Growing Bio-HCI at CHI: Exchanging Materials, Tools, Practices, and Artifacts

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Abstract

Biological Human-Computer Interaction (Bio-HCI) has recently emerged as a rapidly growing and evolving area of research that explores the intersections of biology and technology. While vast in scope, the integration of biological systems, processes, and organisms within HCI serves as fertile ground for developing new, sustainable perspectives and methods of design. Consequently, this workshop aims to grow the ecosystem of Bio-HCI works by facilitating a space for experienced researchers and practitioners to exchange biomaterial recipes, biofabrication tools, biomaking practices, and biodesigned artifacts. Participants will share these contributions in a show-and-tell format—providing physical samples to demonstrate and explain their work. The show-and-tell will further provide a scaffold for drawing connections between works and serve as a starting point to discuss challenges, tensions, and barriers, followed by future opportunities. All show-and-tell contributions will be compiled into a collective zine to highlight, disseminate, and cultivate the current ecosystem of Bio-HCI at CHI.

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CCS Concepts

• **Human-centered computing** → *Interaction design*; • **Hardware** → *Emerging technologies*; • **Social and professional topics** → *Sustainability*.

Keywords

Bio-HCI, Biodesign, Biomaterials, Biofabrication, Sustainability

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1 Introduction

As the CHI community becomes increasingly attuned to ecological challenges brought about by climate change [19, 39, 65, 91], many researchers have turned to *biodesign* to find sustainable solutions. Biodesign—an interdisciplinary field focused on designing *with* biological systems [70]—specifically addresses problems of sustainability by aligning design processes to biological temporalities and cycles through utilizing living organisms and bio-based matter that are renewable and regenerative [49]. This intersection of Human Computer Interaction, biodesign, and other recent developments

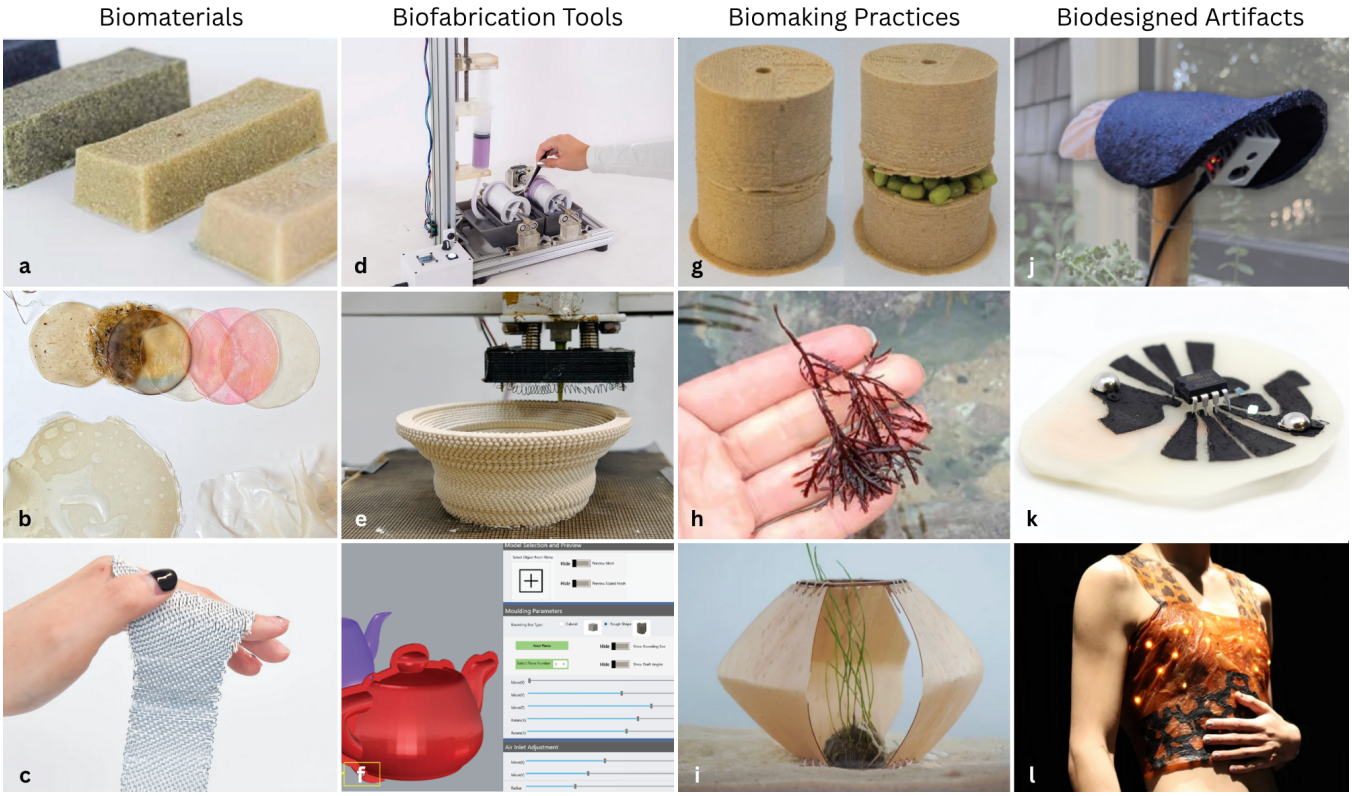

Figure 1: The primary goal of this workshop is to exchange Bio-HCI knowledge of specific *biomaterials* such as (a) oyster shell and algae biocomposites [86], (b) algae and moss bioplasics [102], and (c) algae biofibers [108]; *biofabrication tools* such as (d) spinning machines for making biofibers [108], (e) hardware ad-ons for 3D printing biopastes [13], and (f) modeling tools for creating mycelium molds [35]; *biomaking practices* such as (g) unmaking biomaterial objects through growth [88], (h) foraging for local biomaterials [86], and (i) degrading and dissolving biomaterials to functionalize applications [66]; and *biodesigned artifacts* such as (j) a biocomposite hood for interactive bee cavity nests [94], (k) a beeswax bioplastic micro-controller shield [55], and (l) a microbial cellulose wearable [8].

in biotechnology has led to the emergence of a new and rapidly evolving area of **Biological HCI (Bio-HCI)** [6, 32, 68, 79, 106].

The Bio-HCI community has particularly championed the development and integration of **biomaterials**—bio-based and biodegradable materials [16, 70]—as functional components within interactive systems and artifacts (Figure 1, a-c). For example, living organisms such as plants [24, 42, 43, 85, 107], slime mold [64, 75], bacteria [17, 20, 36, 51, 81, 103, 105], and algae [22, 44, 76] have been used to create inherently interactive displays. Other living organisms like microbial cellulose [8, 71, 73, 74] and mycelium [34, 35, 58, 67, 100] have alternatively been grown and harvested to develop a range of biotextiles and biocomposites. Meanwhile, more complex combinations of bio-based ingredients have resulted in a rapidly expanding library of bioplastics, biopastes, biocomposites, biofibers, and biofoams made from algae [4, 55, 72, 86, 90, 96, 108], gelatin [55, 60, 62, 94], wheat flour [23, 90, 93], chitosan [30, 88, 96], casein [41, 95] and food waste [12, 14, 15, 69, 83].

However, these biomaterials are not a 1-for-1 replacement for existing materials such as plastics, ceramics, or metals. They require new corresponding **fabrication tools** that support the unique affordances and properties of biomaterials (Figure 1, d-f). As such, Bio-HCI researchers have built custom 3D printers to extrude coffee ground biopastes [83] and mycelium biocomposites [67], as well as 3D printer add-ons like heaters for drying wet biopastes during the printing process [12, 13]. Meanwhile, new software tools like WeaveSlicer have been used to generate custom g-code for 3D printing complex, overhanging forms from wet biopastes [14, 33]. In the space of e-textiles, researchers have built spinning machines for producing algae-based biothreads [108] and gelatin-based biofibers [60], which have been supported by a software tool to tune the diameter of biofibers [101]. Other digital tools have been developed to simulate the growth of flavobacteria for biodesign prototyping [82] and to generate 3D printed molds that support the growth of mycelium [35]. Such tools further demonstrate a broader perspective in leveraging and mediating the growth of living organisms as a mode of biofabrication [59, 73].

Beyond new tools for biofabrication, the process of designing with biomaterials also surfaces new **practices and perspectives** regarding materiality and agency (Figure 1, g-i). Often drawing from

More-Than-Human philosophies [21, 31, 98], Feminist perspectives [2, 29, 40], and Indigenous knowledges [52, 92], practices such as temporal attunement [11, 45, 77], labor recognition [25], and radical care [26, 64, 104, 107] are often discussed when working with biological matters. Meanwhile, practices such as foraging [63, 86, 90], gardening [99], and do-it-yourself biology [4, 56, 57, 86] have also been brought to the forefront of Bio-HCI projects, highlighting the types of embodied knowledge that often goes overlooked. Along these lines, the inherent biological makeup of biomaterials make them prime candidates for sustainable practices of unmaking, such as biodegrading [7, 8, 66, 88, 90], composting [15, 99], recycling [14, 83], and dissolving [4, 27, 61, 66].

Together, these materials, tools, and practices have led to the development of various **artifacts, objects, and interfaces** (Figure 1, j-l), including: electronic components [27, 38, 55, 64, 73, 89], wearables [8, 37, 47, 48, 59, 96, 107, 108], displays [22, 36, 42, 105], sound installations [11, 45, 81], interactive packaging [62, 88], ecological interventions [14, 66, 69, 90], and more. By designing new technologies and interactions that align with biological cycles and broader ecological systems, these works of Bio-HCI paint a picture of how sustainable bio-digital futures might flourish.

2 Workshop Goals

Motivated by the growth of Bio-HCI, this workshop aims to gather a community of researchers and practitioners working at the intersection of HCI and biodesign to exchange biomaterial recipes, biofabrication tools, biomaking practices, and biodesigned artifacts, as well as discuss some practical challenges that practitioners face and opportunities for how this work to grow in the future. To support these goals, we intend to organize a long workshop (i.e., 2 sessions) for a small group of participants (i.e., 10-20 participants plus 6-12 organizers). In doing so, we make time and space for the depth of discussion necessary to advance Bio-HCI.

- **Fostering a collaborative and focused space** for researchers, designers, practitioners, artists, and scientists with experience in biodesign and HCI to share their work, make connections, and build community.
- **Making a collective zine** of biomaterial recipes, biofabrication tools, biomaking practices, and biodesigned artifacts that are being developed by the Bio-HCI community through participant submissions.
- **Exchanging physical samples and demoing prototypes** that correspond to the zine for gaining an embodied understanding of what is currently being done in Bio-HCI.
- **Discussing barriers, challenges, and tensions** (both technically and philosophically) when working at the intersection of biology, design, and technology.
- **Imagining possibilities, opportunities, and collaborations** for growing Bio-HCI in the future by sustaining and extending our collective zine and online network.

3 Organizers

The organizing team consists of HCI researchers at various stages of their careers from across the globe, whose biodesign practices encompass a broad spectrum of work: from developing new biomaterials and biofabrication tools to designing methods and techniques for interacting with living organisms, to creating interfaces and artifacts that bridge biological and digital systems. Several organizers have prior experience co-organizing workshops, special interest groups, and meetups at CHI [28, 54, 65, 78, 84, 87, 91, 106], DIS [46, 97], TEI [5, 9, 10, 18], and more [1, 3, 53, 80].

Fiona Bell (primary contact) is an Assistant Professor of Human-Centered Computing at the University of Maryland, Baltimore County, directing the Entangled Ecologies Lab. Working at the intersection of HCI, biodesign, and material science, her research is focused on the development of interactive biomaterials that foster regenerative futures.

Jingwen Zhu is a PhD candidate in Human Centered Design at Cornell University. Her research bridges e-textiles, sustainable materials, and biosensing devices. Her work emphasizes community engagement, actively involving artists, designers, and craftspeople from the maker community to broaden the impact of emerging technologies.

Nadia Campo Woytuk is a PhD student in Interaction Design at KTH Royal Institute of Technology in Stockholm, Sweden, exploring critical feminist design of technologies for the intimate body and the social and environmental ecologies it entangles. She uses Research through Design methods, including making with textiles and biomaterials, as well as participatory and speculative approaches.

Fernanda Soares da Costa is a PhD student in Digital Media at the Interactive Technologies Institute (IST) in Lisbon, Portugal. With a background in Industrial Design and hands-on biomaterials practice, she explores sea-derived matter—often regarded as waste—as a medium for interaction and storytelling, cultivating engagements with local ecologies to nurture caring relations with the other-than-human. Fernanda is also a member of Biolab Lisboa.

Lauren Thu is a designer and PhD student in the Everyday Design Studio at Simon Fraser University's School of Interactive Arts and Technology. Her research concerns methodological and material practices for designing with more-than-humans, specifically in how place is reflected in designed materials. She is particularly interested in how place-based sensing technologies may mediate oceanic constituencies.

Qiuyu Lu is an Assistant Professor in the School of Design at The Hong Kong Polytechnic University and director of the Interbeing Lab. His research develops intelligent systems and interaction paradigms that foster mutualism among humans, the environment, and smart devices, combining emerging technologies with material-driven and non-anthropocentric design approaches.

Katherine Song is an Assistant Professor in the Knowledge and Intelligence Design Group in the Faculty of Industrial Design Engineering at TU Delft. Her research seeks to develop material, component, and system-level strategies for integrating biodegradable and living materials as computational advantages in the design of intelligent systems.

Phillip Gough is a Senior Lecturer in Design at The University of Sydney School of Architecture, Design and Planning. His research is part of the Affective Interactions Lab, and focuses on how biomaterials can be used in a circular economy through digital fabrication, integration into interactive devices, and the impact biomaterials have on user experience.

Cindy Hsin-Liu Kao is an Associate Professor in Human Centered Design at Cornell University. She directs the Hybrid Body Lab, which focuses on the design of Hybrid Skins: an emerging form of conformable interface situated at all scales of the human experience. Her lab adopts a broad range of biomaterials and biofabrication tools toward their goal of creating sustainable and ecological Hybrid Skins.

Marion Koelle is a professor for Human-Computer Interaction at Hochschule RheinMain in Wiesbaden, Germany. She designs and develops tools and techniques for personal fabrication and human-AI co-creation and researches biomaterials that integrate with digital technologies to create sustainable bio-digital artifacts.

Valentina Nisi is a Professor at the Instituto Superior Tecnico, University of Lisbon, Portugal and Vice President of the Interactive Technologies Institute. She is affiliated with the HCI Institute at Carnegie Mellon University, USA. Her research focuses on HCI Post-Human sensibilities, applied through Speculative Design, Storytelling and Games. Her recent output touches on natureculture constructs and More than Human Heritage.

Ron Wakkary is a Professor in Interactive Arts and Technology at Simon Fraser University and Industrial Design at Eindhoven University of Technology. His research investigates the changing nature of design in response to new understandings of more-than-human relations, multispecies worlds, and posthumanism.

4 Workshop website

Prior to the workshop, we will make a website publicly available. The website will include our call for participation, the workshop goals and schedule, organizer information, templates for submissions, and a submission link. Our website will also include examples of work in the expected submission template to help inspire and inform interested attendees. Website link:
https://sites.google.com/view/growing-bio-hci/home

5 Distributing the call for participation

We aim to reach a broad range of audiences interested in topics across the spectrum of biodesign, sustainability, materiality, fabrication, more-than-human design, tangible interfaces, and multispecies interactions. We will publicize and promote our call for participation via email (e.g., ACM SIGCHI mailing lists, university mailing lists), social media (e.g., Instagram, Bluesky, LinkedIn), and alternative messaging channels (e.g., Slack, Discord), as well as through personal connections to various related research communities (e.g., DIYbio, STS, critical studies, open source hardware, e-textiles).

6 Workshop submissions

We invite people interested in participating to submit their work through a custom template that will be found on our workshop website. The template will enable participants to submit a specific biomaterial recipe, biofabrication tool, biomaking practice, and/or biodesigned artifact that they have developed. The template will include a balanced combination of written and visual documentation, prompting participants to share specific methods or instructions for replicating biomaterial recipes, utilizing biofabrication tools, implementing biomaking practices, or adapting biodesigned artifacts—essentially acting as a tutorial to support other researchers and practitioners. We recognize that materials, tools, practices, and artifacts are often entangled: for example, a Bio-HCI project might focus on an algae biofiber that is fabricated with a DIY wet spinning machine, facilitated by a practice of care, and applied to make interactive wearables [108]. In these cases, participants will be encouraged to submit multiple pages separated into different aspects regarding the same overarching project. This type of submission will specifically target researchers and practitioners who have prior hands-on experience in Bio-HCI. The completed templates will be submitted through an online form on the workshop website. The organizing team will review all submissions in relation to the workshop goals and make selections based on the depth and diversity of the contribution.

7 Plans to publish workshop proceedings

Accepted submissions will be compiled into a co-authored booklet—a **collective zine**—that will be distributed virtually on our website and physically to the participants at the workshop in Barcelona. The zine will also be published in an open-access format on arXiv, so that it can be referenced and serve as a source of biodesign knowledge for the broader HCI community and beyond. The zine will also serve as an entry point for participants to exchange skills and insights during the workshop. To enrich the zines with tactile interactions, participants will be encouraged to prepare appropriate samples or swatches that can be attached, providing embodied experiences alongside written contributions.

8 Expected size of attendance

Based on recent CHI events of similar topics (such as Microbe-HCI in 2021 [50], Living Bits and Radical Aminos in 2023 [32], Sustainable Unmaking in 2024 [87], Ecological HCI in 2024 [65], and Wearable Bio-HCI in 2025 [106]), we expect at least 20-40 submissions. However, we propose capping the acceptance rate at 10-20 submissions. By maintaining a **small group size** (i.e., 10-20 participants plus 6-12 organizers), we hope to target people who have previous experience in this area. By encouraging more experienced biodesign practitioners at CHI, we hope to facilitate highly in-depth conversations about specific materials, tools, practices, challenges, and future directions.

9 Workshop format

To provide enough time for in-depth reflections and discussions, as well as build a stronger sense of community, we propose a **long format** workshop made up of two sessions with a break in between. The workshop will also be held entirely in-person to encourage participants to engage in embodied, hands-on modes of exploration. We will complement our in-person activities with a variety of asynchronous, online materials that can support the growth of Bio-HCI before, during, and after the conference.

10 Accessibility

We are committed to making this workshop fully accessible and equitable for all participants. As our workshop is centered around building community and exchanging knowledge, we are dedicated to facilitating a safe and comfortable experience. Our schedule, as well as details about the intended workshop activities, will be

posted on our workshop website before the conference to make participants aware of any potential access needs. We will also directly reach out to our participants to see if they have any specific access needs or accommodations, so that we can make sure those needs are met during the workshop. During the workshop, we will check in with participants to ensure that their needs are accommodated and ask participants for their consent before taking any photos, videos, or recordings of the workshop. Furthermore, we will support any translation needs during the workshop, especially English to and from Catalan and Spanish, by working with bilingual organizers (one of the organizers is a Barcelona native), participants, and student volunteers, as well as translation apps.

11 Workshop Activities

Over the course of the two sessions, we will address the workshop goals by: (1) exchanging knowledge via zine distribution and show-and-tell, and (2) critically reflecting on the knowledge exchange and discussing challenges and opportunities. The schedule of the workshop is shown in Table 1.

Table 1: Proposed workshop schedule.

Session	Time	Activity
1	15 minutes	Workshop introduction, zine distribution, and icebreaker activity
1	75 minutes	Show and tell, demonstrations, and physical sample exchange
2	30 minutes	Reconvening, reflecting, and drawing connections between projects
2	60 minutes	Discussing challenges and opportunities, and workshop closing

In the first session, the collective zines will be distributed and participants will partake in a **show-and-tell** of what they have submitted—a biomaterial recipe, a hardware or software tool to support biofabrication, a practice employed when working with biological matters, and/or a biodesigned artifact or interface. While we recognize that Bio-HCI projects will be some combination of materials, tools, practices, and artifacts, we explicitly make these four buckets so that participants can think through possibilities of utilizing or adapting others' work. For example, adapting a spinning machine designed to extrude algae biofibers to instead extrude a different biomaterial recipe. Or translating a practice of care someone employed when working with microbial cellulose to another mode of biofabrication. On top of sharing the project, participants will be highly encouraged to bring physical prototypes to demonstrate and biomaterial swatches to be exchanged. Through a physical show-and-tell, we hope to facilitate a hands-on, embodied knowledge exchange.

In the second session, we will engage participants in small-group reflections where they will make connections between the projects introduced in the first session. We will then broaden the **discussion** by talking through specific tensions, barriers, and challenges we face in our work, as well as potentially opportunities and other generative starting points for future Bio-HCI projects, leveraging this workshop to hopefully inspire future collaborations between participants. More than one organizer will be assigned to each discussion group to lead and facilitate the discussions, as well as take notes and document. We hope to cover a range of topics, such as: How can the work shared in the workshop build on the knowledge presented in each? What are the salient technical challenges arising from working with biomaterials? What ethical or philosophical challenges arise? How can the zine be extended in the future to become a comprehensive resource?

12 Asynchronous materials

Before the workshop, the zines (i.e., the collection of accepted submissions) will be made available online through our workshop website and arXiv so that participants can explore each other's work. We will also create a Slack or Discord group and a participant email chain to enable easy, direct communication before the conference. Through these communication channels, we will gauge what participants are most looking forward to about the workshop and what they hope to get out of it. This way, we can adjust our activities and schedule as needed to meet participant desires and expectations. We hope to use these online communication channels to build rapport before the workshop, organize ourselves during the workshop, and keep the discussion going after the workshop.

After the workshop, we will also update the website with a summary of the workshop (with photos). We will also keep the zine submission templates available for download on our website so that the workshop participants, as well as other interested researchers and practitioners, can continue to use them. Lastly, we will look into the opportunity for re-opening the submission form to keep growing our collective zine with more works, transforming our zine into a **long-term online repository for the Bio-HCI community**.

13 Post-Workshop

After the workshop, we will post key outcomes, accompanied by photos and videos of the workshop, on our website. We will also encourage participants to share their experiences of the workshop and post related reflections and photos on social media or personal websites.

As stated in our plans for publication, we will also make the collection of participant contributions—the collective zine—available online through our website and arXiv for participants to refer back to. Meanwhile, participants will be able to take home the physical copies of the zine distributed at the CHI conference. In the future, we envision distributing the physical zine at other events and communities; for example, adding it to the ACM DIS zine library[1], sharing it at other relevant community events like the Open Hardware Summit[2] and Biodesign Challenge[3], and/or bringing it to local community makerspaces such as Fab Lab Barcelona[4]. Accordingly, we hope that the zine acts as a useful artifact in and of itself that can support researchers and practitioners in future biodesign explorations.

We will also consider the potential of growing the online version of the zine, transforming it into a broader online repository of

[1] https://dis.acm.org/2025/call-for-zines/
[2] https://2025.oshwa.org/
[3] https://biodesignchallenge.org
[4] https://fablabbcn.org/

works at the intersection of biodesign, biotechnology, and HCI. By promoting both the zine and the broader online repository, we hope to inspire further experimentation and exploration, cultivating a repertoire of materials, tools, practices, and artifacts for Bio-HCI.

14 Call for Participation

Calling all researchers and practitioners with hands-on experience in biodesign, biofabrication, and biomaterials to participate in Growing Bio-HCI at CHI! This workshop aims to facilitate a time and space for the Bio-HCI community to exchange biomaterial recipes, biofabrication tools, biomaking practices, and biodesigned artifacts, as well as discuss some practical challenges that researchers face and opportunities for how this work can grow in the future. The workshop will be entirely in-person, consisting of two 90-minute sessions for an experienced group of 10-20 practitioners.

We invite submissions in the form of developed material, tool, practice, and/or artifact for the Bio-HCI community. All submissions are due February 12 AoE via the submission link on our website and should utilize the designated templates also found on our website. We will review submissions in relation to workshop goals and make selections based on the depth and diversity of the contribution. Accepted submissions will be compiled into a collective zine, which will be posted on our website, published on the open-source arXiv platform, and printed out to be physically distributed in Barcelona. At least one author of accepted contributions must attend the workshop and register for both the workshop and one day of the main conference. Learn more and submit here: *https://sites.google.com/view/growing-bio-hci*

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