

Engineered Living Materials (ELM)

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Proposers Day
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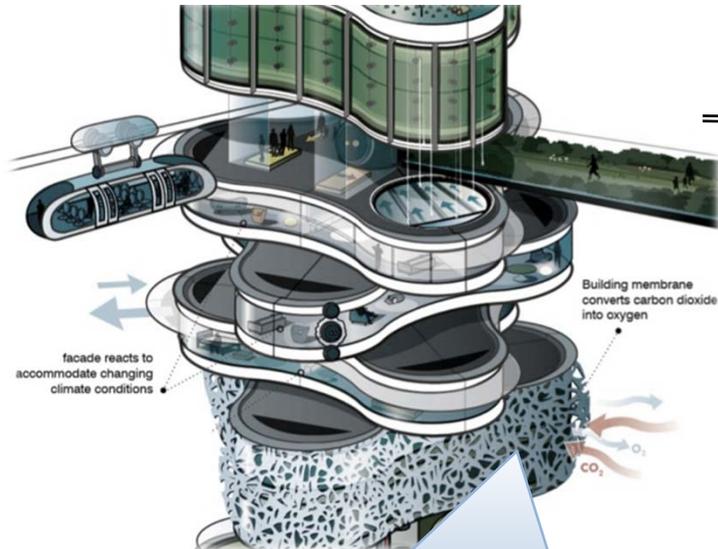
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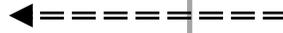
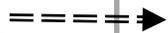
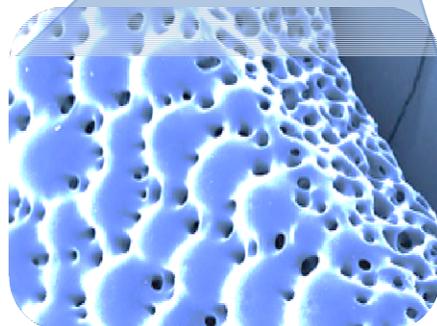
Long-term Vision: rationally designed living materials

Architect's Concept: a building with a *living* facade that adjusts porosity according to weather, while capturing CO₂ and respiring O₂



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Manufacturing



- Specify Design Elements**
- Dimensions
 - Strength / Flexibility
 - Added bio-functions, *e.g.*
 - Tunable porosity
 - CO₂ capture
 - Self-repair

ELM Technology

- Implement Design**
- Choose chassis organism(s) and/or scaffolds
 - Use genetics to control development sense and response physical attributes

- Grow Materials**
- Progenitor cells
 - Growth medium
 - Scaffolding materials



ELM

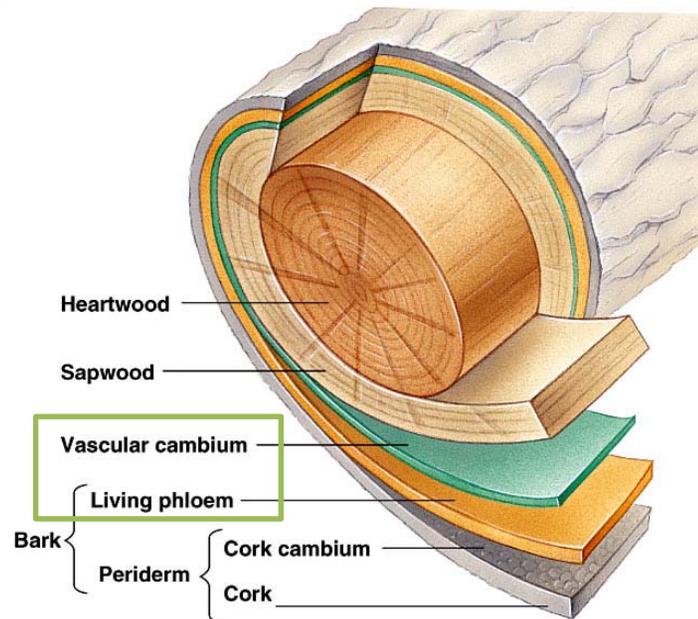


Can we incorporate living cells into building materials to leverage biological function?



Features:

- Strong
- Arbitrary shapes



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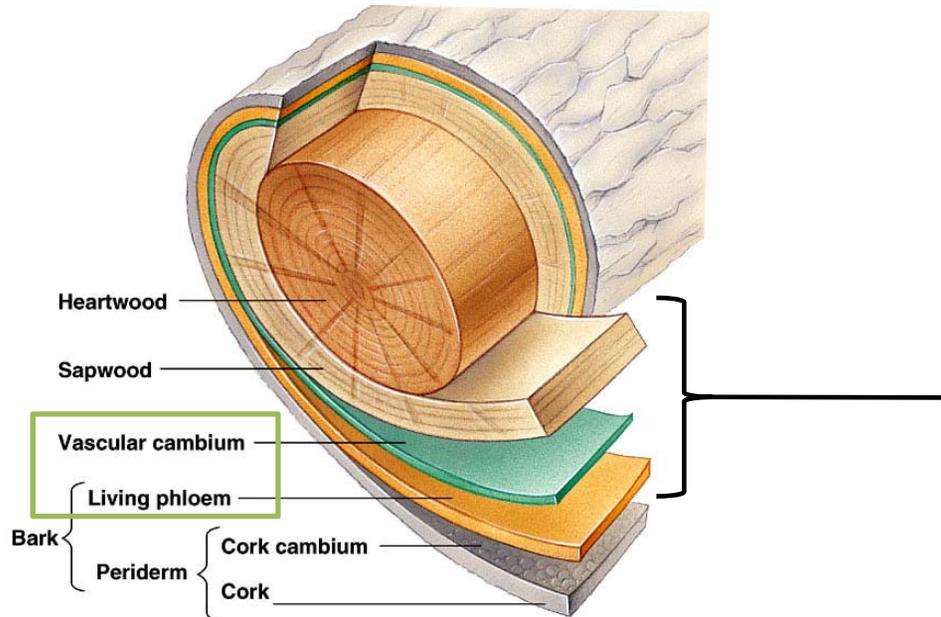
Features:

- Strong
- Grown on-site
- Self-organizing
- Self-repairing



What will it take?

Track 1: Hybrid Living Materials



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Develop inert materials that:

- support the viability of cellular components
- interface with cellular functions
- are cheap and easy to assemble into large-scale structures
- adopt arbitrary 3D shapes

Engineer cells that:

- grow rapidly
- have controllable growth dynamics
- can repair in response to damage
- have coordinated multi-cellular functions
- are robust in built environments

Track 2: Programmed Living Materials

Create developmental programs that:

- are genetically-encoded
- require no external cues
- produce multi-cellular systems
- specify cell fate and 3D shape

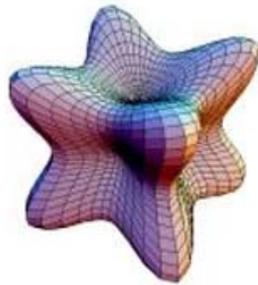




Pillars of ELM Technology



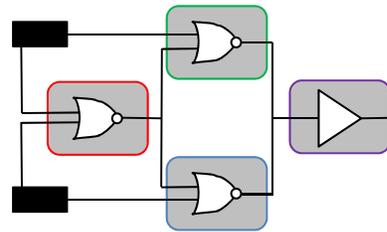
Materials Science



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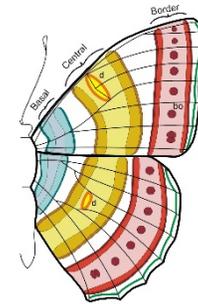
- Create strong, lightweight, and flexible scaffolds
- Create materials that support the growth of cells

Engineering Biology



- Engineer desired functions into living components
- Enable viability in changing environments

Developmental Biology

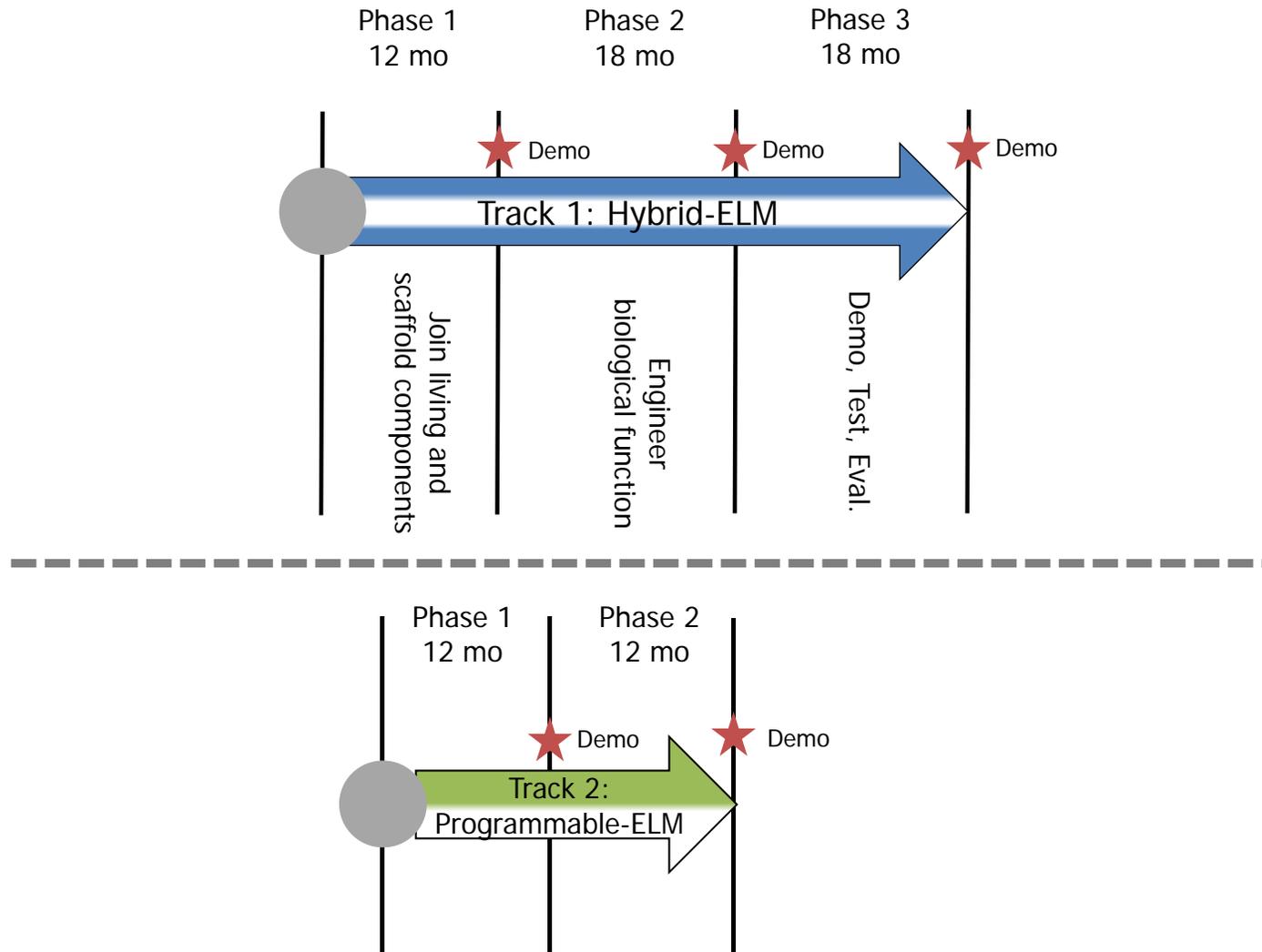


<http://sites.biology.duke.edu/nijhout/>

- Manipulate the organization of living components
- Coordinate the behavior of living components



ELM Program Organization And Notional Schedule





Anticipated Proposer Schedule



OR

