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Becoming cyanobacteria, becoming a biodesigner

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Abstract

This demonstration presents a biodesign toolset developed through three years of situated research in a BSL-1 biological laboratory. The project investigates how more-than-human sensibilities can be articulated within conventional lab environments typically structured around human-centred biological experimentation. Adopting a "Becoming cyanobacteria" stance informed by the philosophy of becoming, the author positions the laboratory as a shared field observed from a microbial scale, with particular attention to cyanobacteria's phototactic behaviours and optical sensing. The toolset includes a redesigned biodesign lab notebook, a DIY phototaxis toolbox built with physical computing and 3D printing, mixed-reality systems using HoloLens 2, and a custom VR application, *Cyano Vision*, which visualises cyanobacteria's sensorial relations to light from a non-human perspective. Rather than proposing a universal methodology, these tools function as situated artefacts that materialise one possible configuration of more-than-human biodesign practice. Through hands-on engagement and documented use cases, attendees are invited to reflect on how biodesign infrastructures, tools, and experimental protocols might be reoriented to better accommodate non-anthropocentric ways of knowing and designing within laboratory settings.

Demo: Biodesign Conference

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Introduction

Biodesign scholarship has increasingly emphasised the field's heterogeneity, noting that contemporary biodesign laboratories no longer operate under a single methodological or epistemic paradigm, but instead diversify according to their objectives, ethical positions, and institutional contexts (Crawford 2023; Ihls and Pollini 2025; Karana 2020; Marseglia *et al.* 2025). Within this landscape, biodesigners have explored non-anthropocentric and more-than-human (MTH) modes of inquiry through interdisciplinary practices that challenge instrumental approaches to living systems (Kuznetsov *et al.* 2018; Pollini 2024; Sawa 2016; Stefanova 2021). Recent research has further foregrounded MTH sensibilities through speculative, relational, and posthuman design tools that question dominant human-centred assumptions (Bell *et al.* 2023; Chen and Pschetz 2024; Kim *et al.* 2025; Vu *et al.* 2024). However, a persistent tension remains between these aspirations and the highly specialised, sterilised infrastructures of biological laboratories, where microbial-scale experimentation often reinforces anthropocentric control and optimisation. This demonstration is positioned within this critical gap.

This demonstration presents a situated biodesign toolset developed through three years of practice-led research in a BSL-1 biodesign laboratory within an industrial design engineering faculty. The work explores how MTH sensibilities can be surfaced, negotiated, and performed within a conventional biodesign lab environment that is typically optimised for sterilised, human-centred biological experimentation.

Adopting the *Becoming-with* stance toward cyanobacteria informed by the philosophy of becoming (Kim *et al.* 2024), the author frames the laboratory as a shared field rather than a site of control, attending to cyanobacteria's phototactic behaviours, optical sensing, and temporal relations at the microbial scale. Through this lens, the author developed experimental tools that mediate between biological experimentation, design practice, and speculative technological interventions.

The toolset consists of four main components (see Figure 1). First, a redesigned **Biodesign Lab Journal** supports documenting interdisciplinary tensions, situated decision-making, and MTH reflections during laboratory practice (Kim *et al.* 2025). Second, a **Phototaxis Toolbox** – a DIY physical computing array assembled using 3D-printed components, Raspberry Pi, and CircuitPython – modulates light conditions for cyanobacterial phototaxis experiments. For exhibition purposes, this setup will be displayed with Petri dishes that do not contain living organisms, ensuring biological safety. Third, **HoloLens 2** enables hands-free operation in sterile conditions while overlaying experimental information through augmented reality. Fourth, a **Meta Quest 3** headset running *Cyano Vision*, a Unity-based VR application, visually explores the optical sensing of cyanobacteria from a non-human perspective.

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Figure 1. The four-component biodesign toolset. (A) Reflective biodesign lab journal with stickers and a bookmark for documenting interdisciplinary tensions and more-than-human reflections (Kim *et al*. 2025). (B) Phototaxis toolbox array consisting of 3D-printed components, a Raspberry Pi, and a CircuitPython-controlled light modulation system for cyanobacterial experiments. (C) Author conducting hands-free laboratory work using HoloLens 2 with an augmented reality overlay under sterile conditions. (D) Author experiencing *Cyano Vision* through Meta Quest 3 to speculate cyanobacteria's optical response from a non-human perspective.

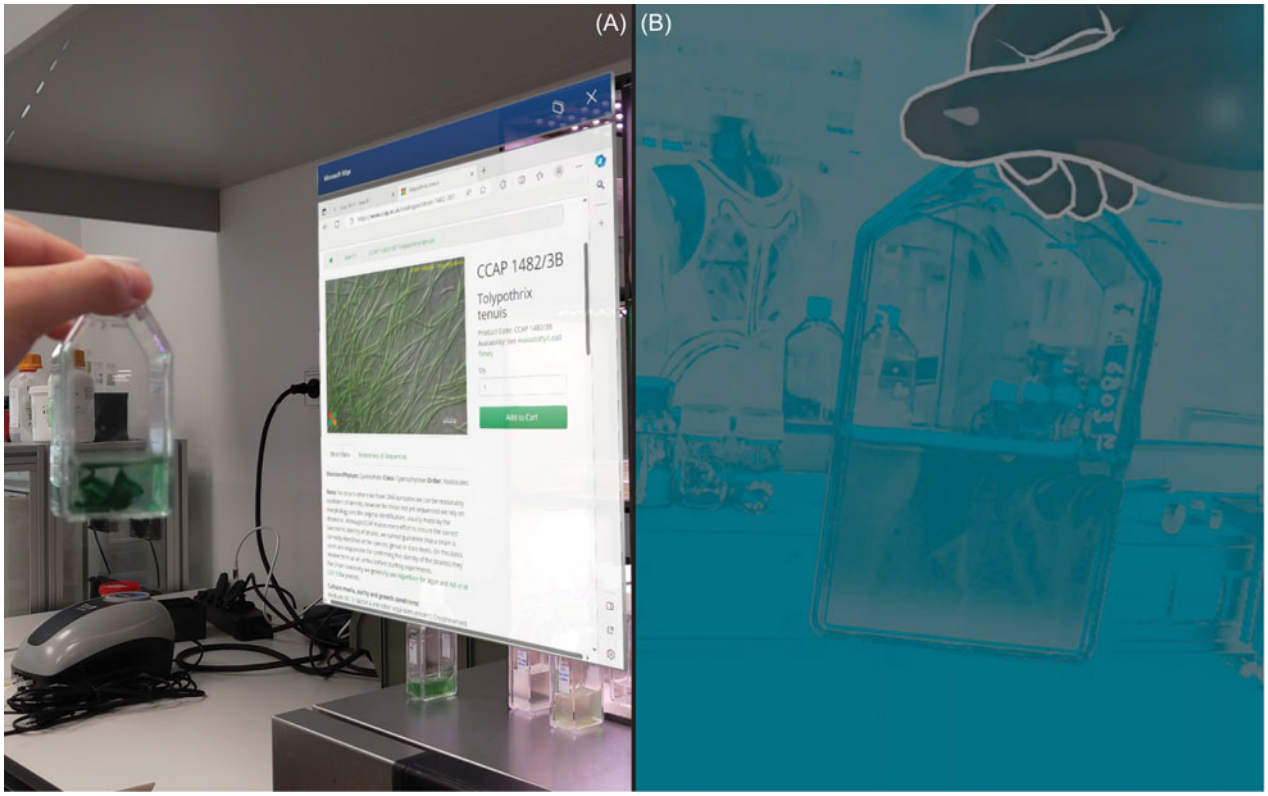


Figure 2. First-person perspectives from mixed-reality systems during laboratory practice. (A) Augmented reality view through HoloLens 2 showing experimental information overlaid onto the physical laboratory environment during hands-free operation. (B) Virtual reality view through Meta Quest 3 running *Cyano Vision*, depicting the visual speculation of cyanobacteria's optical sensing and sensorial relations to light within the laboratory space.

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All tools will be spatially arranged as a coherent biodesign workstation, moving between instrumental and speculative modes. Limited copies of the lab journal will be available for browsing and potential use in participants' own contexts. The phototaxis toolbox will be displayed in an experimental configuration. Recorded documentation of HoloLens 2 and Meta Quest 3 use in real laboratory settings will be presented via a standing screen; upon request and depending on time constraints, attendees may experience *Cyano Vision* directly using the Meta Quest 3 (Figure 2). Ideally, the demonstration will be installed in an independent room that juxtaposes familiar biological laboratory paraphernalia with unfamiliar experimental tools. This immersive arrangement will allow attendees to step into the author's situated experience of biodesign, prompting reflection on the field's boundaries and future directions beyond anthropocentric ways of biodesigning in laboratory settings.

The demonstration requires:

- One table (minimum 110 × 60 cm)
- One standing screen (approx. 40 inches)
- Relocatable power tap (minimum three outlets)
- One independent room (minimum 3.3 m^2, optional)

Impact statement. This work offers the biodesign community a concrete example of how more-than-human perspectives can be explored within everyday laboratory practice rather than remaining abstract ideals. By materialising a situated, reflective toolset, it invites designers and researchers to rethink how biodesign tools shape relationships between humans, microbes, and experimental environments.

Data availability statement. The *Cyano Vision* is available at https://github.com/OEOxr/CyanoVision-MR. Please note: This application was developed for exploratory research and has not undergone formal validation. For further information or access to the application, contact the corresponding author.

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