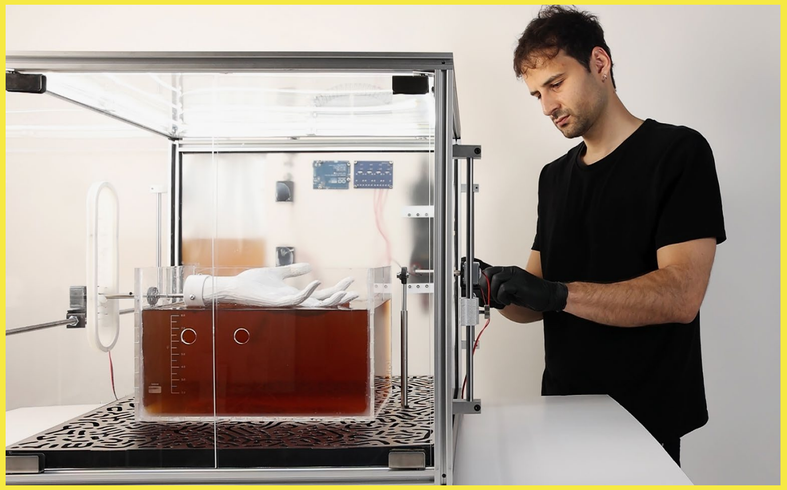
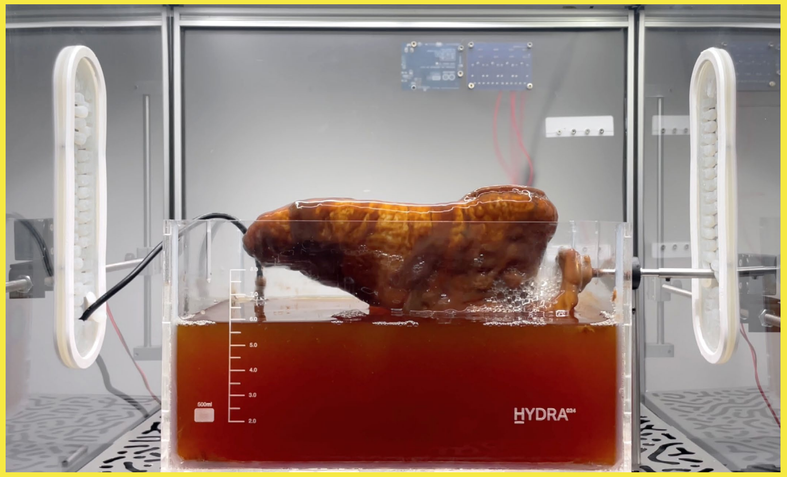
Three-Dimensional Biomaterial Growth

BY MARKOS GEORGIOU | © IMAGES FROM THOMAS SCRIMGEOUR

Hydra is a biodesign project that challenges traditional manufacturing by treating growth as part of the design process. By working with living materials, it opens up new possibilities for sustainable making, experimentation and design thinking.





Hydra began with a simple but important question: What if materials could be grown instead of manufactured? As designers and scientists explore new sustainable biomaterials, one challenge has remained consistent, the tools we use to make things are still designed for plastics, metals, and other conventional materials, which mostly use extractive models.

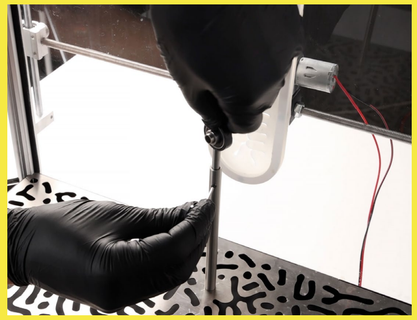
Living materials behave differently, yet most laboratories and design studios rely on flat trays, static incubators, and equipment that restrict biological growth to two-dimensional sheets.

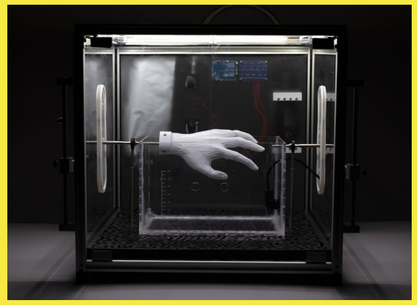
Hydra was created to address this gap. It is a living manufacturing platform, a modular, programmable bioreactor that grows materials and products directly in three dimensional forms. Instead of machining or moulding matter, Hydra cultivates it using bacteria fed with agroindustrial waste. It proposes a shift from fabrication to cultivation, where growth becomes a central part of the design process.

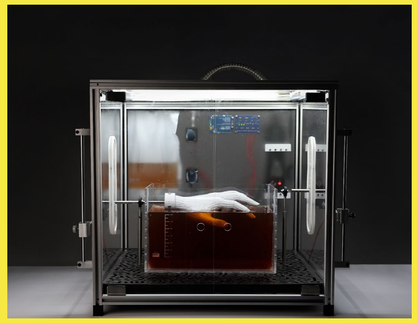
Why a New System Was Needed

The past decade has seen a rise in interest in biomaterials such as mycelium, algae-based bioplastics, and various biocomposites. These materials offer promising alternatives to plastics and textiles, but they are almost always grown flat.

Flat sheets require post-processing such as cutting, stitching, laminating, or heat forming, steps that reintroduce waste and synthetic components into what should be sustainable systems. They also limit what these materials can become, as designers always have a flat sheet as a starting point. Hydra challenges this by offering a platform designed around biology itself.







Its internal environment controls temperature, oxygen, humidity, pH, and fluid movement, giving designers the ability to influence how a material grows, forms, thickens, or structures itself. Hydra introduces a set of growth-driven processes that enable biological materials to form around and inside moulds, allowing the organism to build three-dimensional shapes rather than flat layers. The focus is not on the mechanics of each method, but on what they collectively unlock: the ability to shape living materials as they grow.

Materials grown dynamically with Hydra, grow up to five to seven times faster compared to static cultivation. The system requires minimal energy, produces no toxic byproducts, and runs on organic waste streams. More importantly, it eliminates the separation between growing and making, allowing material and form to emerge together.

What Hydra Makes Possible

Hydra's significance lies in the possibilities it unlocks. By allowing biological materials to grow directly into three-dimensional forms, and by supporting a wide range of living organisms, it opens new directions across fields ranging from healthcare and textiles to product design and regenerative materials. Designers could one day grow structures that fit the body more naturally, explore textiles formed without cutting or stitching, artificial skins, sustainable packaging, or cultivate seamless components shaped entirely through biological growth.

Researchers can use Hydra to test new material behaviours, experiment with custom moulds, and investigate how living systems respond to controlled environments. Not all of these applications exist yet, but Hydra provides the platform that makes them imaginable, a tool that expands what biological materials could become and how they might be used in future sustainable manufacturing.

Rethinking Manufacturing

Hydra invites a reconsideration of how materials are made. Conventional manufacturing is built on extraction, high energy use, long supply chains, and globally distributed production networks.

Hydra instead suggests a future where materials can be grown locally, on demand, using waste streams and biological processes. It supports the idea of a regenerative, distributed model of production: one where biology becomes a collaborator, growth replaces extraction, and design becomes an act of stewardship rather than depletion.

This is not only a technical shift but also a conceptual one. A reimagining of making that values responsiveness, care, and environmental alignment.

Hydra's Role in Education and Design

Design as a discipline has always evolved, and today it is becoming more multidisciplinary than ever. While not every designer will work with biology, nor should they, the mindset that biodesign fosters is valuable across all fields. Whether someone is designing furniture, products, interiors, or systems, working with living materials introduces ways of thinking that prioritise patience, experimentation, adaptability, and long-term ecological awareness.

Biodesign offers new creative possibilities and encourages designers to consider materials not as static substances but as dynamic, responsive systems. For students, this opens a space where creativity and science reinforce one another, and where new ideas emerge from understanding how materials behave, evolve, and interact with their environment.

Hydra is one example of how these worlds can connect. It is a reminder that the tools of the future may not yet exist, and part of a designer's role is to imagine and build them.

My Journey

Studying product design revealed both the strengths and limitations of traditional manufacturing, encouraging me to experiment with natural and biological materials from early on. My studies in Barcelona and later in Brighton opened up more exploratory and sustainable approaches, and I began to see how few tools existed for designers to work meaningfully with living systems.

Through years of research, hands-on experimentation, and material exploration, this understanding grew into Hydra, a project I developed during my Master's at the Royal College of Art, shaped by the desire to connect creativity, science, and new ways of making.

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