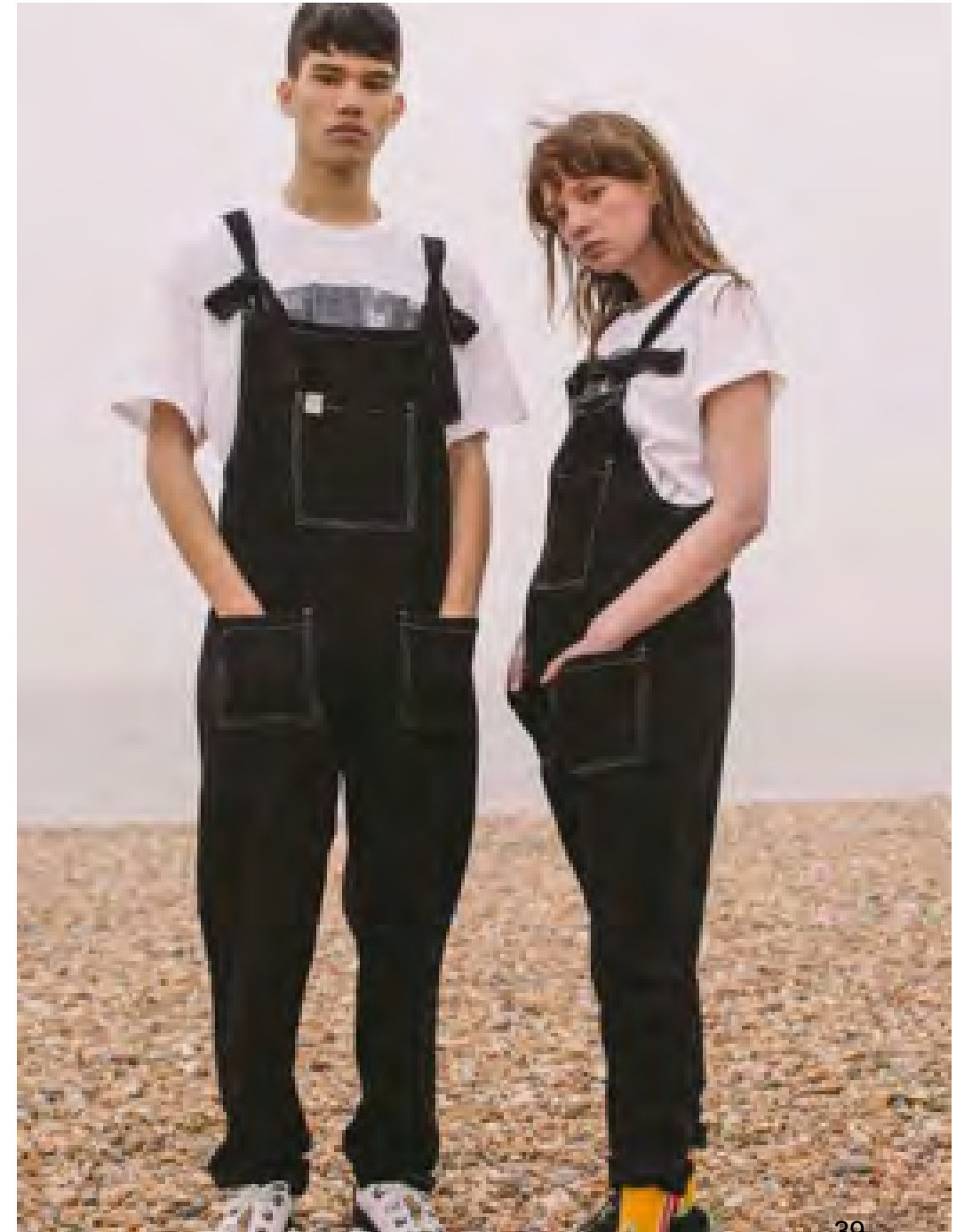
Throw collected lint in trash.
Do not wash it down the drain.

Stop using fabric conditioner because they help release microplastics from clothes.
Use vinegar to help clean + deoderize your clothes.



LUCY & YAK

Lucy and Yak is a UK based brand who manufacture in India. Their organic cotton products range in sizes and colours. They are transparent with their business, showing their workers and materials. Lucy and Yak also donate to a local girl's school in the area of the factory, promote a plastic free lifestyle and make products that are built to last. You can shop online or visit their shop in Brighton, UK. .



ARDSLY

Ardsly is a shoe company that makes shoe soles out of old tyres.

6 tyres are discarded each second, and they take 400 years to degrade. This company is putting the tyres to good use for long lasting, handmade shoes. The leather used for the shoes are by-products and the shoes are packaged without plastic.



BATOKO

Batoko is a swimwear brand which makes their swimsuits out of 100% recycled plastic bottles. They have great ethics and make sure their workers are treated fairly and have a safe working environment. Batoko also ensures that their manufacturers avoid environmental degradation.



FOURTH ELEMENT OCEAN +

Fourth Element Ocean Positive is a range of water-sports wear made using recycled nylon from ghost fishing nets and other discarded waste. All their packaging is compostable. They also help fund many amazing ocean focused charities – including Olive Ridley Project.



Denim is the most detrimental fabric to the environment because of how it is made. Denim is dyed and washed over and over to create the desired colour. The dyes and chemicals enter the environment through the polluted water that is not discarded or properly. Buying second hand denim is the most sustainable, but Everlane are creating a line of sustainable denim. The waste water is treated so it is safe to drink, the rest is a thick sludge that is being made into bricks. And it is run on solar panels.

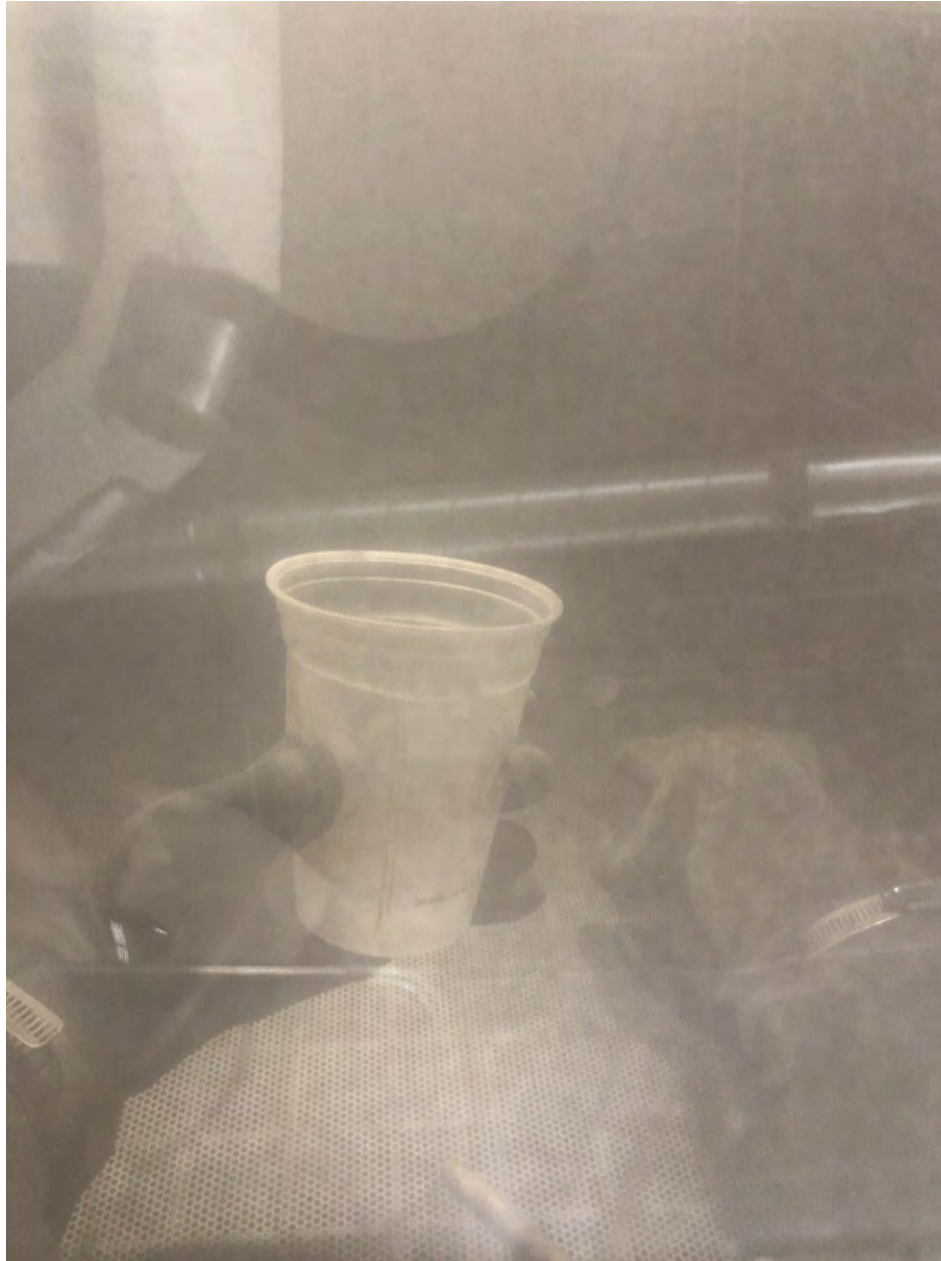


SCOBY PROCESS



My scoby process after 2 weeks of growing. I didn't expect the growth, but I am satisfied with the results. I find it interesting that the scoby grows unexpectedly fast after the first week.

PLASTICS



I am exploring how to use and manipulate plastics. I am planning to make jewelry. Here I am sandblasting plastic for a desired matte effect.



recycled jewelry

Plastics

I chose used water bottles & manipulated its shape to create jewelry + accessories.

With exploring its form, I made a concept finger cast, rings & a bracelet.

ring



process



process



process



process



OCEAN PLASTIC



Plastic bottles trimmed for accessory.

Plastic bag for the lacing of the necklace.

The reflectivity has a shimmering effect.

FOOD WASTE



IMPACT

Food waste is food appropriately ready for human consumption that is discarded.

This occurs when edible food is intentionally discarded by consumers after they fail to plan their meals properly.

Store food till it spoils or goes past the expiry date.



IMPACT

At times, food waste can also happen due to oversupply in markets.

Retailers also tend to reject a lot of food because it doesn't conform to their quality and aesthetic standards.

A 2013 FAO (Food and Agriculture Organization of the United Nations) report, one-third of all food produced in the world for human consumption does not find its way to our tables.



IMPACT

Food waste that ends up in landfills produces a large amount of methane – a more powerful greenhouse gas than even CO₂. For the uninitiated, excess amounts of greenhouse gases such as methane, CO₂ and chlorofluorocarbons absorb infrared radiation and heat up the earth's atmosphere, causing global warming and climate change.

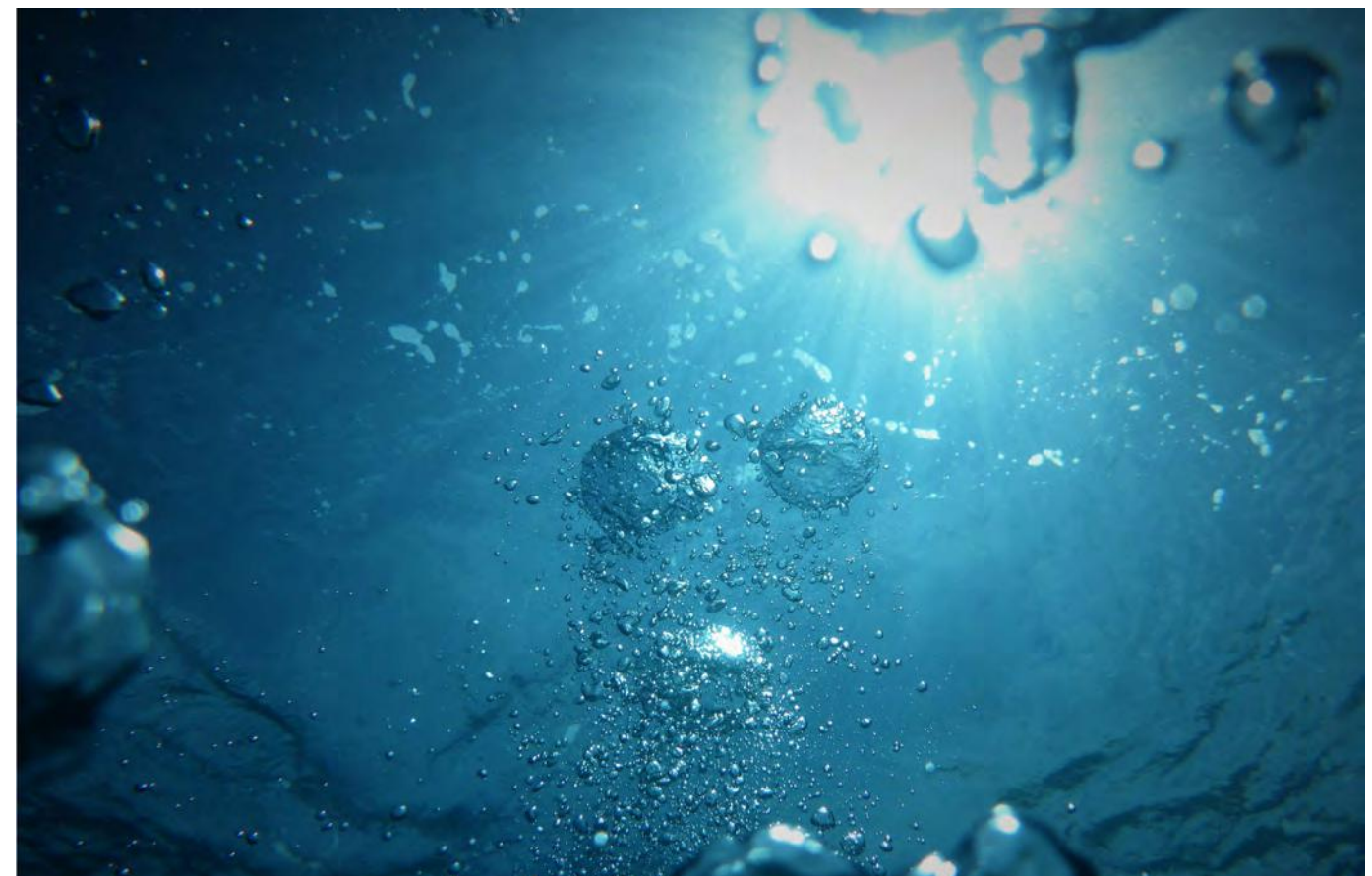


IMPACT

With agriculture accounting for 70 percent of the water used throughout the world, food waste also represents a great waste of freshwater and ground water resources.

It is said that a volume of water roughly three times the volume of Lake Geneva is used just to produce food that is not eaten.

By throwing out one kilogram of beef, you are essentially wasting 50,000 liters of water that were used to produce that meat.



IMPACT

In the same way, nearly 1000 liters of water are wasted when you pour one glass of milk down the drain.

If you look at land usage, around 1.4 billion hectares of land, which is roughly one-third the world's total agricultural land area, is used to grow food that is wasted.

Millions of gallons of oil are also wasted every year to produce food that is not eaten.



IMPACT

To stop food waste, a first step, priority should be given to balancing production with demand. This essentially translates to lesser use of natural resources to produce food which is not needed.

Secondly, If oversupply happens, steps should be taken to redistribute the food or to divert it to people who are in need.

Consumers should also try to buy food in accordance with a meal plan so that they don't end up wasting edible food.

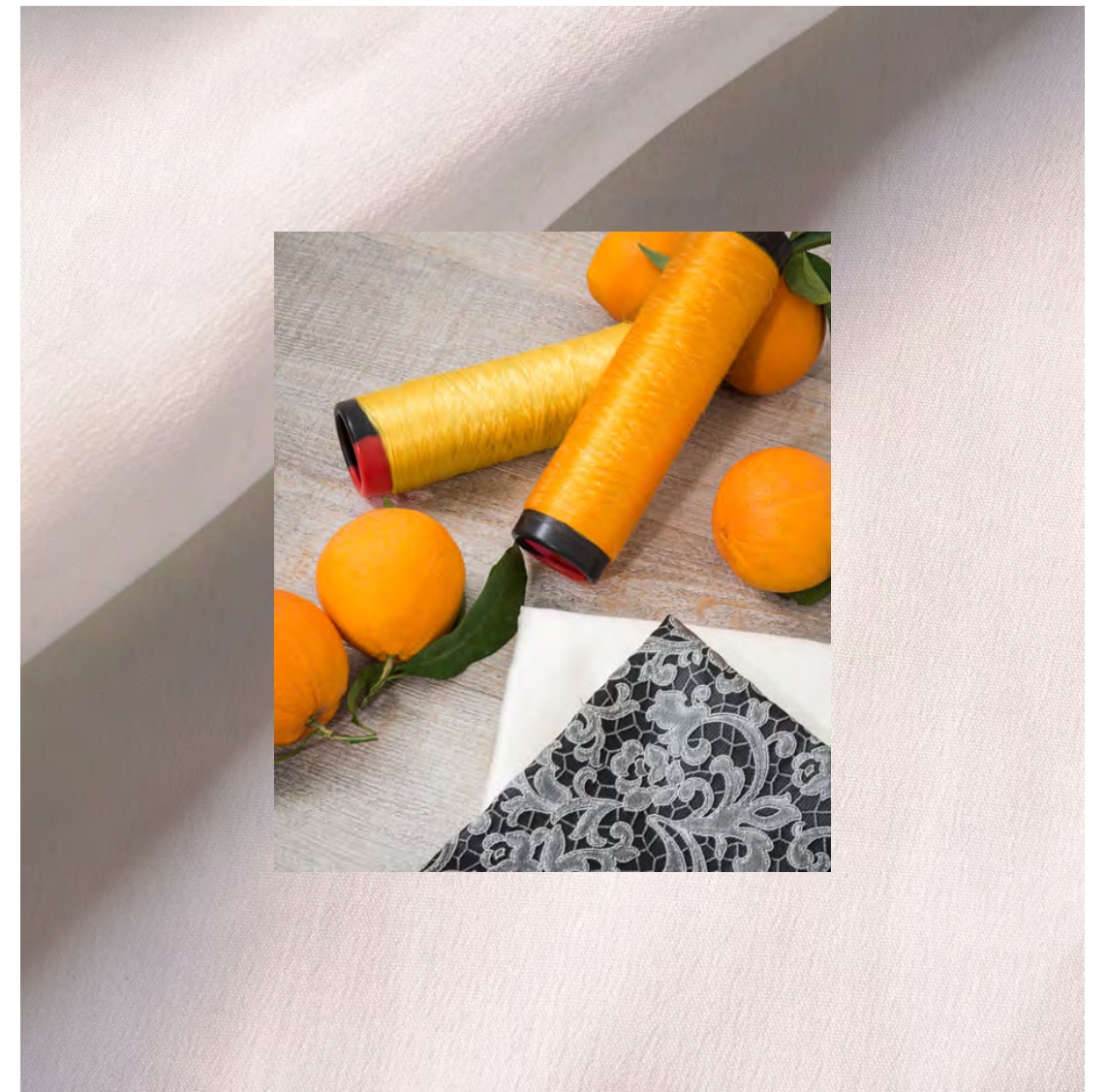
an average home can divert about 150 kg of food waste a year from local waste disposal facilities by adopting home composting.



BRANDS

Innovative designers are looking for new, renewable resources for fiber, like Italian-based company **Orange Fiber**. The company makes yarn from orange peels that are a byproduct of making juice.

The yarn was recently used in a collection by Salvatore Ferragamo, the first fashion house to employ Orange Fiber yarns.



The production of pineapples is another area where waste is becoming a resource.

Piñatex uses the fiber of pineapple leaves and turns it into a soft, yet flexible material, which can be used as an alternative to PVC and leather.

The leaves are the byproduct of existing agriculture, and their use creates an additional income stream for farming communities.



BRANDS

In Germany, milk has become a textile resource, as is the case with **QMilk**, who works with the dairy industry to use milk that can't be sold for consumption.

About 2 million tons of this milk goes to waste in Germany alone, and with its technology, QMilk is turning it into natural fibers.

Coffee grounds are being used for their anti-odor capabilities in performance apparel, and even the culture that's used to make kombucha is being used as a potential for new textiles.



Circular Systems Agraloop™ transforms food crop waste into high-quality BioFibre while producing only beneficial effluents. Providing regenerative benefits to people, planet, and industry.

The Agraloop™ can utilize a range of feed stocks including oil-seed hemp, oil-seed flax, and rice straw as well as pineapple leaves, banana tree trunks and sugar cane bark.

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BRANDS

S. Café technology, with a low-temperature, high-pressure and energy saving process, combines coffee grounds onto the yarn surface, changing the characteristics of the filament, and offers up to 200% faster drying time compared to cotton.

Coffee grounds within S.Cafe yarns absorb odors your body produces throughout the day. The grounds within the yarn fills in little microscopic holes creating a shield preventing UV rays from skin contact.



FOOD WASTE

I used guava for its skin-hardening properties.

I was inspired by its naturally rounding form.



For people who broke their arms,
I made a hard-shell
brace after you wear a cast.



FIBER

FIBER

Natural Fiber



100% Cotton

Soft, fluffy staple fiber that grows in a boll, or protective case, around the seeds of the cotton plants of the genus *Gossypium* in the mallow family *Malvaceae*. The fiber is almost pure cellulose. Under natural conditions, the cotton bolls will increase the dispersal of the seeds.

Pros: absorbs moisture, comfortable

Cons: shrinks easily, flammable.

Natural Fiber



58% Cotton 42% Linen

Linen is a textile made from the fibers of the flax plant. Linen is laborious to manufacture, but the fiber is very strong, absorbent, and dries faster than cotton. Garments made of linen are valued for their exceptional coolness and freshness in hot and humid weather.

Pros: absorbs moisture, allows circulation

Cons: fibers weaken to direct sunlight, easily wrinkles.

Manufactured Cellulosic Fiber



52% Viscose 48% Acetate

Viscose is rayon fiber that is made from natural sources such as wood and agricultural products.

Acetate is a man-made fiber that is made from the acetic acid ester of cellulose.

Pros:
v: breathability and absorbency.
a: drapes well, fast drying

Cons:
v: weak when wet, absorbs body oil
a: poor abrasion resistance

Manufactured Cellulosic Fiber



95% Rayon 5% Metal

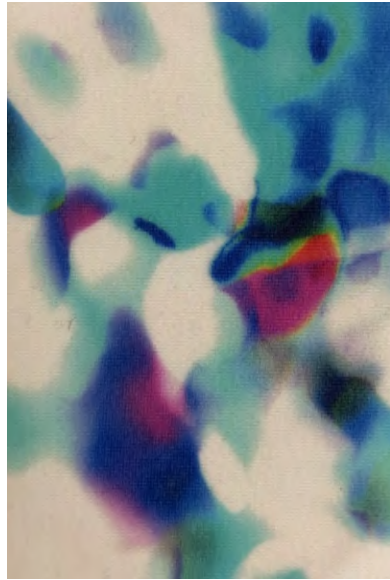
Rayon is made from purified cellulose, harvested primarily from wood pulp, which is chemically converted into a soluble compound. The many types and grades of rayon can imitate the feel and texture of natural fibers such as silk, wool, cotton, and linen. Often called artificial silk.

Pros: soft, durable, comfortable.

Cons: stretches, low-resiliency.

FIBER

Manufactured Synthetic Fiber



80% Polyamide, Nylon 20% Elastan

Examples of naturally occurring polyamides are proteins, such as wool and silk. Synthetic polyamides are commonly used in textiles, automotive industry, carpets, kitchen utensils and sportswear due to their high durability and strength.

Pros: high abrasion + fatigue resistance

Cons: low resistance to chemicals, high shrinkage

Manufactured Synthetic Fiber



100% Polyester

A category of polymers that contain the ester functional group in their main chain. Polyesters include naturally occurring chemicals, such as in the cutin of plant cuticles, as well as synthetics such as polybutyrate.

Pros: strong, flexible, less wrinkling

Cons: not as breathable, temperature sensitive.

Natural Protein Fiber



22% Wool 78% Polyester

A textile fiber obtained from sheep and other animals, including cashmere and mohair from goats, qiviut from muskoxen, from hide and fur clothing from bison, angora from rabbits, and other types of wool from camels.

Pros: warm, lightweight, absorbant

Cons: affected by moths, absorbs odors, scratchy on skin.

Natural Protein Fiber



100% Silk

Silk is a natural protein fiber, some forms of which can be woven into textiles. The protein fiber of silk is composed mainly of fibroin and is produced by certain insect larvae to form cocoons. The best-known silk is obtained from the cocoons of the larvae of the mulberry silkworm *Bombyx mori* reared in captivity.

Pros: soft, comfortable, resists oil

Cons: expensive, needs special care like dry-cleaning, yellows with age.

FIBER

Manufactured Protein Fiber



Banana Fiber

Just like hemp, which produces a flowering and a stem section, banana stems and peels yield fibers that can be made into textile products. This practice has actually been done for many centuries, but it's only recently that the world of Western fashion has caught on to the textile potential of the common banana.

Pros: soft like silk, delicate silky interior fiber.

Cons: high level of stiffness compared to cotton.

Future Fiber



Banana

Banana fibre, also known as musa fibre is one of the world's strongest natural fibres. Biodegradable, the natural fibre is made from the stem of the banana tree and is incredibly durable. The fibre consists of thick-walled cell tissue, bonded together by natural gums and is mainly composed of cellulose, hemicelluloses and lignin.

Pros: sustainable

Cons: not as breathable, temperature sensitive.

FIBER CONCEPT

Manufactured Synthetic Fiber

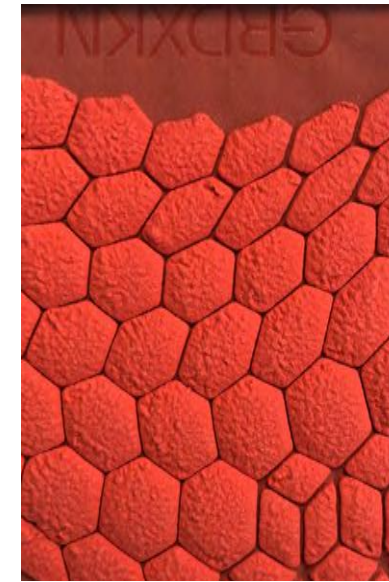


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GRDXKN Material Swatch:

This textile was my favorite item because of its embossed property. The multi-faceted shape allows for a protective mobility, which is a unique feature for wearable products.

Material Connexion states it was a priting technology transforming a 2D fabric to 3D structure. It is a combination of rigidity + flexibility where needed. Applications include apparel, accessories, footwear & upholstery.

Drawstring Bag



Features:

Lightweight

Strong

Flexible

Sustainability:

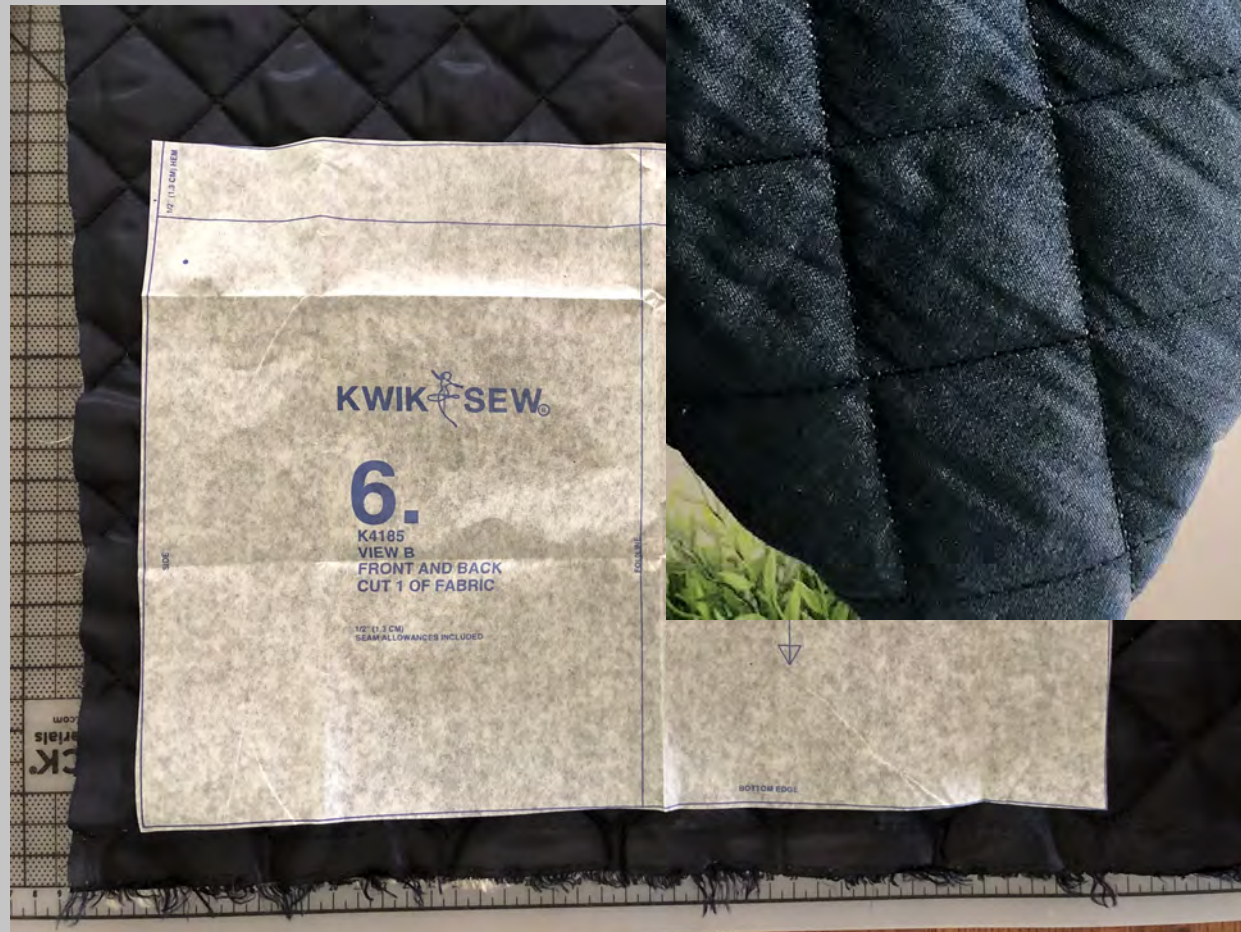
The positive aspects of polyester is that it is made from recycled plastics, therefore can be accessed without need to manufacture from virgin stock. This has started a trend for new polyester type fabrics made from recycled plastics.

Application:

The properties of a drawstring bag is that it's easily accessible for storage. Therefore, polyester will be durable to hold items within the bag.

FIBER PROJECT

Repurposed Polyester fiber,
sewn into a small handbag.



Polyester can be manufactured
from recycled plastics.

We don't have to manufacture
from virgin resources.

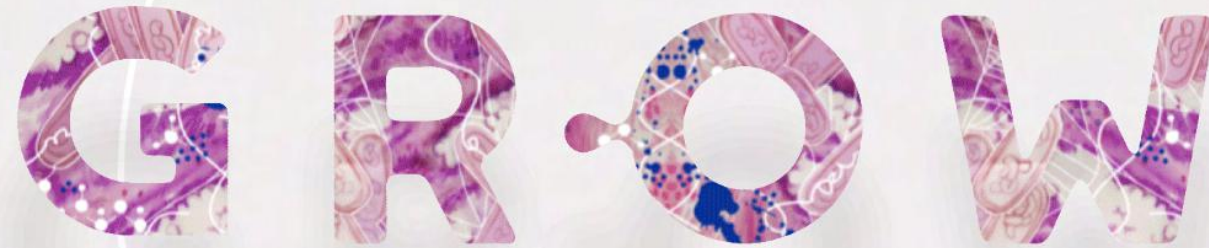
CHAPTER 2: BIOFASHION

GINKGO BIOWORKS

One of the larger bio tech companies, **Ginkgo Bioworks** specializes in genetic engineering to produce bacteria with industrial applications.

They specialize in new enzymes for new applications, using a combination of rational design + machine learning processes to identify better **enzymes**.

An **enzyme** is a substance produced by a living organism which increases rate to bring about a specific biochemical reaction.



GROW

Strain improvement seeks to increase efficiency, reduces cost, and improve the sustainability of products made by custom organisms.

Examples of the industrial use of enzymes include cheesemaking, pharmaceutical production, and clothing manufacturing..

MODERN MEADOW

Modern Meadow looks to build on decades of innovation, to tap into nature's toolkit to create biologically advanced materials that signify a new era: The Biofabrication Age

Inspired by leather, Zoa™ will be Modern Meadow's first generation of materials created with their designed **collagen protein**. This is produced without reliance of animal-based agriculture.

Not yet available commercially, Zoa™ will inspire new creative possibilities for designers. Zoa™ will be highly adaptable and enable us to develop materials with thought-leading brands to push innovation forward.



BOLT THREADS

Bolt Threads makes a synthetic silk using biotechnology that mimics properties of spider silk.

Engineers at Bolt Threads figured out a way to **design yeast** that produce protein that can be made into a fiber.

The proteins from the yeast brewing process are then isolated, purified and squeezed into long thin fibers using a die. From here the fibers are used to make products such as clothing



LIVING COLOUR

Living Colour is a biodesign research project exploring the possibilities of natural textile dyeing with bacteria that produce pigment.

The brand explores an alternative to toxic synthetic textile dyes. The pigments found in some bacteria are biodegradable and friendly to humans, animals and the environment.

Together with scientists Living Colour investigate *optimum growth conditions for bacterial pigments, ways to speed up the growth process and the possibilities of growing bacteria in patterns by subjecting them to sound frequencies.*

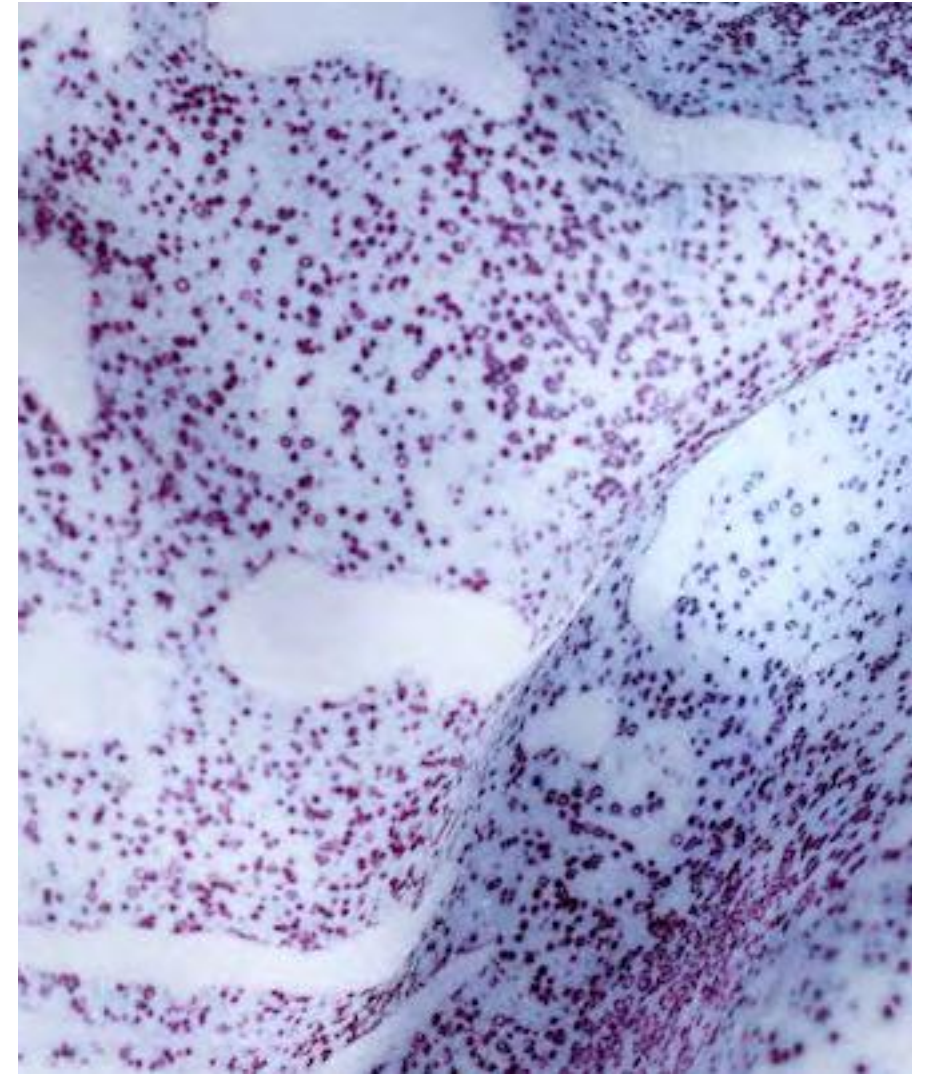


FABER FUTURES

Faber Futures Founder, Natsai Audrey Chieza says “we provide really unique insights for people who are trying to understand what this field is. We help them to map out and build frameworks around sustainable futures as linked to biodesign and biofabrication.”

Faber Futures aims to encourage and accelerate this growing community who look to working with nature rather than merely taking from it.

The company is using bacteria to dye textiles. The team has developed a suite of dyeing methods with a pigment-producing bacteria called **Streptomyces coelicolor**. An organism that produces antibiotics, geosmin (the smell of rain) and gives beetroot its flavour.



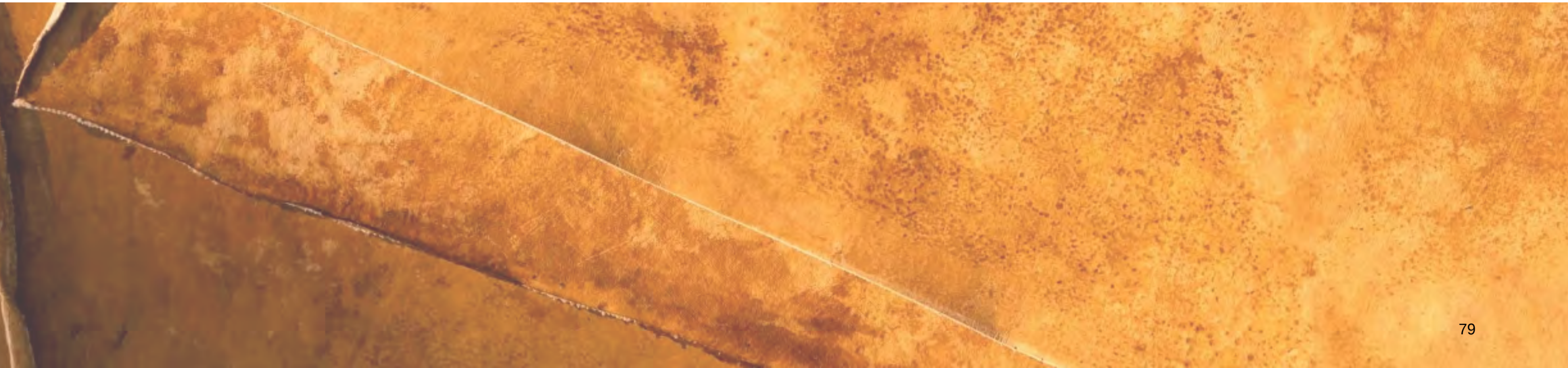
REISHI

Reishi is an innovative materials brand focusing on creating high quality product with Mycelium.

Reishi's woven structure resembles the tight, triple-helix of collagen—it's what inspired their patented Fine Mycelium™ process, which gives material its strength.

Through testing hundreds of samples and protocols at Vartest, one of the world's most respected leather testing houses, Reishi materials shown its breakthrough with biomaterials.

Reishi™ matches the strength and durability of cowhide—the gold standard for leather.



AlgiKnit makes a bio yarn from kelp, seaweed or algae via the readily abundant biopolymer 'alginate'.

“We aim to operate in a *closed loop product lifecycle*, utilising materials with a significantly lower environmental footprint than conventional textiles, to bring sustainable bio-based textile alternatives to the footwear and apparel industries.” via AlgiKnit.com.

AlgiKnit develops biomaterials from the most renewable and fastest growing organisms on earth - **kelp, laminaria digitata** to be precise, a large brown alga also known as oarweed. It grows up to 10 times faster than bamboo and is grown in aquatic farms around the world in coastal communities, often by fishermen and women, thus **providing income** for them during off-season.



NEFFA produces MycoTEX a textile made from mushroom mycelium. Mycelium, the spores of mushrooms, is an incredible material, since it only needs little water to grow, and has the potential to be antibacterial.

With thier Body-Based modelling process NEFFA create garments of this new textile that perfectly fit your body without the need to cut and sew.

Our shorter supply chain eliminates the need for chemicals and pesticides. NEFFA looks to only grow what is necessary and to have no textile waste during the production phase.

And AFTER wearing, can simply burry garment in the ground and it will naturally decompose.



Project AlgaeFabrics envisions algae as a future raw textile material .

Organic organisms of algae are spread globally in the oceans and lakes and are the crucial element in the carbon flux as it **converts large volumes of CO2 to oxygen.**

In places with an excessive growth, algae unwanted and cause problems like worsening water quality and negative effects on local communities.

Cladophora, an algae species we work with, is rich in Cellulose making up to 70% its' content. This makes a great potential to upgrade algae value and apply it in the textile industry through textile yarn.



Singtex product emphasis is on the development of eco-friendly functional textiles, making them one of the leading providers of such eco-friendly functional textiles in Taiwan.

Singtex successfully invented the S.Café® eco-friendly coffee yarn in 2008.

When applied to textile fibers it enhances their functionality without affecting dye performance. No solvents are used in the production process.

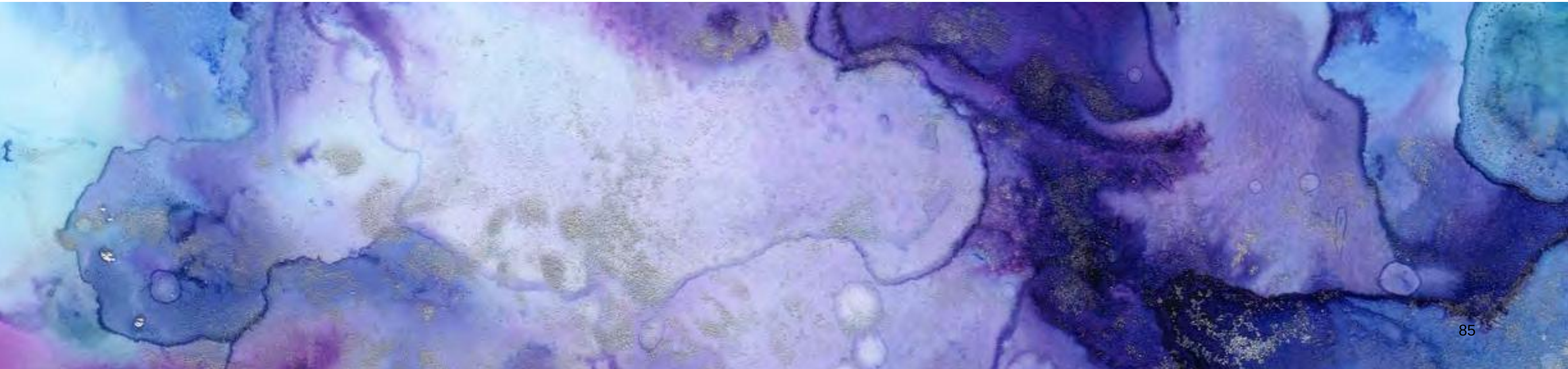
Nor does it require the high-temperature carbonizing treatment of conventional carbonized materials. This reduces CO₂ emissions by around 2.7 kg.



In the TedTalk, Biofabricate by Suzanne Lee, I was enlightened by the ways to use biological life for sustainable approach to future product applications. Fabricating & experimenting with biological growth systems can lead to solutions that make previous manufacturing methods seem illogical. Suzanne speaks upon a fabric she was able to grow with living organisms within a few days that saved a significant amount of resource energy. This would have taken months by our current manufacturing processes. Lee highlights that we shouldn't have to sacrifice resources + health to produce our goods. It is an exciting time because we are just starting to grasp the power of biofabrication & exploration to understand product possibilities.



Lauren Bowker mentions Alexander McQueen as inspiration and he implemented the use holograms to present his ideas. Carbon emissions that changes color to tell you how much air pollution you've absorbed each day. Bowker studies and specializes in additional color-changing compounds responsive to various invisible elements for application in transportation UX, aeronautics, technology, healthcare, retail, textiles & more. Color changing possibilities can create solutions in many sceanrios relating to wearables. Our bodies emit natural heat to each specific activity we do whether its sport, leisure, and even sleep. The ability for wearables to understand and communicate through reactive colors is exciting for the soft goods industry.



BIOPLASTIC



water
corn starch
vinegar
glycerin



BIOPLASTIC PROJECT



Bioplastic earring.

bioplastic was made from water, corn starch, vinegar, & glycerin. this material has a transparent, membrane-like texture. the sheen & organic surface create visual interest for earrings & accessories.



Use scoby for labeling + packaging within sustainable clothing brands.

Using scoby, a bacteria & symbiosis grown culture, for labeling + packaging to find opportunities within sustainable clothing brands. We are able to withdraw from using finite resources & provide a new sustainable approach to labeling + packaging.



In the case of water + washing clothing I would like to collaborate with technological companies like bolt threads in order to develop a waterproof quality for scoby.

Bolt threads is an innovative company that creates bio engineering materials from bacteria as well, but desirable qualities like durability + water proofing.

SCOBY PREP





SCOBY PACKAGING



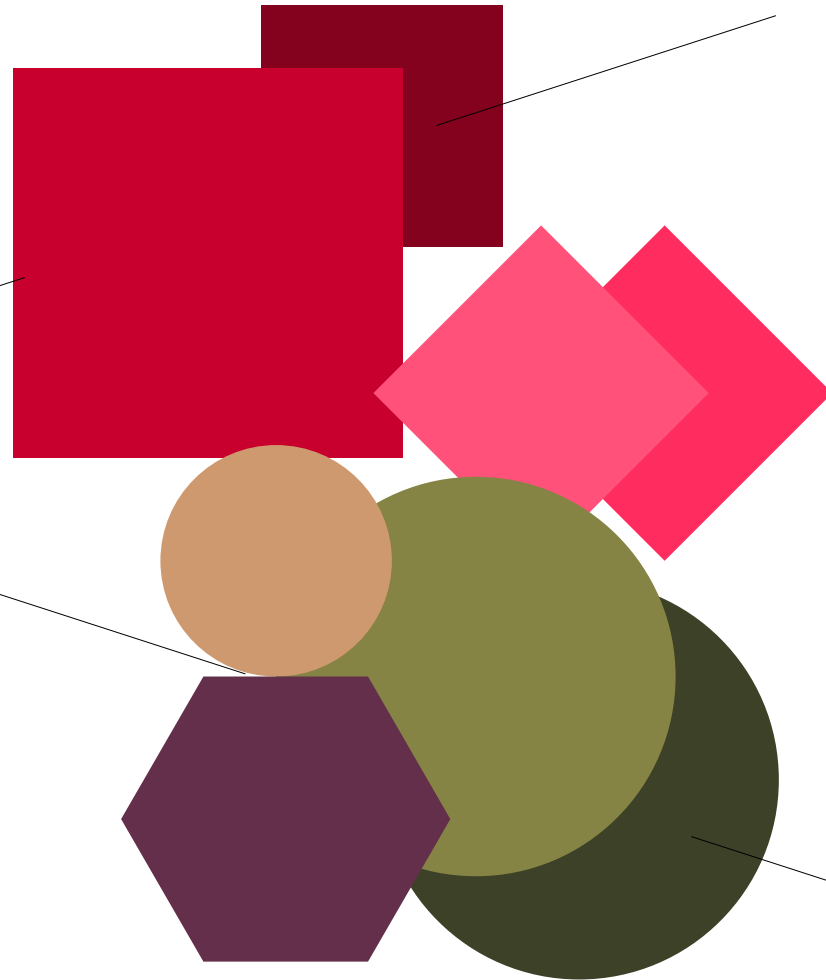
Scoby packaging + branding for sustainability clothings brands.

This can be an incremental initiative for industry awareness.

NATURAL DYES



NATURAL DYES



rose petals



for natural dyes use natural materials themselves
like wools, silk, linens .

common lilac
& crac willow



INDIGO DYE PROJECT



indigo dye face mask.

re-use mask covering nose + mouth.
masks also used to help refrain from touching face.

NATURAL DYES

Orange: carrots, gold lichen, onion skins

Brown: dandelion roots, oak bark, walnut hulls, tea, coffee, acorns

Pink: berries, cherries, red and pink roses, avocado skins and seeds

Blue: indigo, woad, red cabbage, elderberries, red mulberries, blueberries, purple grapes, dogwood bark

Red-brown: pomegranates, beets, bamboo, hibiscus (reddish color flowers), bloodroot

Grey-black: Blackberries, walnut hulls, iris root

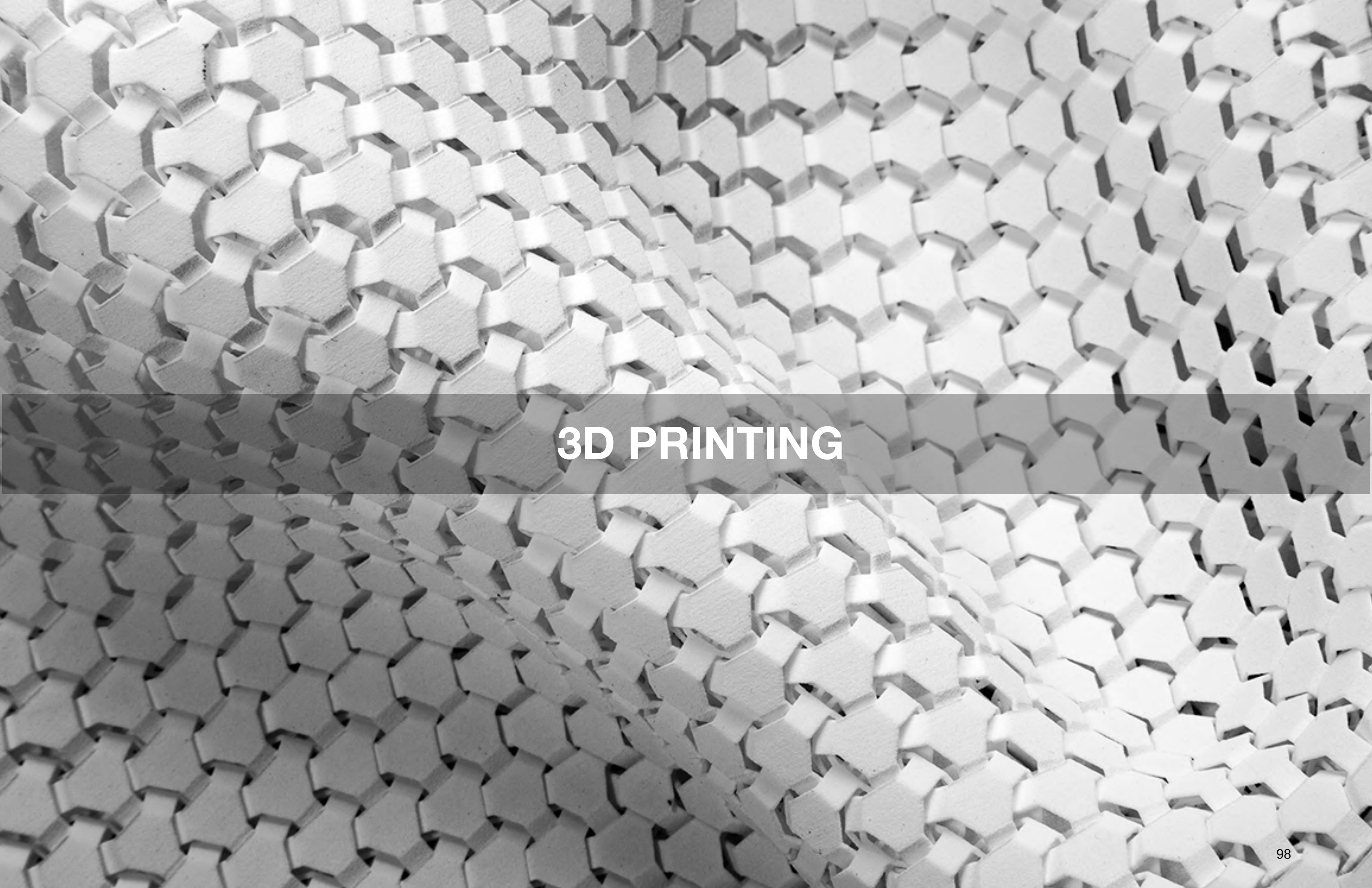
Red-purple: red sumac berries, basil leaves, daylilies, pokeweed berries, huckleberries

Green: artichokes, sorrel roots, spinach, peppermint leaves, snapdragons, lilacs, grass, nettles, plantain, peach leaves

Yellow: bay leaves, marigolds, sunflower petals, St John,s Wort, dandelion flowers, paprika, turmeric, celery leaves, lilac twigs, Queen Anne,s Lace roots, mahonia roots, barberry roots, yellowroot roots, yellow dock roots



CHAPTER 3: DIMENSIONAL SURFACES



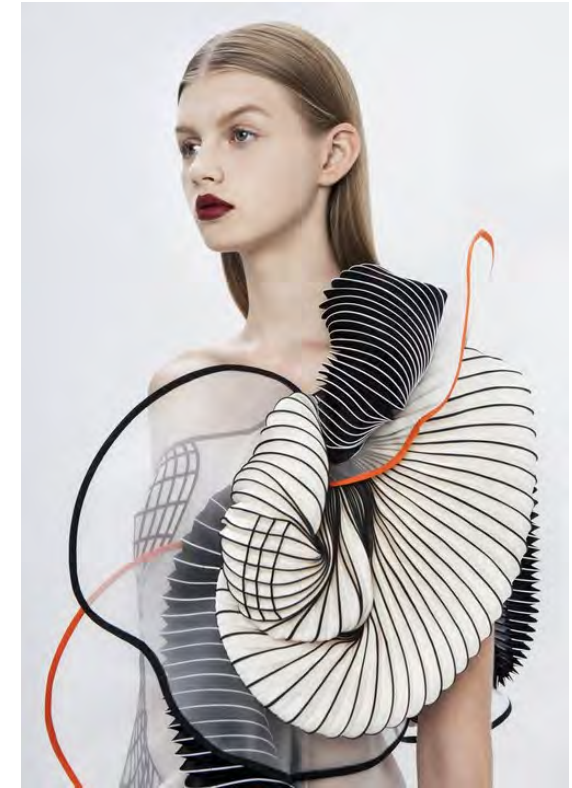
3D PRINTING

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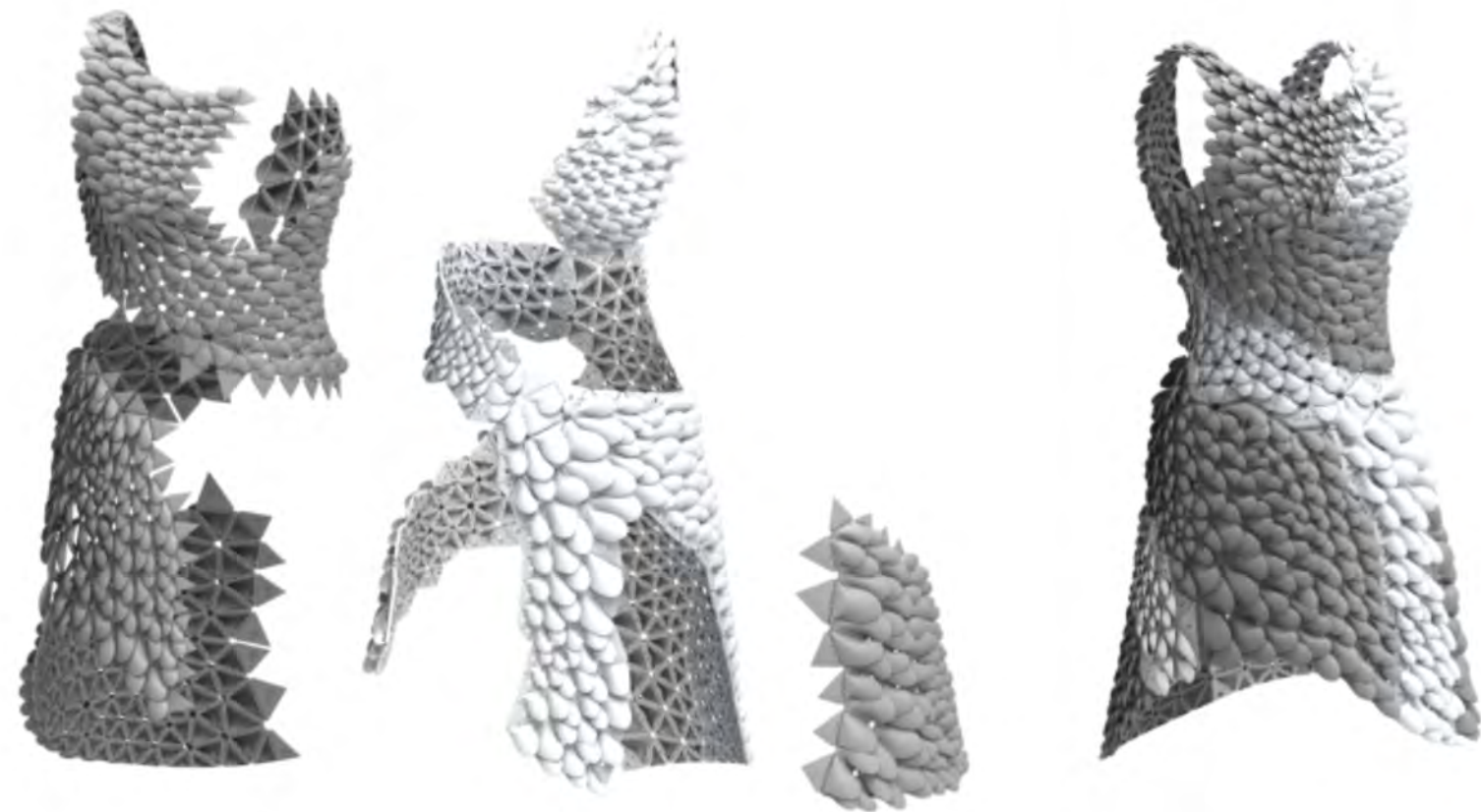
NERVOUS SYSTEM

Jessica Rosenkrantz & Jesse Louis-Rosenberg created **Nervous System** to explore a design approach that relates process and form in a context of interactivity and openness.

“Our inspirations are grounded in the natural forms and corresponding processes which construct the world around us.”

To evolve such forms, we systematically engage in generative processes. Instead of designing a specific form, we craft a system whose result is a myriad of distinct creations.

These systems are interactive, responding both to changes in specific variables and to physical inputs. There is no definitive, final product, instead the many designs created allow for mass customization.



THREEASFOUR

THREEasFOUR's 'Biomimicry' collection explores the way in which biological forms and natural morphologies can be replicated in a fashion context with 3D printing.

The 3D printed dresses were the first demonstration of Agilus30 material from Stratasys, which has extreme flexibility and durability, and represents a big step forward for 3D printed fashion design.

Plants transmute light into life. Human beings transmute life into consciousness and love. These three – light, life, and love – are one, each an expression of the other, three dimensions of the same existence. Unity is the basis of all existence, unity of life is the unity of consciousness

'Human Plant' Collection

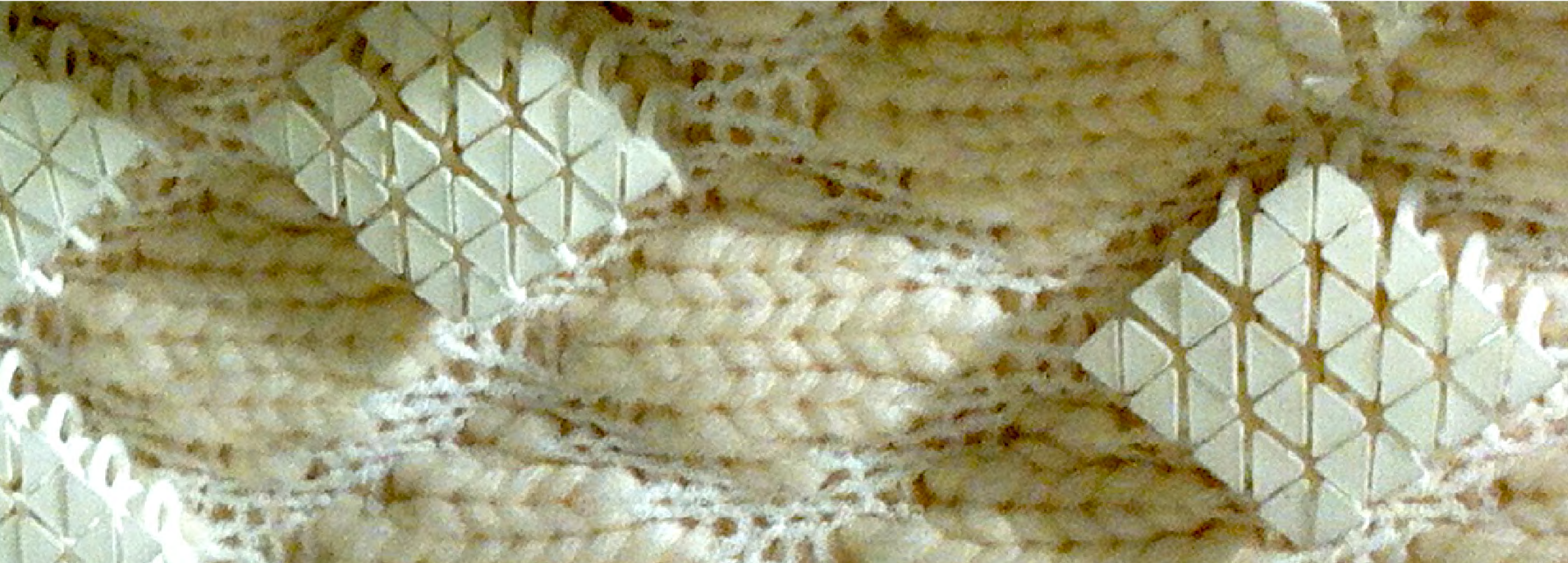
'Biomimicry' collection

PRINGLE OF SCOTLAND

Pringle of Scotland collaborated with material scientist Richard Beckett to create a series of 3D-printed fabrics for the collection using selective laser sintering (SLS).

To produce textiles that could move like traditional cloths, Beckett chose specific machinery that could create the tiny nylon parts needed to keep the material flexible.

"I used an EOS Formiga P100 SLS system due to its ability to build at high definition, one of the few systems that would allow you to build such complex movable parts at this size," Richard Beckett



NABIL EL-NAYAL

Noa Raviv First on the scene in 3D printing was the Syrian-born designer Nabil El-Nayal, who started using 3D printing and scanning techniques in 2009 when it was unheard of in the fashion industry.

“I am researching to understand how we currently use technology and figure out how to disrupt and challenge equipment to do things they were not designed to do”.

“It’s not about adding tech for tech’s sake, but to change and push forward the narrative of fashion.”



Pauline Loctin's PLI.Ē Project is designed the wearable origami costumes.

“Paper can be a fragile material to work with and that is exactly why we decided to make the impossible, possible. No matter which element we would be confronted to, water (rain), wind, we wanted to show that we are limitless.”



Stratsys is the leading global provider of 3D printing and additive manufacturing solutions

Stratasys has been involved in numerous collaborative fashion projects with some of most well-known innovative designers including Neri Oxman, threeasFour, Iris Van Herpen and Julia Koerner and the avant-garde 3D printed fashion pieces have featured at various Paris and New York Fashion Weeks and catwalks.”

Neri Oxman is an architect, designer, and professor at the MIT Media Lab, where she leads the Mediated Matter research group. She is known for 3D printed art and architecture that combine design, biology, computing, and materials engineering.



PROS

rapid prototyping

flexible design

print on demand

strong + lightweight

fast production

minimized waste

cost effective

ease of access

environmentally friendly

CONS

limited materials

restricted building size

non-reliable life of material

design inaccuracy {tolerances in print}

post process [sand, cleaning, rinsing]

printing large volumes stay a constant price.

What is Lacking?

There is still a gap in how 3D printing can be integrated within fashion in our daily wearables. As we see trends in the fashion world flourish in 3D printing exploration, these garments are difficult to visualize in the manufacturing workflow of current brands. However, as Pringle of Scotland integrates 3D printing within wovens it starts to become functional as our daily clothing.

I think what is lacking is the trust in 3D printed clothes. My main questions are:

1 will I be comfortable?

2 will this clothing last?

Getting consumers to trust 3D printed clothes, is a simple direction to embrace

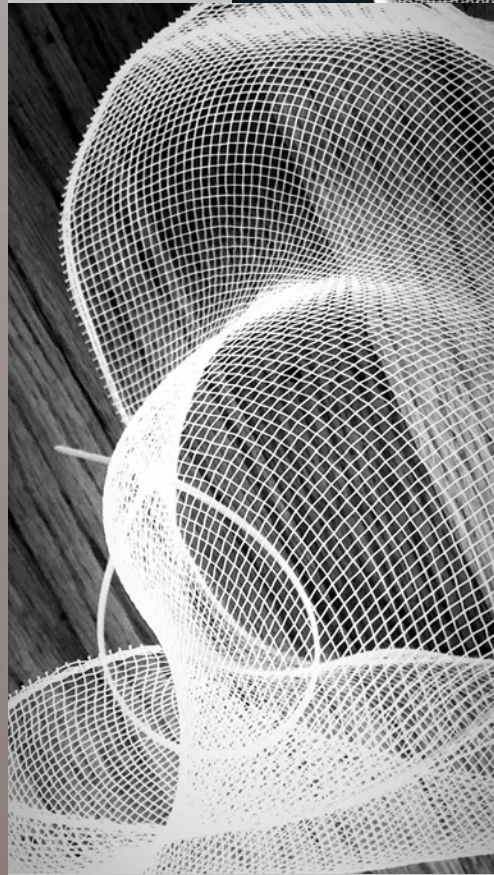


Behnaz Farahi explores the potential of interactive environments & their relationship to the body. She addresses issues towards emotion, bodily perception and social interaction & explores solutions through computational design, interactive technologies, additive manufacturing and digital fabrication. Her work is informed by cognitive philosophy, which is helping people to think about their own mental states, their own existence, through the lens of the cognitive sciences.

Behnaz believes wearables is the extension of ones body. It can provide a way we can change the perception of the world and how we can communicate with one another and our bodily awareness. Farahi works in understanding the human body and the spaces we occupy.

She uses opale techonology that recognizes facial emotions as reaction within material. For example if you smile then I want to smile back, and if you are defensive I want to protect myself. Farahi asks can this idea be implanted in a wearable? So this causes a shift in communication because people around wearable will seei the clothing in defensive state will learn to create space or vice versa wearable in happier state will cause more welcoming communication.





With the limited of materials at our disposal I resontaed with the struc-
ture of buckram.

In a time of social distancing I
wanted to apply the idea of commu-
nication through wearables.

In the hopes that covid-19 will pass,
I believe this wearable can be a
transitional symbol from masks to
our normal state.

The organic forms represent the
expression

I was inspired by Behnaz Farahi's
idea of communicating our emo-
tions through wearables. This form
could communicate the
expression of freedom at a respect-
ful distance.



I used a water-filled ziploc bag for volume.

& a glue gun for the 3D Pen effect.

The dried glue created a storage for small accessories.



CHAPTER 4: WEARABLE TECHNOLOGY

MATERIAL REGROWTH

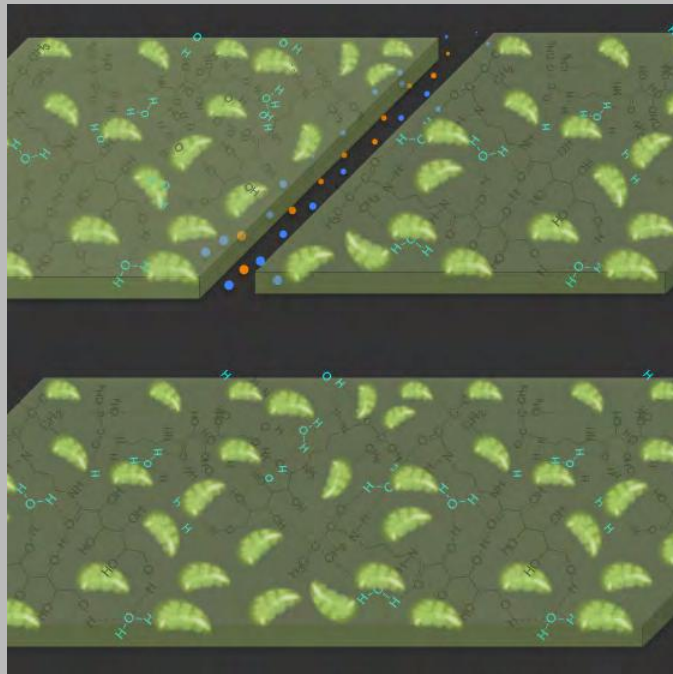


visualizing the future of wearable
technology through re-grown clothing.

inspired by the bamboo mushroom (*Phallus indusiatus*).

self heading smart materials

New MIT-developed technology is Gel-like synthetic polymer with chloroplasts, one of the biological compounds that allow vegetal cells to capture sunlight. The only issue is that this compound is extremely unstable and starts to degrade after a few hours.



MATERIAL REGROWTH

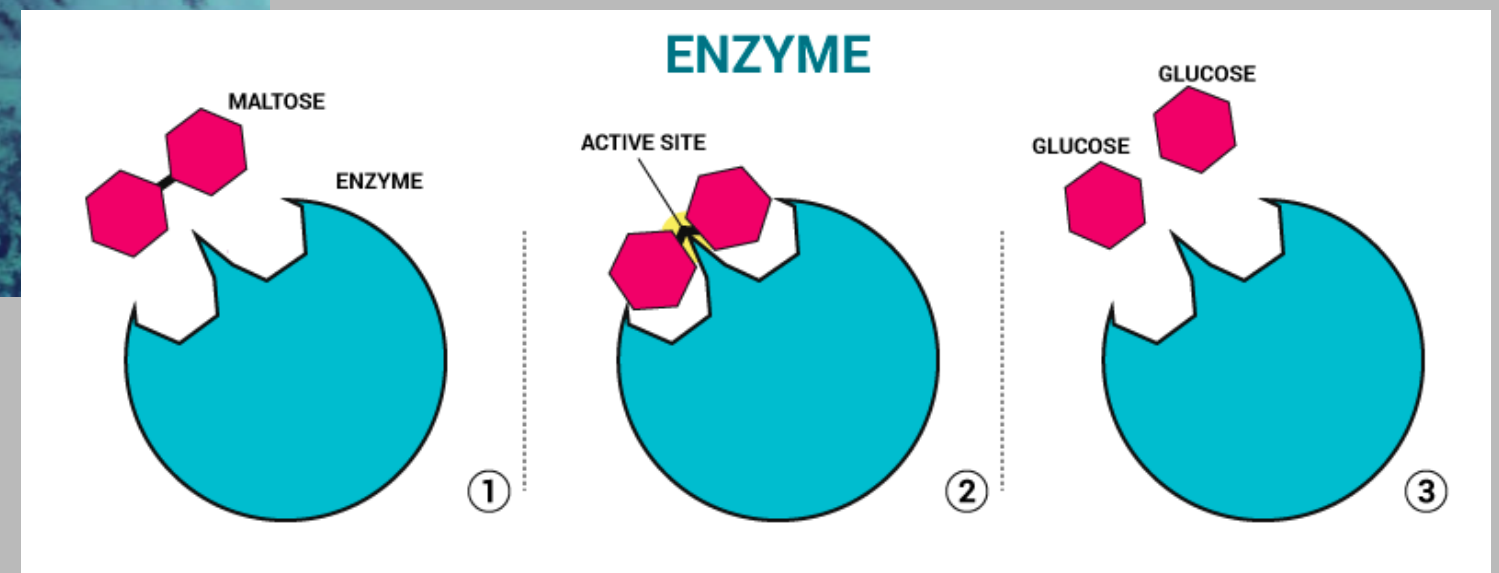


Torn-gear on live television can cost brands money & reputation.

Enzymes are the machines of biological engineering, performing the chemical transformations of the living world. There are hundreds of thousands of enzymes that are relevant to the products

The Ginkgo team used our codebase and domain knowledge to pool together a library of 942 unique enzymes, sampled across enzyme families, ecological niches, and structural homologies.

Because Ginkgo has the capability to search through the broad range of biodiversity that exists, we are able to identify and test enzymes that would not have been found otherwise.



CHAPTER 5: SYNTHESIS



using a combination of 3D PEN + 3D form using buckram, I visualized a future concept shoe.

The idea is having feather-light capabilities for optimized performance.

Getting to as close to a barefoot feel as possible.