

# Why Biomaterials Are So Interesting?

Will Lockett

- Potatoes are made of coal
- Wood is made of plastic
- You don't need a Purpose to make a Plan

- Potatoes are made of coal [ Restructured Organic Inputs ]
- Wood is made of plastic
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[https://archive.org/details/environm  
entpower0000odum\\_u7w5](https://archive.org/details/environm<br/>entpower0000odum_u7w5)

- Potatoes are made of coal [ Restructured Organic Inputs ]
- **Wood is made of plastic** { The Ethico-Aesthetics of Plastic }
- You don't need a Purpose to make a Plan

# Materials

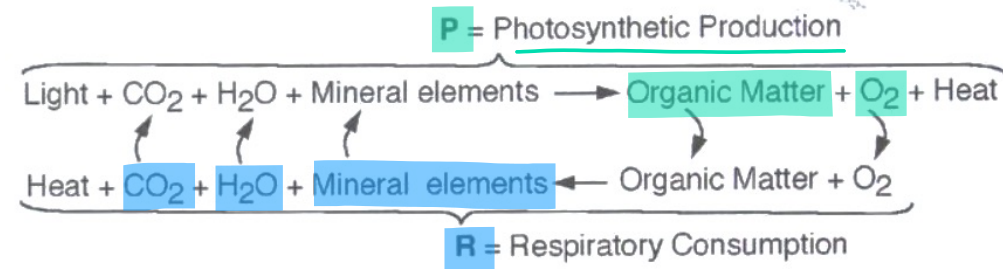
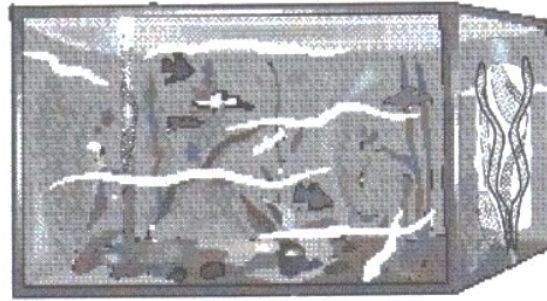
Filter by qualities

Biotumen Racwyn Martyn	Flax fibre Studio RYTE	Wool, Natural dye Claudy Jongstra	Pollution Gaia Darrigo	Giant hogweed Atelier Schaft	Microalgae, Wood powder Laura Bordini	Lignin, Cellulose Basse Stiltgen	Slime mould Tahiya Hossain	Beeswax Unknown	Pineapple leaves Nathalie Spencer	Microgreens, Agar Raquel Ruiz-Fernández	Pineapple waste Andrea De la Peña	Coffee waste Zhekai Zhang	Posidonia oceanica Francesco Cantini	Mycelium Biobased Creations	Beetroot Katlijn Westland	Eggshell Sibel Chen	Mycelium Caracara Collective	Salt Atelier LUMA, Katlijn Sibbel
Amacazo Color Amazonia	Himalayan balmam Sophie Ferrier	Algae Margarita Talep	Shell, Kelp Valparaiso Makerspace	Rockweed Jeanmet Leenderse	Japanese knotweed Alaa Abu Asad	Jute Alexander Marinus	Lichen, Wool, Cotton Mint-Luijmes	Lupine fibre Eflasmibjan	Cotton waste Austėja Platūkytė	Mycelium Loop Biotech	E-Waste glass Fornace Brioni, Snehetta, Studi...	Agricultural waste Katya Bryskina, SPACE10, Tom...	Cyanobacteria Alejandra Orjuela	Ochre, Gelatine, Glycerine Soowon Chae	Eelgrass Studio Kathryn Larsen	Japanese knotweed Maswell Fertik	Milk The Old Fashioned Milk Paint Co.	Bark Lewis Duckworth
Soil Natural Earth Paint	Food waste Odeya	Body fluid Cristina Deste	Castor oil Estalio Rain	Food waste Ricardo Cenedela	Hemp residue LOVIN	Figue Rosana Escobar	Cellulose Racwyn Martyn	Egg Vera Gulkers	Soil, Seeds Adi Segal, Danny Freedman, EL...	Wood Buro Belén	Corn husk, Corn cob Aplada Vorechart	Tree bark Evelina Kudabate	Celery, Chard Katie Lubbers	Cassava starch, Cardboard waste Teodora Rava	Repurposed fiberglass resin An atelier of other	Mycelium Mogu	Soil Lucie Ponard	Tree bark Lucia Kenny
Caruba palm Diction	Gelatine powder Sankini Gupta	Human hair Anna Ilyas	Bacteria Laura Bonetton	Ceramic, Coffee ground Sara Baptista de Silva	Algae Mariss Melissas	Hutullo Color Amazonia	Indigo Kaia Chauhal	Gelatine, Glycerine Zuzma Yagmur Cetiner	Mycelium Officina Compositioli	Mussel shell LABIVA	Milk The Old Fashioned Milk Paint Co.	Pine needle Gaerik MJK Wall	Scoby June Fox	Avocado Grisa Dreize: Facchinato	Trainers Goertjan Splink	Poppy seeds Diction	Recycled clay, Recycled plastic Claire Ellis	Seawater Rain Wu
Bacteria Vienna Textile Lab	Milk Tessa Silva	Chewing gum Bianca Storch	Scoby Ash Hastipogu	Blue elf cup Liene Kazaka	Oyster shell Franklin St. Studio	Cyanobacteria Cintia Ferrati	Mycelium BioDigital Matter Lab	Onion peel Madra	Orange peel, Tea leaves Kikkis	Cardboard waste, Paper waste HONEXT	Seashell Studio Mikura	Silk Linda Nurk	Ceramic waste Hanneke de Leeuw	Clay Estudio Mameuca	Clay Kate Studley	Salisy Marco Federico Cagnoni	Seashell Hors-Studio	Hemp, Microgreens Yi-jing Chen
Mycelium Marta Pita Guerreiro	Coconut husk Poia Salicúa	Wood Fait Grown	Morning glory, Bindweed Franklin St. Studio	Soil Emy Bendsorp	Sugar Yasine Ben Abdallah	Silkworm cocoon Marlene Huisoud	Ceramic waste Cooper Wray Siegel	Scoby Rina O	Recycled plastic Bureau Baggerman, Jessica den...	Flower Elena Renée Pereira	Algae Daniel Elkayam	Banana fibre Green Banana Paper	Chontaduro Color Amazonia	Rabbit skin Diction	Algae Randa Kherba	Pine sawdust, Sodium alginate David Cabra	Clay, Organic matter Urban Reef	Chicken waste Giuseppe Abate
Cardboard EveryOtherDay	Recycled plastic Coline Le Quenven	Cow intestine Studio KBB	Walnut Natural Earth Paint	Composite Martina Taranto	Dandelion Daisy Newdick	Sucrose Silke Weilbach	Fish skin Paula Martin	Phytoplankton Luis Undritz	Maqui tree LABIVA	Fungus Jesse Adler	Human hair Antonin Morign	Human hair Oksana Bondar	Mycelium composite Johanne Hestvold	Flax CQ Studio	Prickly pear Martina Taranto	Latex Magdalena Sophie Orland	Building waste Majra Deberg Alencar	Cattle intestine, Pig bladder Tobias Trübenbacher

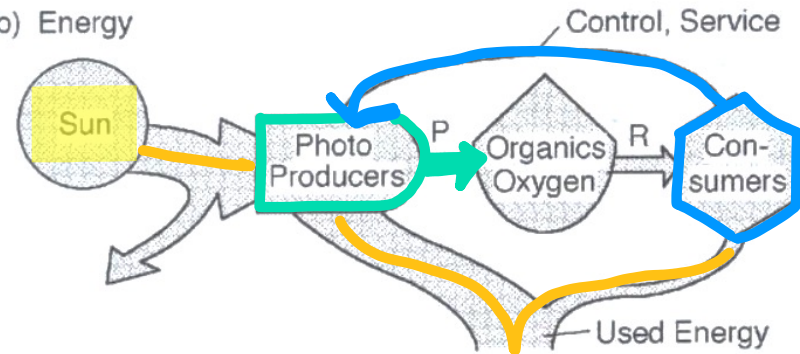
- Potatoes are made of coal [ Restructured Organic Inputs ]
- Wood is made of plastic { The Ethico-Aesthetics of Plastic }
- You don't need a Purpose to make a Plan // Niche Formation //

# [ Restructured Organic Inputs ]

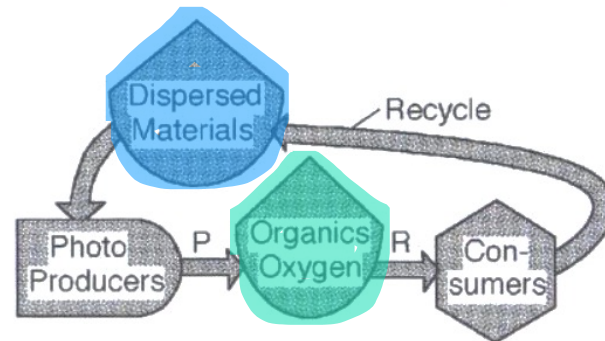
(a) Balanced Aquarium



(b) Energy



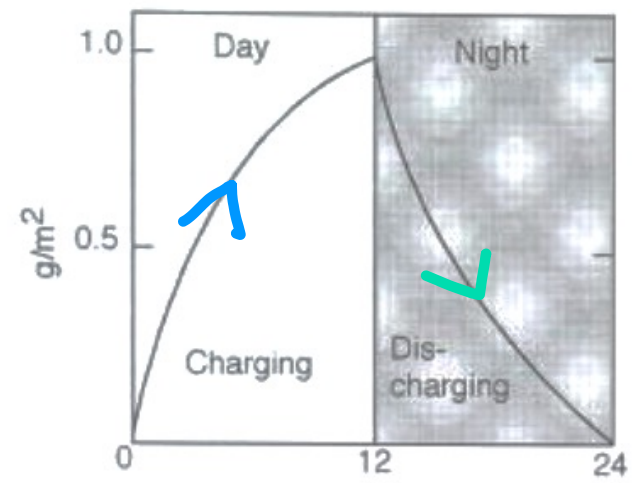
(c) Materials



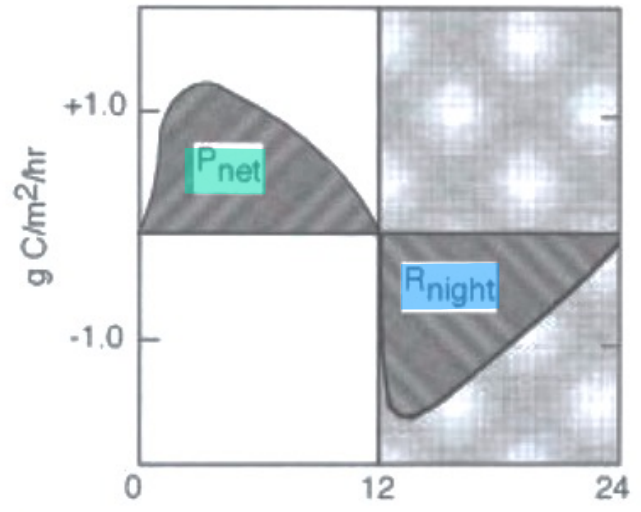


[ Restructured Organic Inputs ]

(a) Labile Biomass Stored



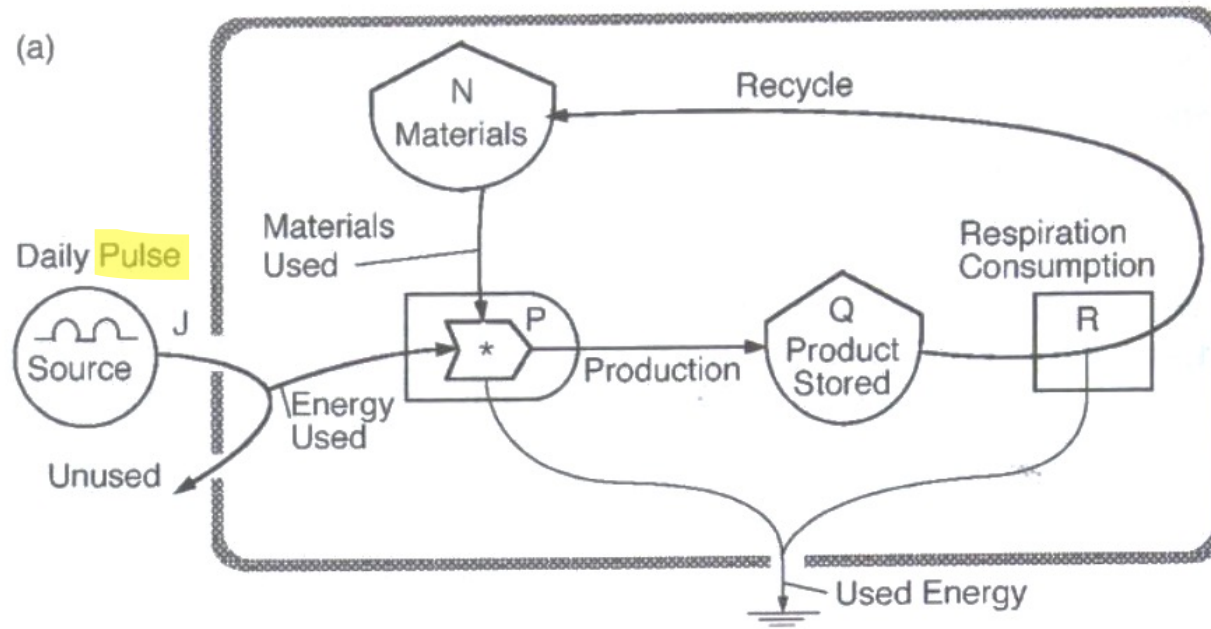
(b) Metabolic Rate



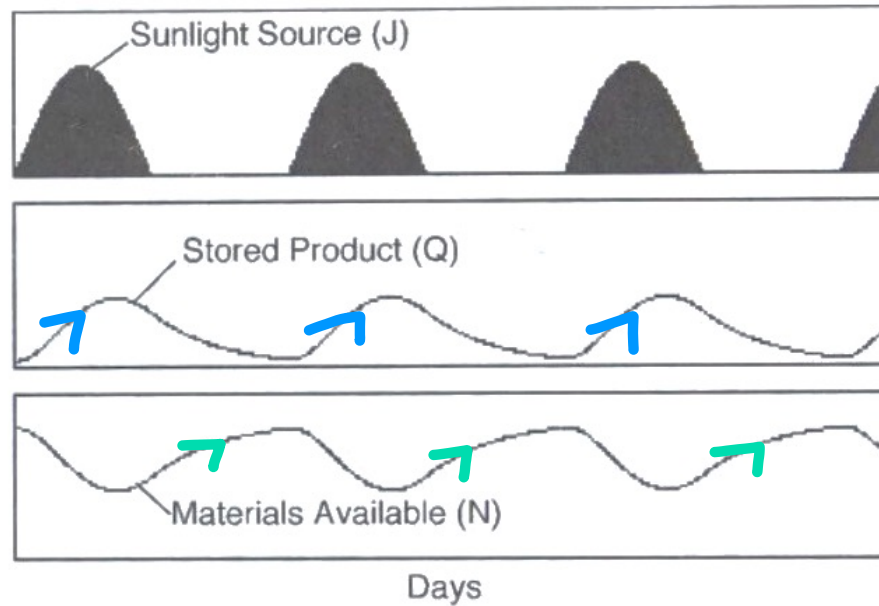
(c) Input



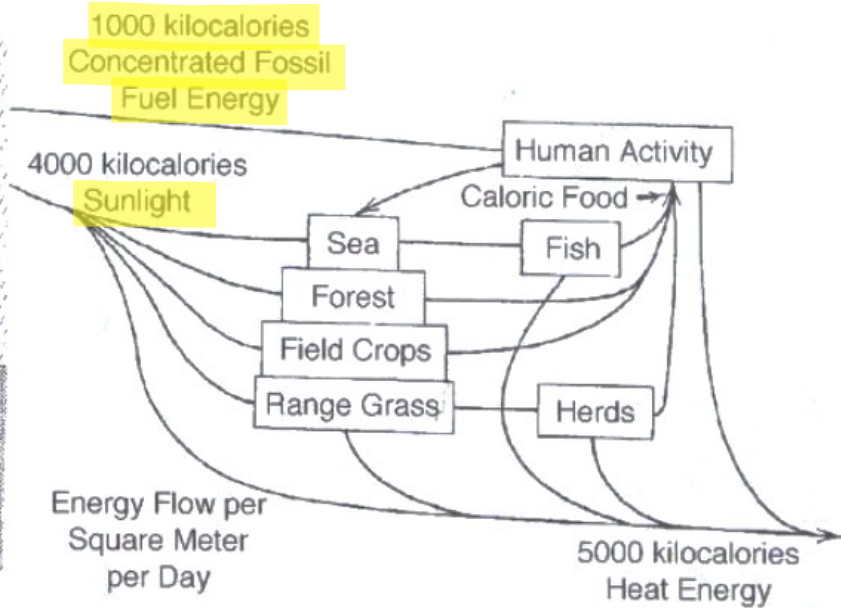
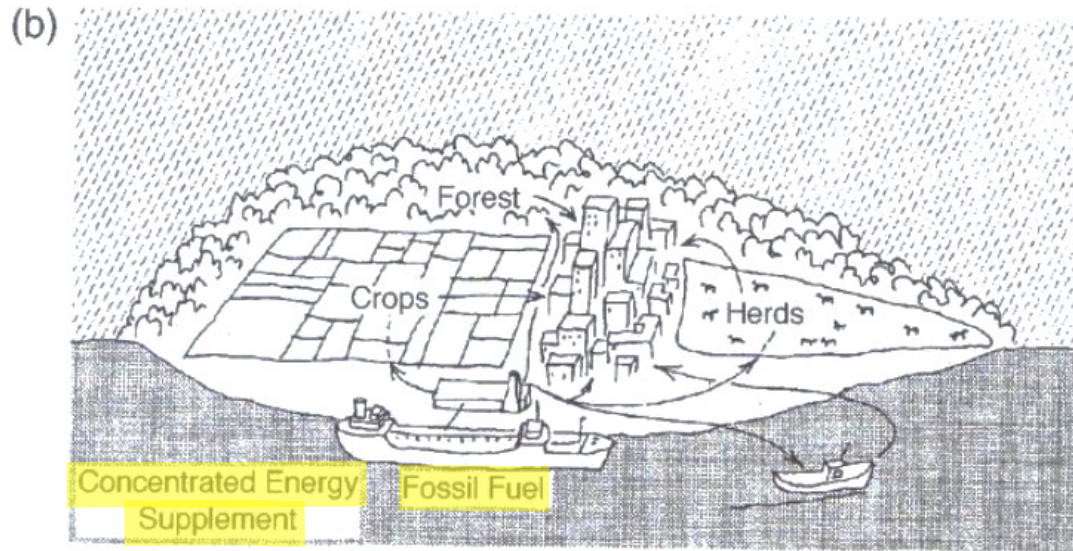
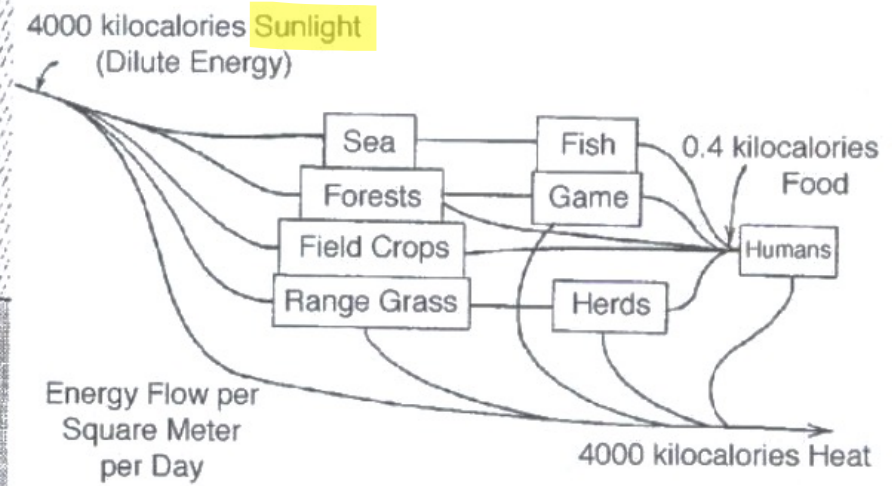
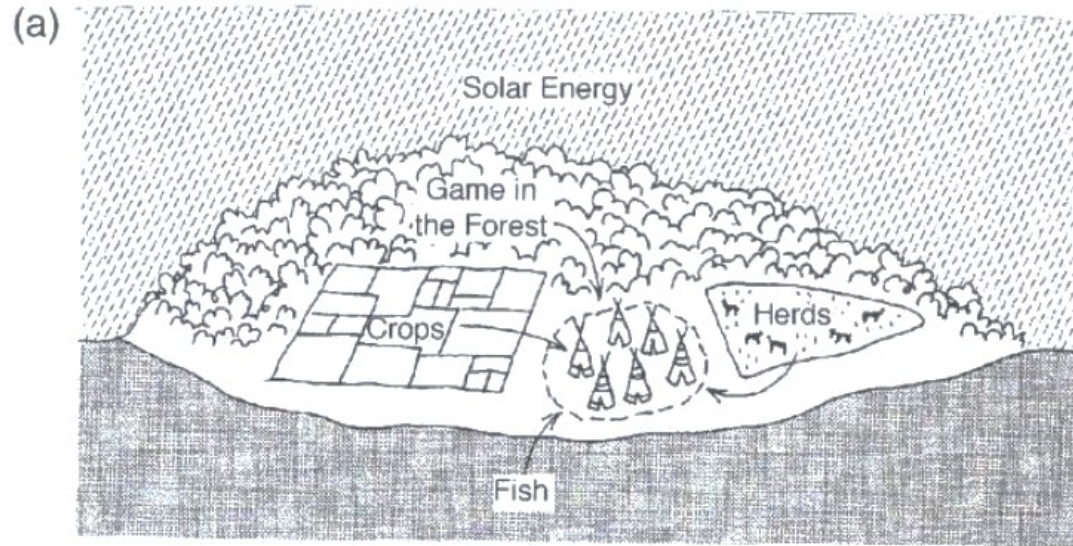
# [ Restructured Organic Inputs ]



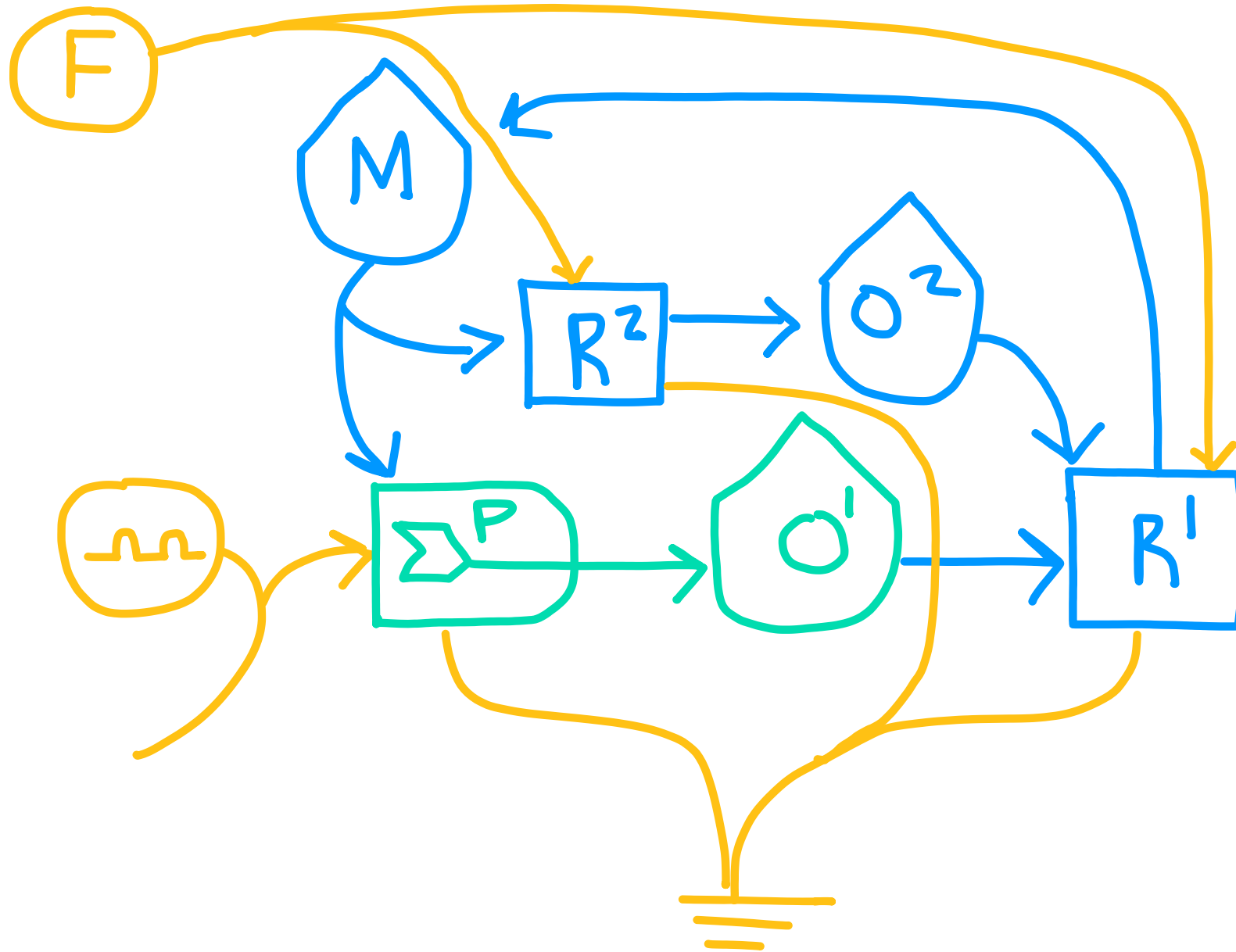
(b) Computer Simulation



# [ Restructured Organic Inputs ]

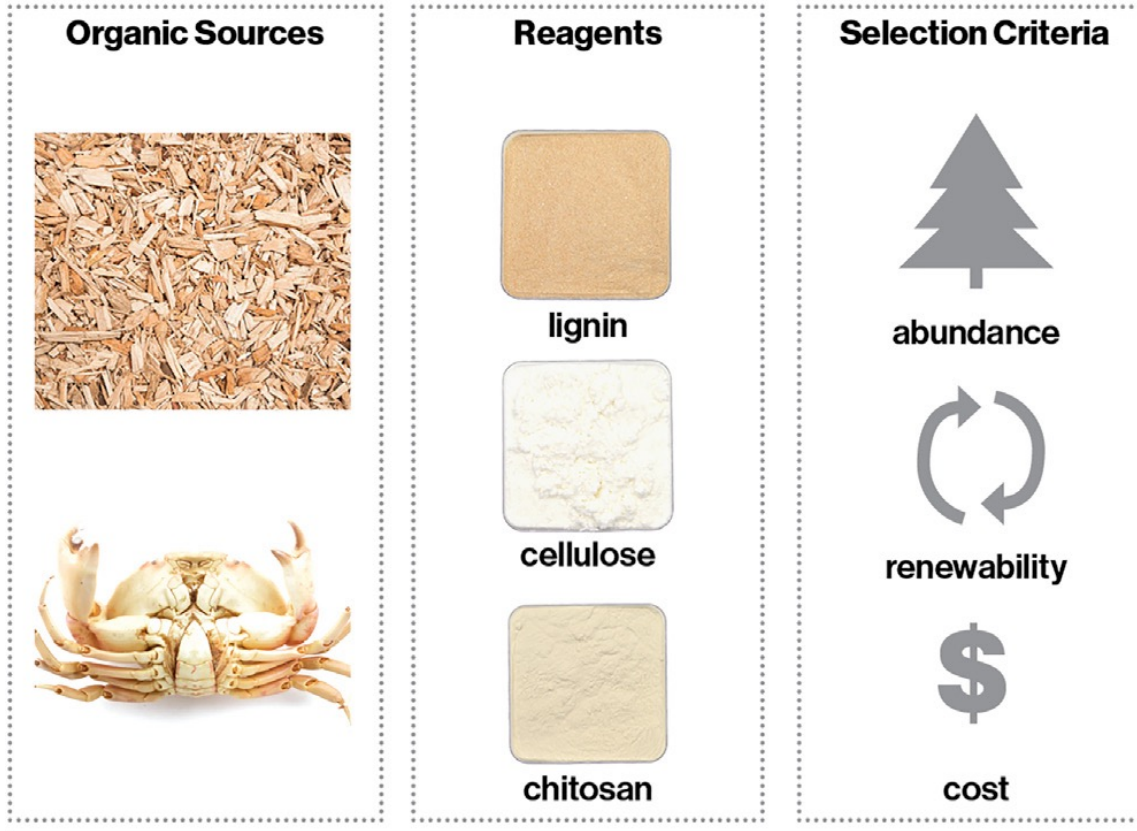


[ Restructured Organic Inputs ]



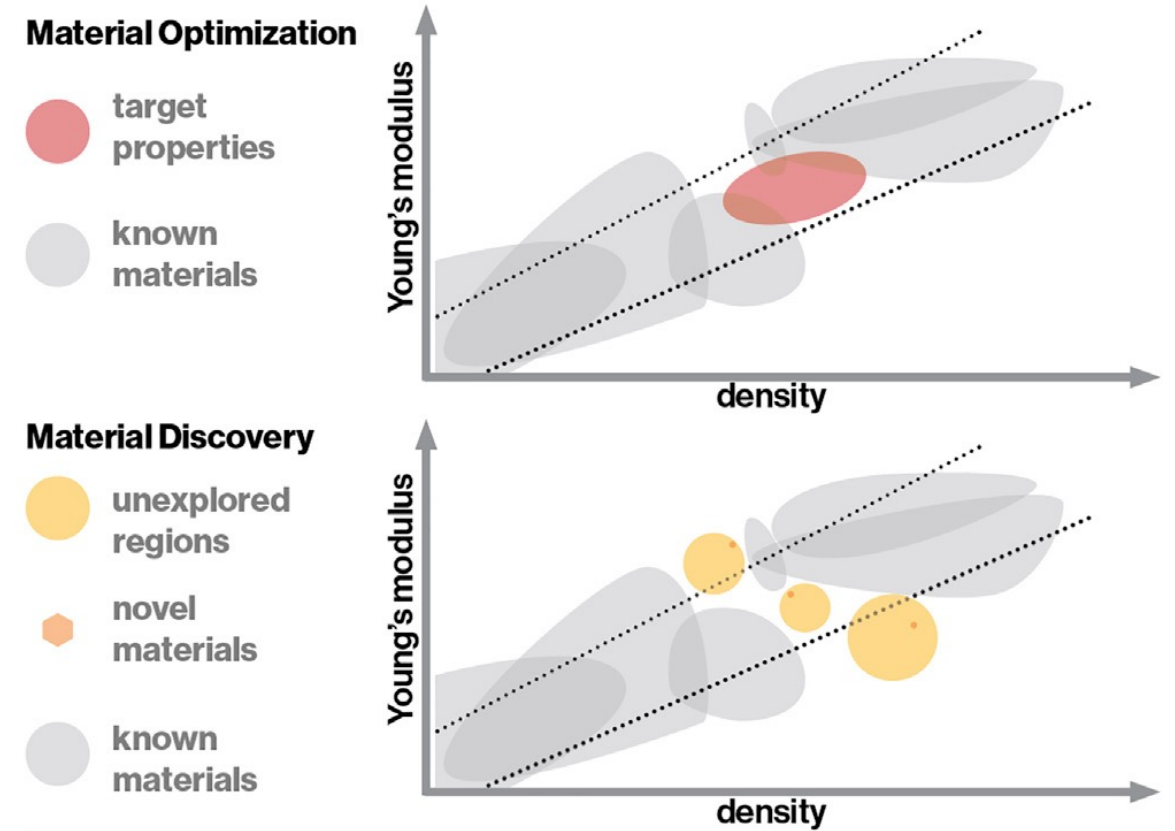
# Material and Goal Selection

A



source material selection

B



experiment goals

[https://www.cell.com/matter/fulltext/S2590-2385\(22\)00590-2](https://www.cell.com/matter/fulltext/S2590-2385(22)00590-2)

Lee, Shen, Buehler, "An automated biomaterialomics platform for sustainable programmable materials discovery," *Matter* (2022)

# Hydrogel Mixing

A

Reagents



a. lignin



b. cellulose



c. chitosan

Input Ratio

A  
[X%]

B  
[Y%]

C  
[Z%]

experiment goals

formulation

A

B

C

B

Homogenization

hydration

blending

mixing

biocomposite hydrogel

X% A

Y% B

Z% C

C



component selection

homogenization

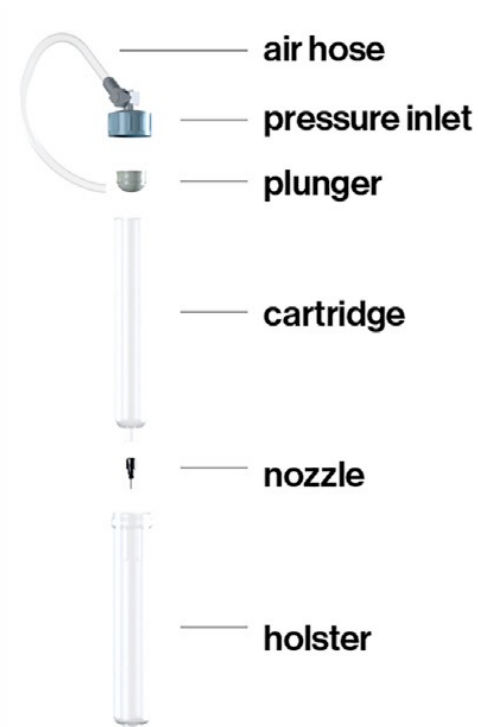
loading and preparation

# Fabrication

A



B



tensile



compressive

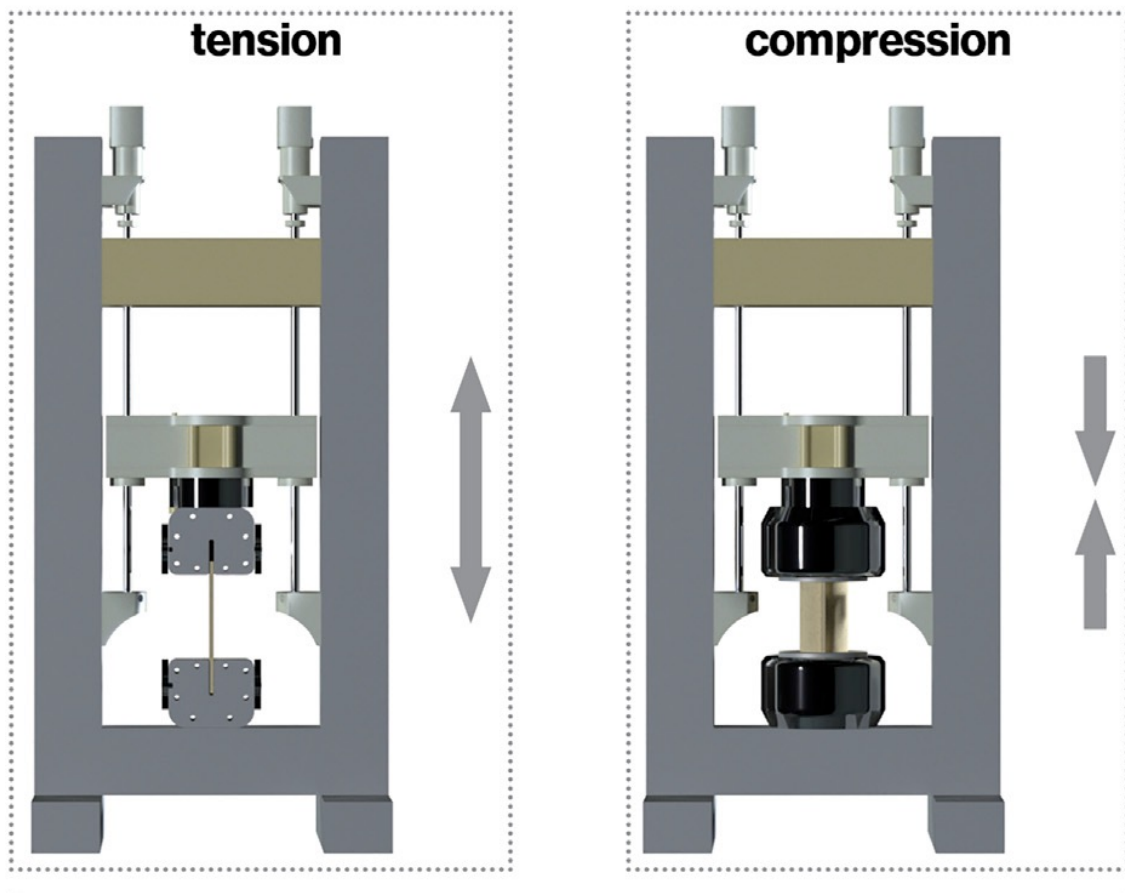


**additive manufacturing system**

**test geometries**

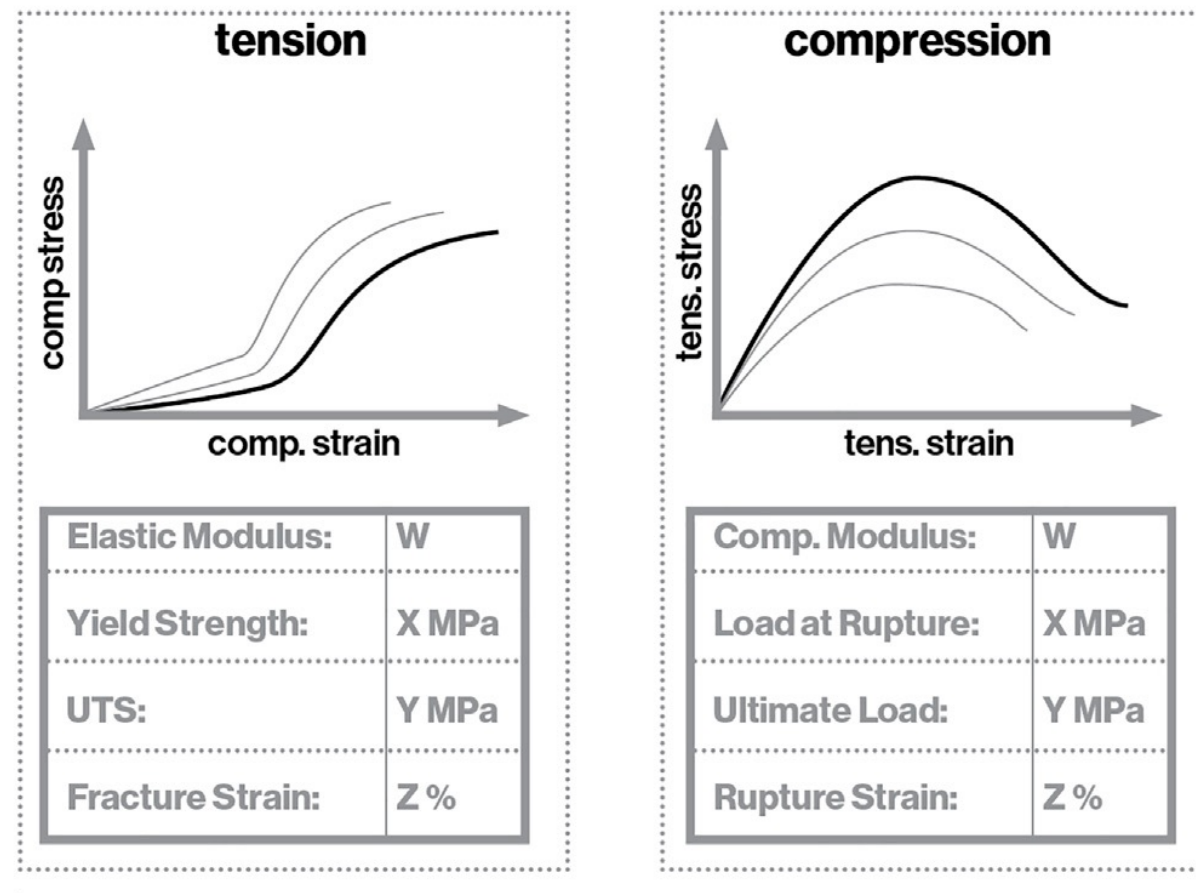
# Mechanical Testing

A



testing equipment

B



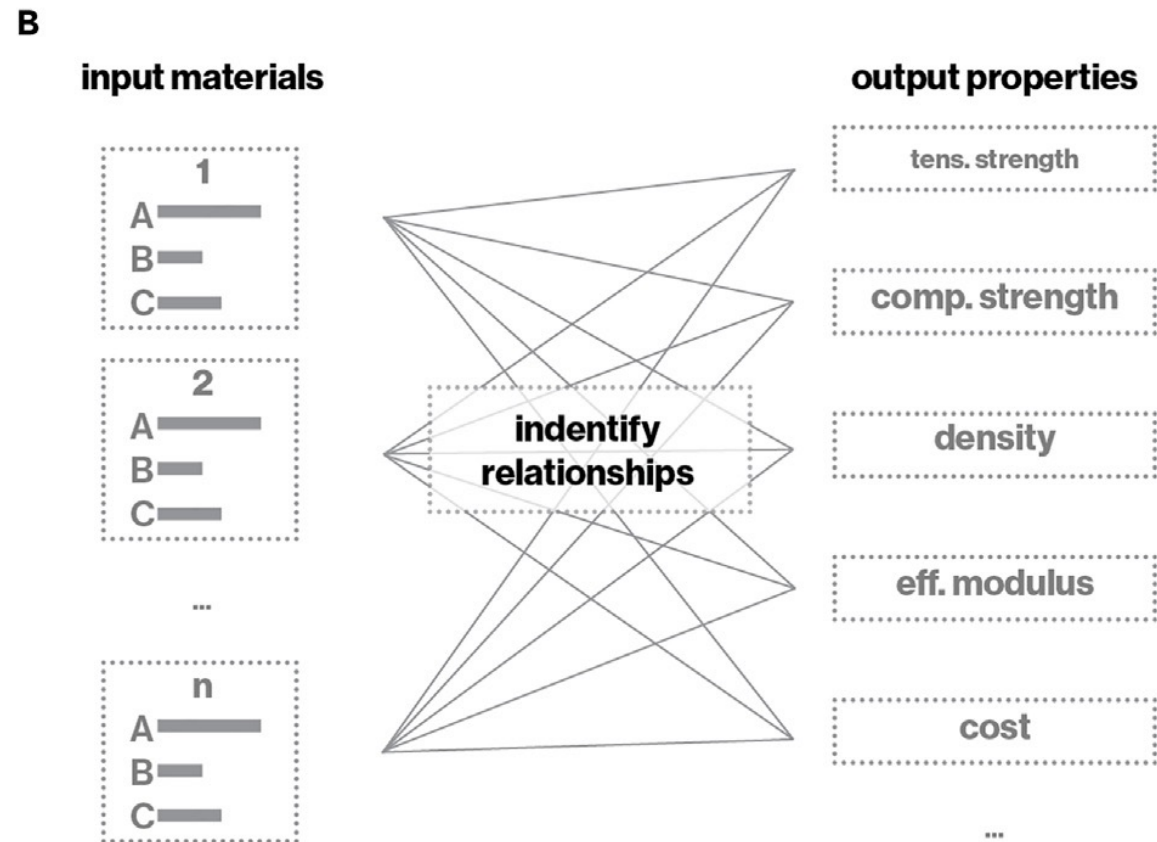
output data



# Modeling and Experiment Selection

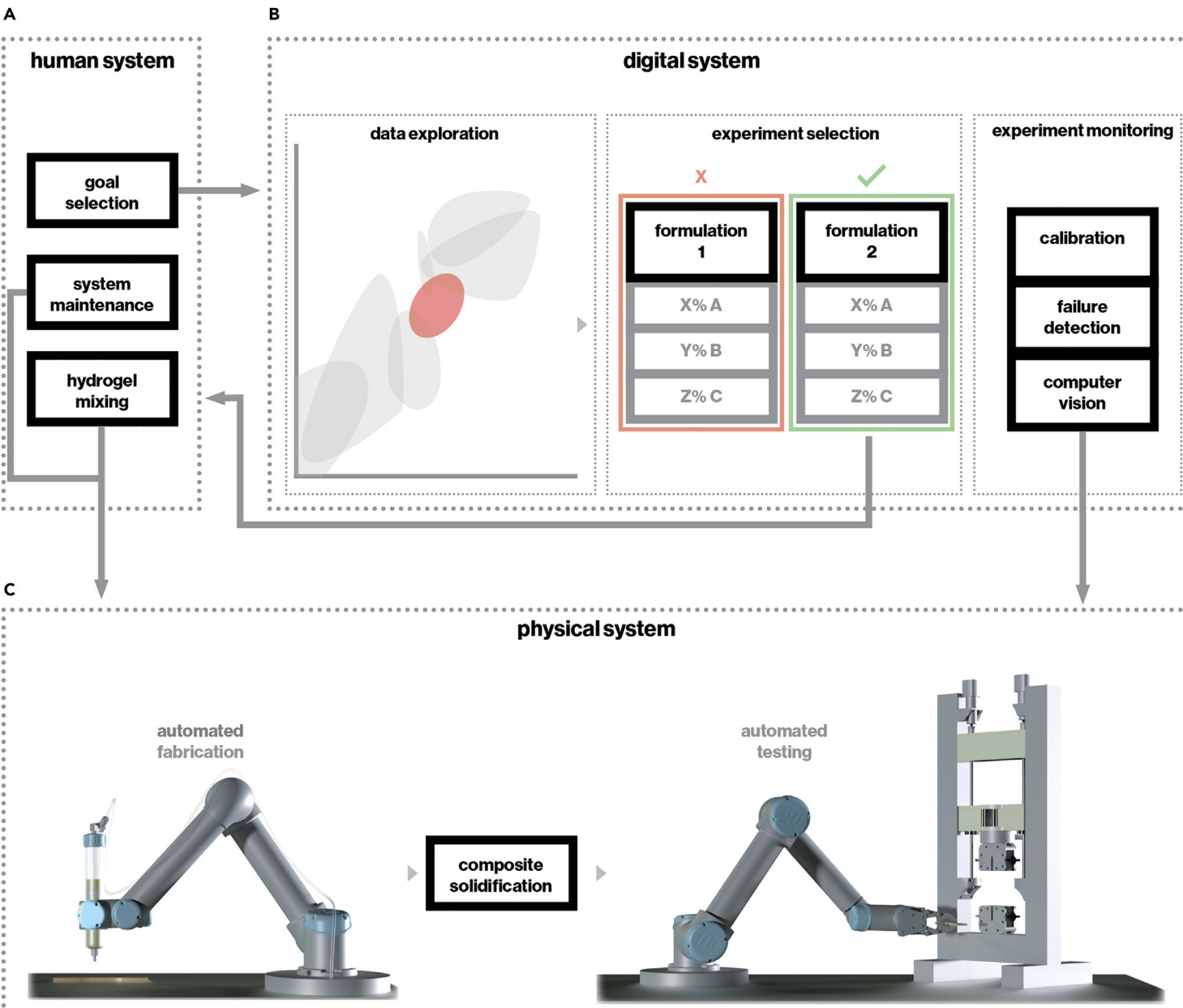


**data exploration**

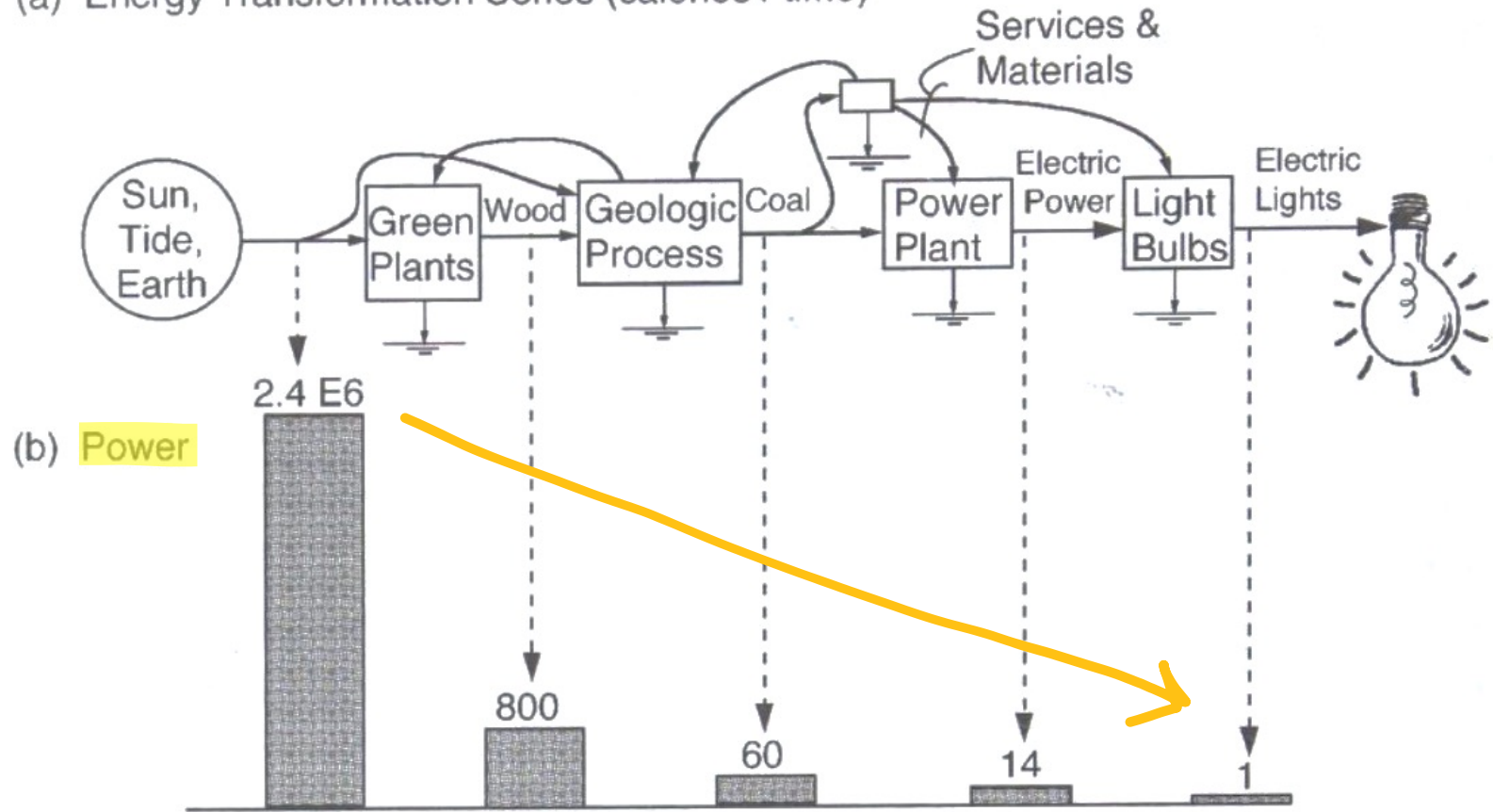


**modeling**

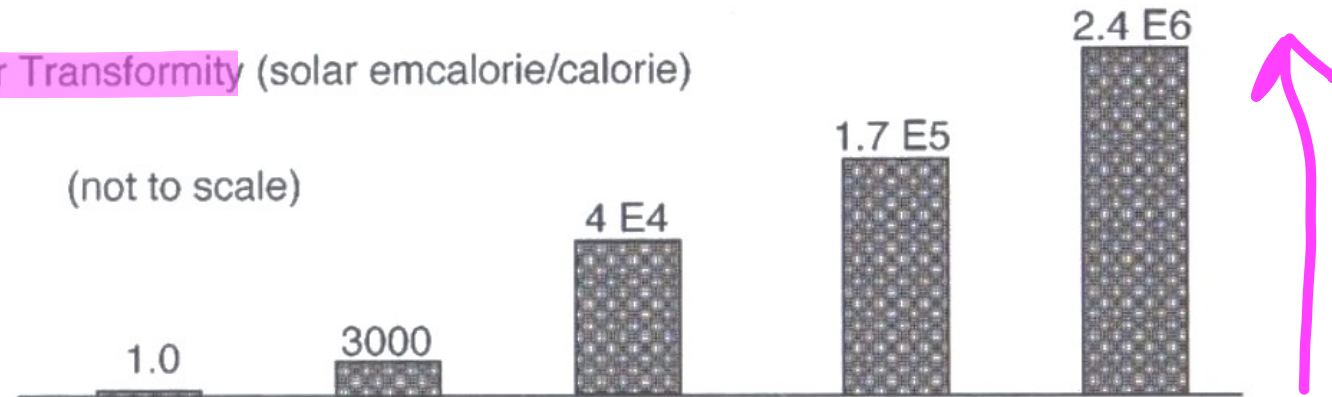
# Automated Fabrication and Characterization



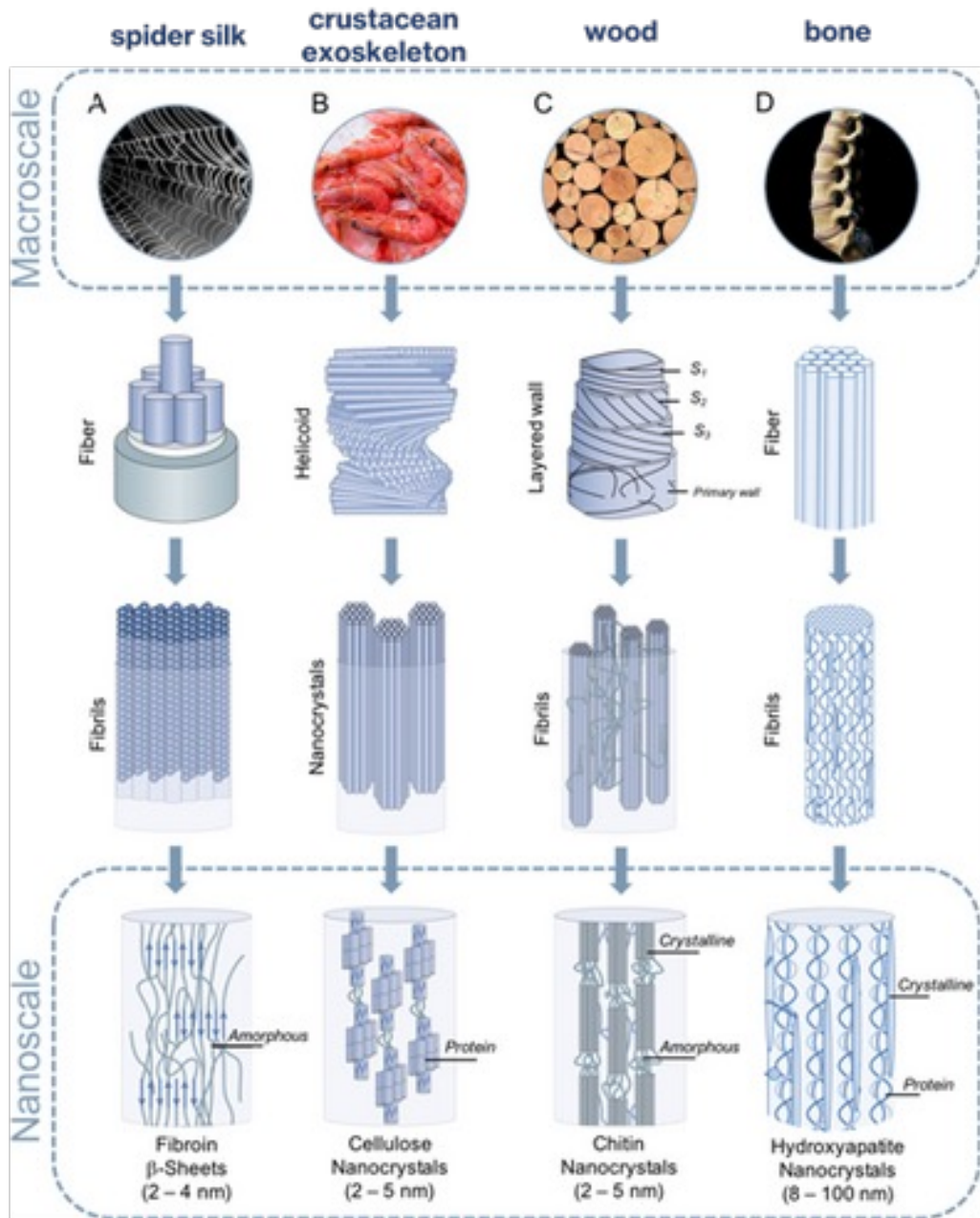
(a) Energy Transformation Series (calories / time)



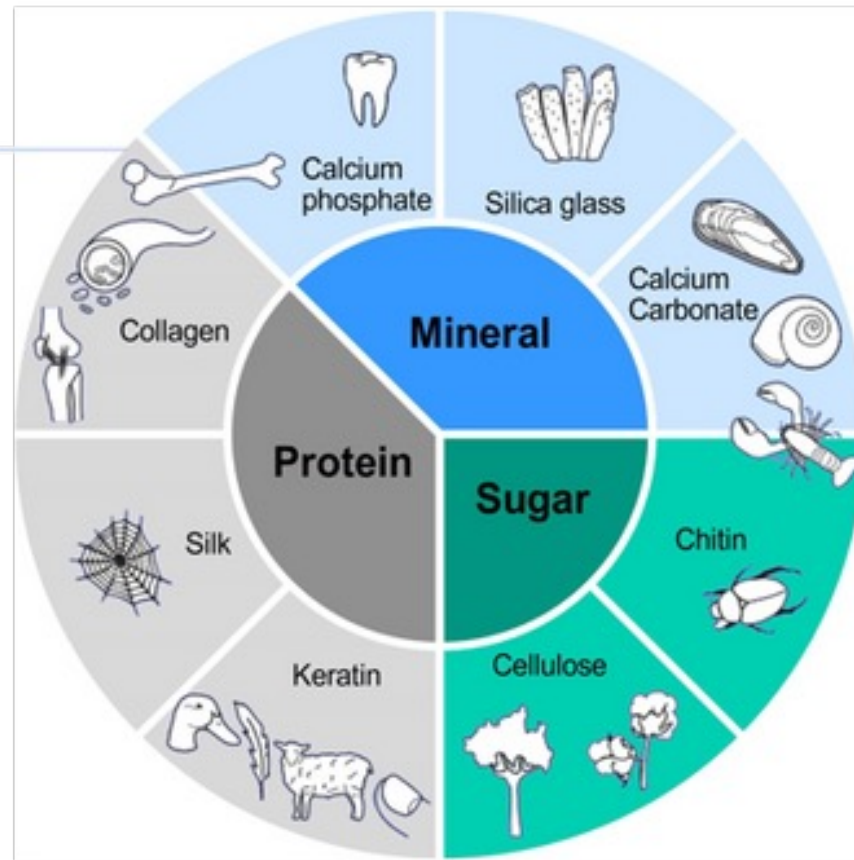
(c) Solar Transformity (solar emcalorie/calorie)



### a Examples of Hierarchical Biological Materials

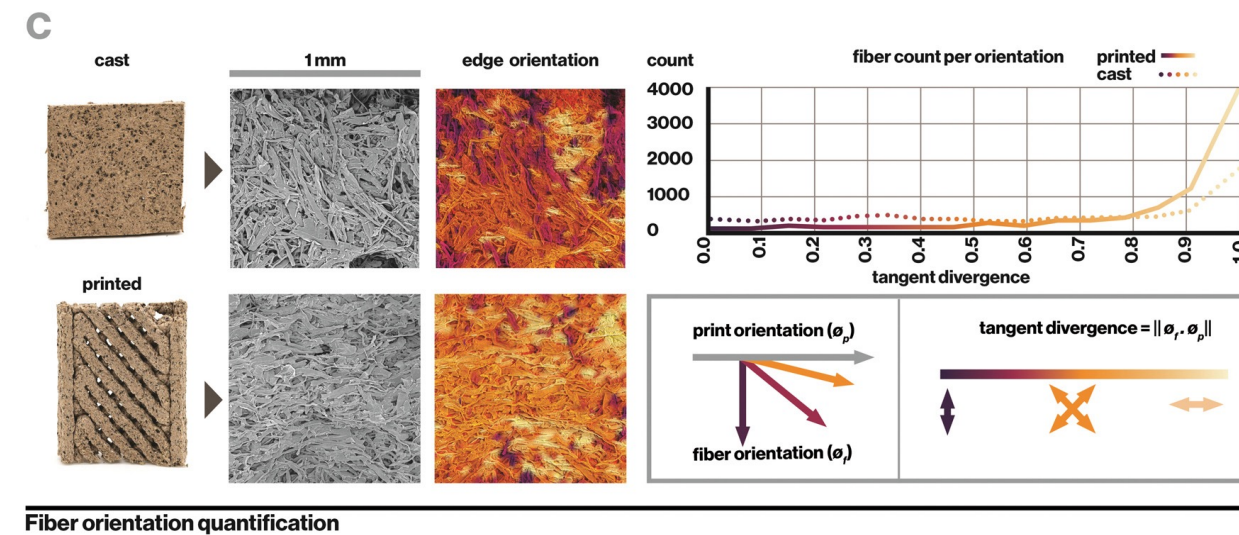
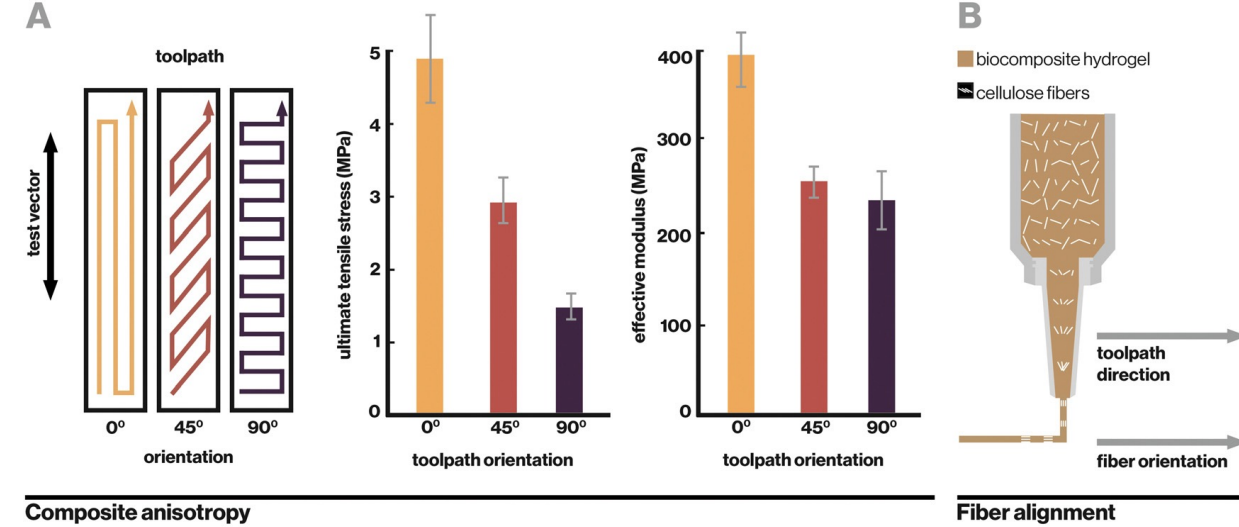


### b Compositions of Biological Materials

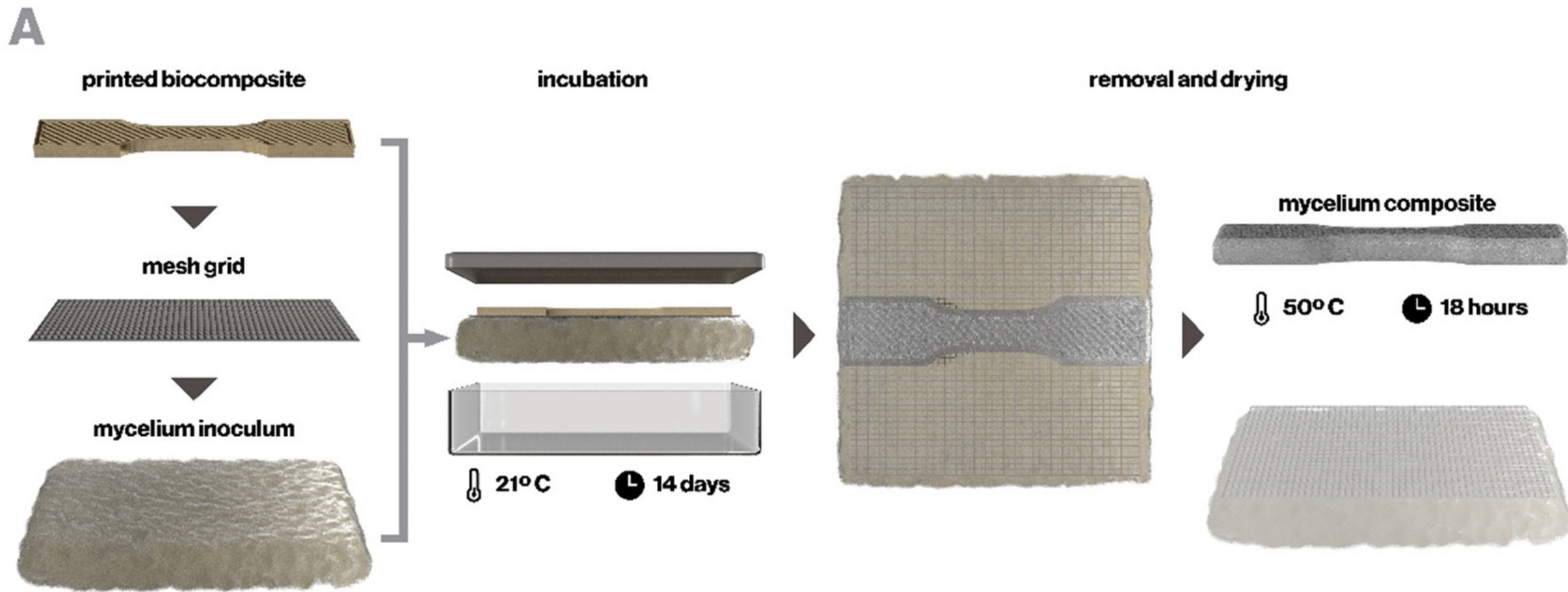


### c Universality-Diversity Paradigm

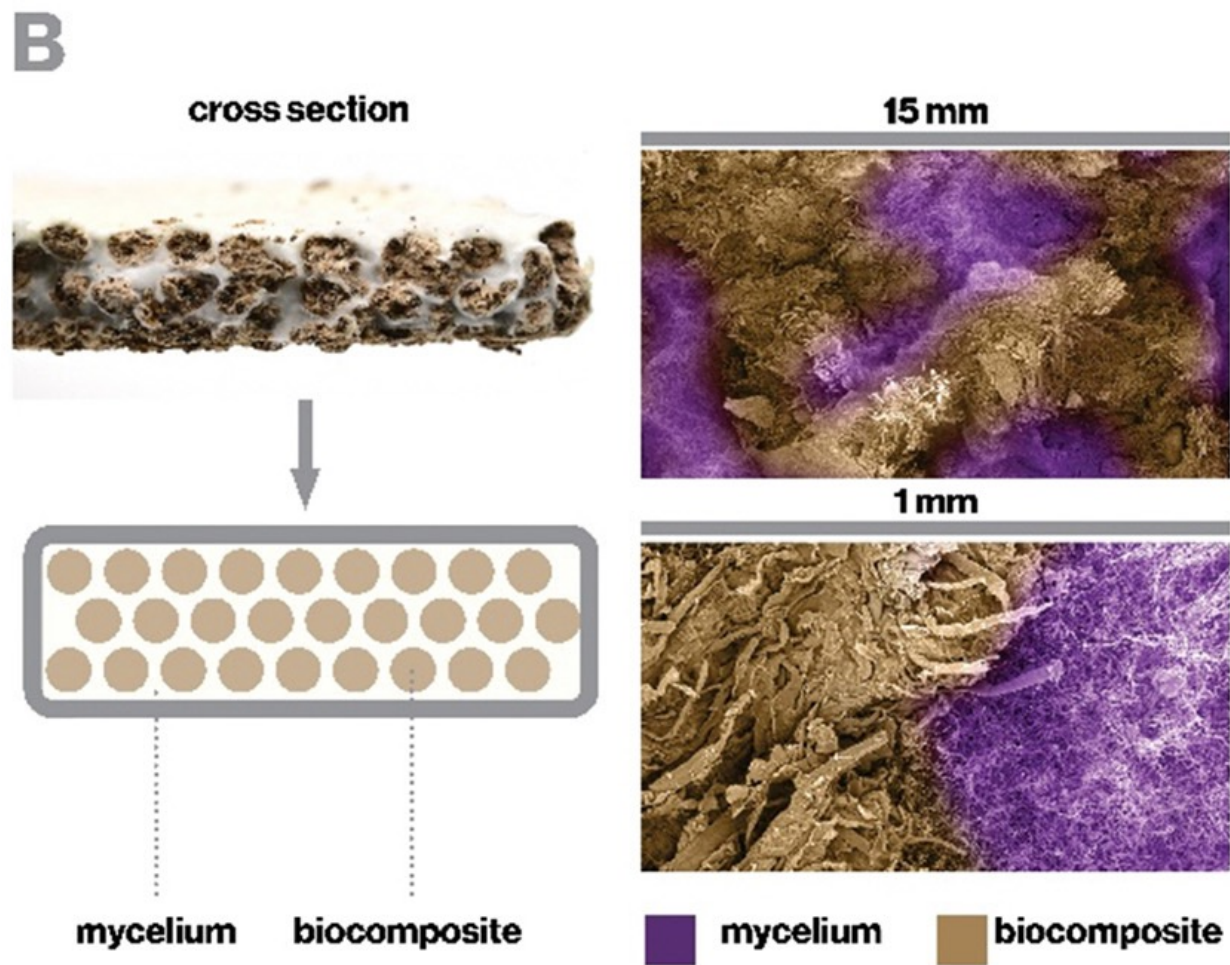




Sabrina C. Shen,<sup>‡</sup> Nicolas A. Lee,<sup>‡</sup> William J. Lockett, Aliai D. Acuil, Hannah B. Gazdus, Branden N. Spitzer and Markus J. Buehler, “Robust myco-composites: a biocomposite platform for versatile hybrid-living materials,” *Materials Horizons*, (2024)



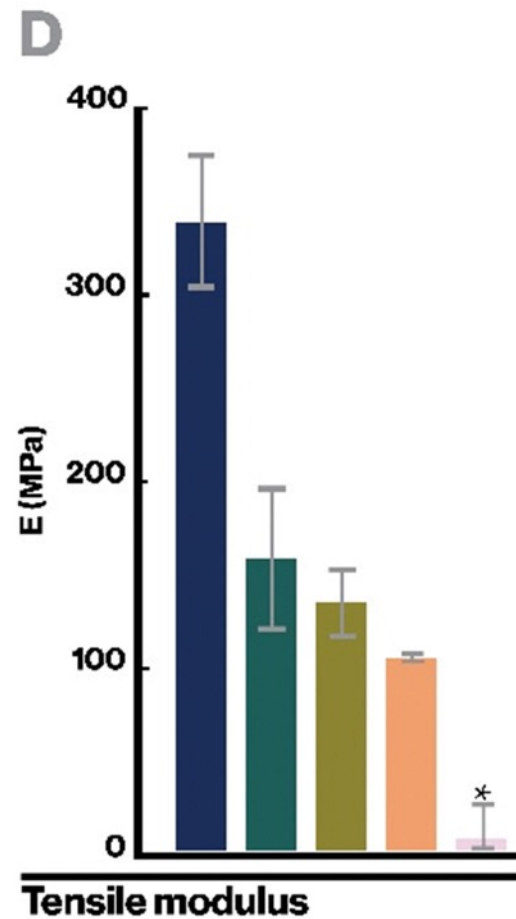
**Indirect inoculation process**



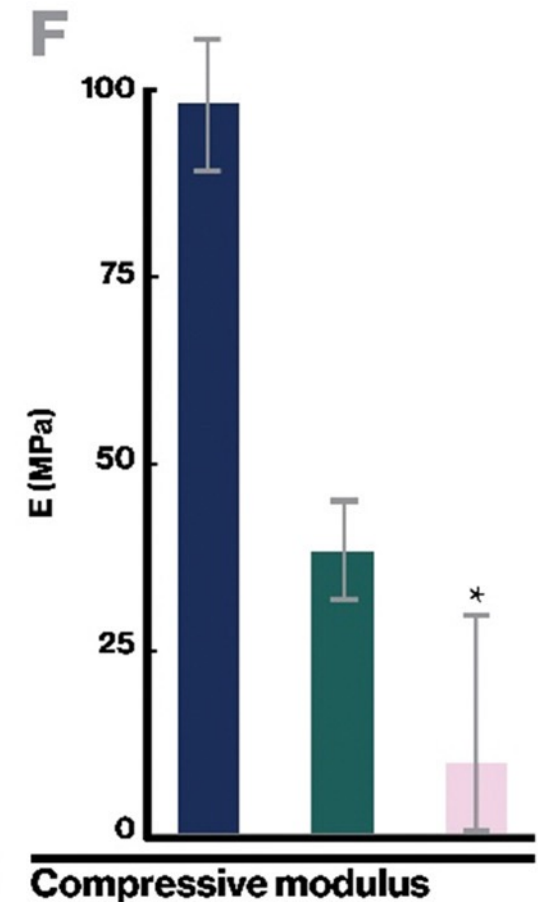
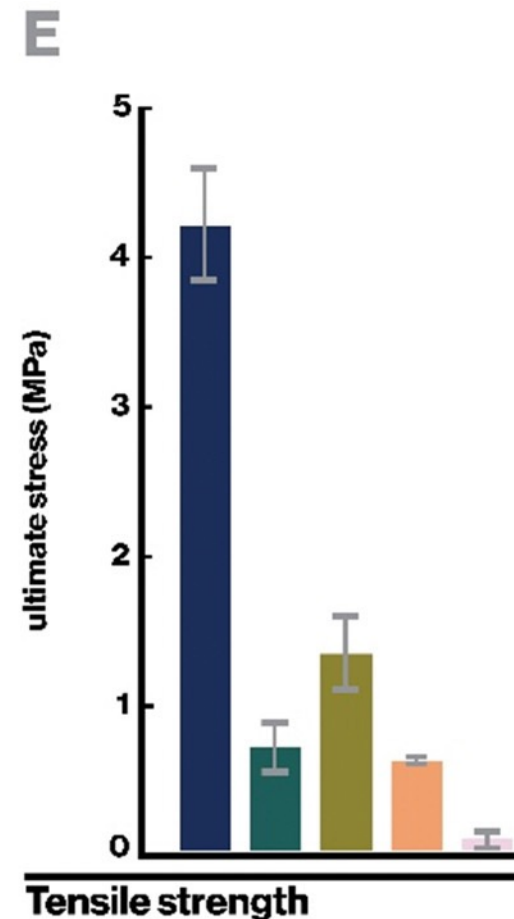
### Distribution of mycelium and biocomposite



\* tensile and compression data reported together

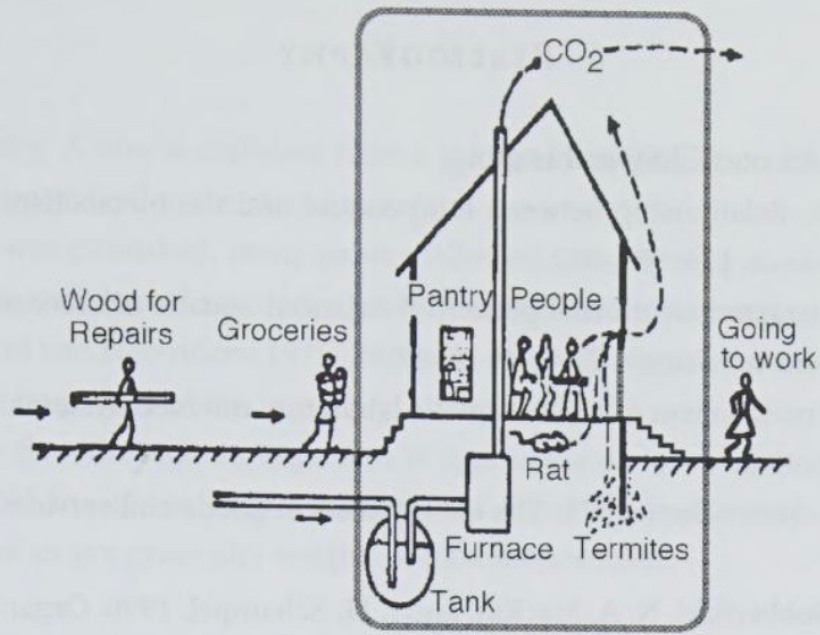


### Indirect inoculation of a printed composite

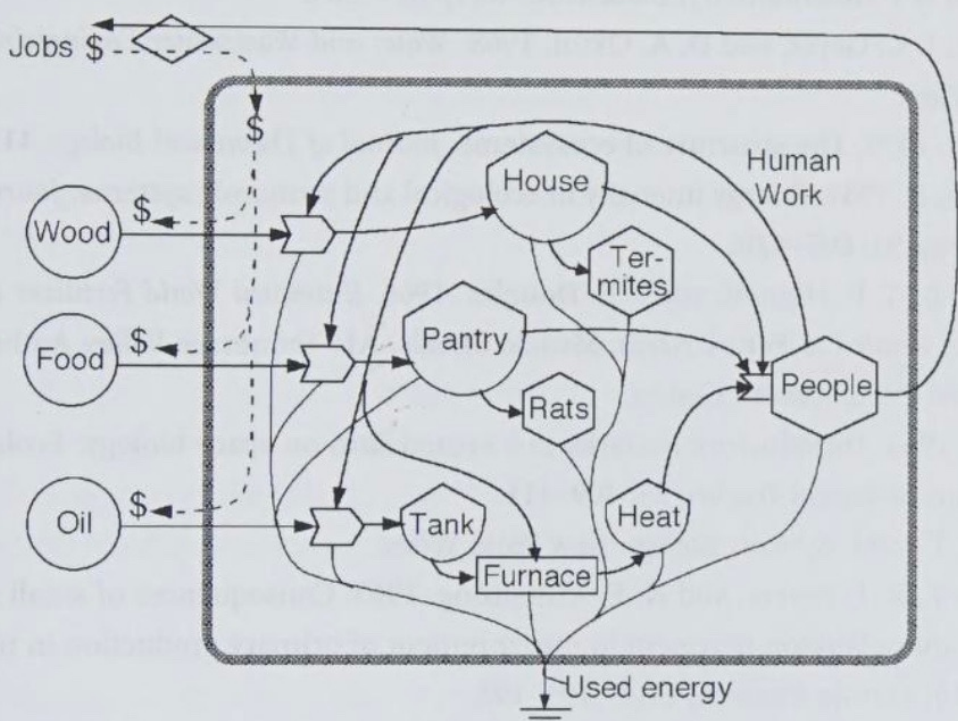




(a)

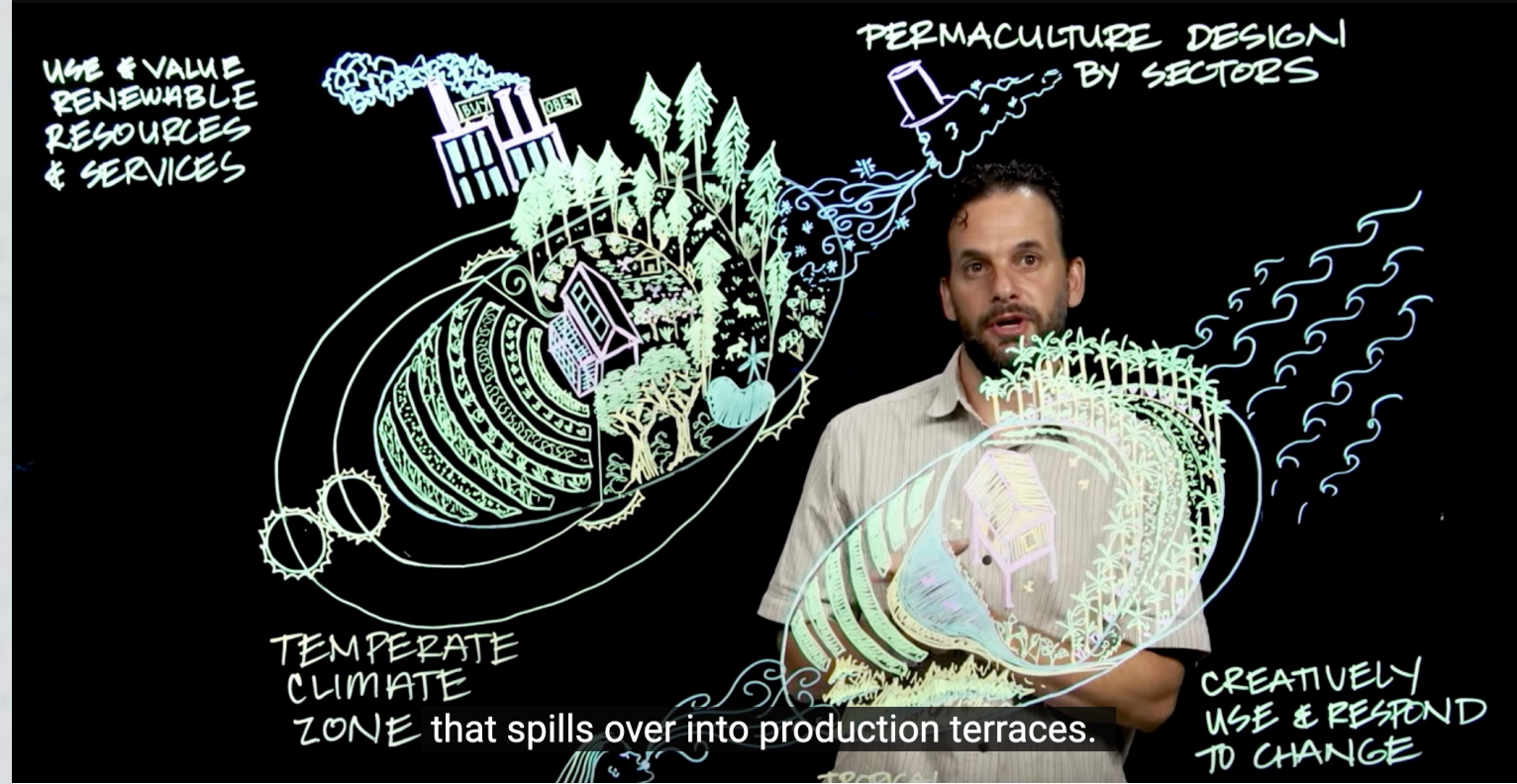


(b)



USE & VALUE RENEWABLE RESOURCES & SERVICES

PERMACULTURE DESIGN BY SECTORS



TEMPERATE CLIMATE ZONE that spills over into production terraces.

CREATIVELY USE & RESPOND TO CHANGE

(a) Energy Transformation Series (calories / time)

