awaking

Developing Practices Using Living Systems and Establishing Bio Art Labs: Guidelines and Perspectives from the Field

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Executive Summary

This white paper brings together diverse voices from the international bio art community to examine the current state of practice, share lessons learned, and propose pathways for the future. Produced within the framework of the Bio Awaking project—a Creative Europe-supported collaboration between partners in Serbia, Bosnia and Herzegovina, Slovenia, and Croatia—it reflects a shared commitment to advancing sustainable, inclusive, and socially engaged bio art.

Bio art occupies a unique space at the intersection of art, science, and environmental activism. By working directly with living systems, artists reveal the cultural, ethical, and ecological dimensions of biotechnology, often opening public debate where scientific discourse alone may not reach. The establishment of bio art laboratories, whether institutional or grassroots, is crucial to sustaining this work—providing access to the equipment, materials, and collaborative frameworks necessary for experimentation, education, and public engagement.

The sections of this white paper address complementary aspects of this emerging field. Authors reflect on the conceptual foundations of bio art, its role in science communication and public engagement, and the infrastructural, ethical, and ecological considerations of working with living media. Practical guidance is offered for establishing and running bio art labs, from funding and safety protocols to community outreach and cross-sector partnerships. By combining conceptual insight with practical guidance, this white paper serves as both a record of current thinking in the field and a roadmap for future development. It is intended for artists, curators, educators, scientists, cultural organizations, funders, and policymakers—anyone invested in building infrastructures that support responsible, imaginative, and impactful work with living systems.

Introduction

Bio art, as an evolving interdisciplinary practice, occupies a unique position at the intersection of art, science, and society. It engages directly with living systems, biological processes, and the ethical, cultural, and political questions that arise from our ability to manipulate life. Over the past two decades, this field has grown from isolated artistic experiments in scientific laboratories into a global network of practitioners, institutions, and communities who integrate biology as both medium and subject.

The establishment of bio art laboratories is a crucial step in supporting and expanding this practice. These spaces—whether embedded in universities, cultural institutions, community labs, or artist-run initiatives—enable creative work that requires access to tools, materials, and expertise traditionally restricted to the sciences. Beyond being sites of production, bio art labs are also platforms for public engagement, ethical reflection, and dialogue, bridging the gap between specialized scientific research and broader societal discourse.

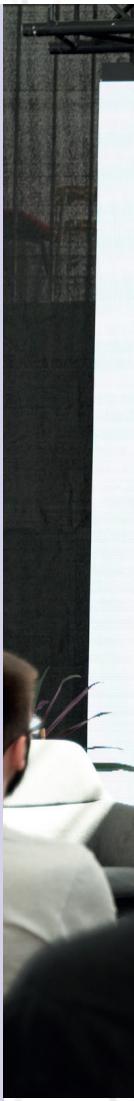
This white paper, Developing Bio Art Practices and Establishing Bio Art Labs: Guidelines and Perspectives from the Field, is produced within the framework of Bio Awaking, a transnational project uniting partners from Serbia, Bosnia and Herzegovina, Slovenia, and Croatia. Europe, as a shared natural environment, is facing significant environmental challenges, and the Western Balkans—rich in biodiversity but heavily affected by pollution—represents both a site of vulnerability and of opportunity. Bio Awaking addresses these challenges by advocating for sustainable development through participatory bio art installations, fostering dialogue between artists, scientists, policymakers, and the public. Its activities include the Bio Art Forum in Novi Sad, hands-on workshops, study visits, a mobile laboratory program, and festival exhibitions, all aimed at building a network of bio artists across Europe and strengthening their capacity to work with biomaterials.

The contributions gathered here draw on the expertise of leading artists, curators, researchers, and cultural organizers. Together, they explore conceptual foundations, practical guidelines, democratization strategies, ecological engagement, and ethical considerations. The aim is to offer both inspiration and actionable guidance—for artists seeking to expand their practice, for institutions looking to host bio art activities, for policymakers aiming to foster innovation, and for communities seeking to engage with the life sciences in more inclusive and sustainable ways.

By compiling lessons learned from the field, this white paper seeks to strengthen bio art's role as a catalyst for interdisciplinary collaboration, critical inquiry, and responsible innovation—ensuring that the future of biotechnology is shaped not only by scientific agendas, but also by cultural imagination and civic participation.

Biomediality and Microperformativity

Jens Hauser



Biomediality

While from an art historical perspective, art practices employing biotechnologies seem to continue the long-standing quest for aesthetic life-likeness, animation or aliveness, they operate, however, beyond imagination, representation, metaphor and simulation. Art that utilizes biotechnology can, but does not necessarily address thematically linked issues (Hauser, 2008). The specific materialities matter as general epistemic indicators to reflect a post-digital paradigm for which Roy Ascott coined the term moist media, "comprising bits, atoms, neurons, and genes in every kind of combination," and in which "the dry world of virtuality and the wet world of biology" merge (Ascott, 2001). In the recent past though, the generic catchword 'Bio Art' has also be claimed to describe iconographies to promote new ways of representing life, to include soft- and hardware to explore biological aspects or patterns, thus downplaying crucial ontological differences in practice, meanwhile neglecting the particular relationship, namely that of co-corporeality, between work and participant, and the importance of an actual organic presence, "with which the viewer comes into contact and with which he can sensually or multi-sensorially accomplish an affective corporeal projection." (Hauser, 2008)

An important question is how the media arts use biotechnologies and strategies to stage aliveness, and how they contribute to a continually changing concept of media, following a logic Jay David Bolter and Richard Grusin describe as remediation (1999): existing media are continuously shaped by newer ones and each new medium "appropriates the techniques, forms, and social significance of other media and attempt to rival or refashion them in the name of the real" (1999). Artists purposefully link instances of biomediality with pre-existing media – telecommunication, photography, etc. – to the biomedial realm, e.g. DNA is often used in place of traditional media to store or process extra-biological data. But also media definitions significantly before telecommunication or computational tools or infrastructures can gain relevance again, such as the notion of the 'milieu', e.g. 'growth media' in contemporary cell and tissue culture techniques. Nonetheless, "cultural studies and traditional media studies generally lack consideration of natural science

Jens Hauser delivering the talk
"Biomediality and Microperformativity: A Genealogy of a Contemporary Paragone"
at Bio Art Forum, Novi Sad, May 2024.
Photo: Elvira Kakuszi

and its history" when ignoring that the concept of medium since the 17th century was understood as 'intermediary element' in the natural sciences before it was superimposed by connotations as "'means' or 'tool'" (Porath 2008). In order to situate biotechnological art in the space between 'life' and 'media', I have proposed the concept of biomediality. It denotes all factors arising from technical manipulation or appropriation of living organisms or organic entities, elements and processes, which do not just represent, control, transmit, store or process something with regard to which they are supposed to be indifferent (information, text or images, sound, etc.), but which actually produce what they pretend to merely mediate. Biomediality can be understood as a special form of 'loose coupling' (Heider, 1926) of de- and re-organized biological entities (e.g. nucleotides, cells, model organisms), or as 'organized atomism' that differentiates itself qualitatively, however, from that of media understood merely physically, in that organisms as a central point of reference are or were, in the first instance, organized. Functional differences put forward by artists can be covered broadly by distinguishing three instances of biomediality (Hauser, 2016):

Biological Media: life-enabling milieus as existential conditions that enable a 'body' and its internal functions. Technically, this comprises experimental systems where milieus are simulated, biotic and abiotic ones, for example, in tissue culture, with incubators and growth media etc.
Biomedia: technical transformative-generative means (Thacker, 2004) whereby biological systems do something beyond their own organic purpose; "processing bodies" – molecules, organisms, populations, cells as synthesis factories, viral promoters, programmed bacteria etc.
Media of Biology: instances of measurement employed to measure, analyse and observe; dispositives in which one organic system reveals something about another to produce knowledge – historically positioned in the tradition of microscopy or cell cinematography – such as biomarkers, biosensors, DNA chips, or electrophoresis.

Employing biological agency in performative ways, such art increasingly indicates a general shift in focus from primarily human actions to nonhuman agency, including biological-technical hybrids that may have inherent performativity, beyond the artist's or the scientist's will. Cross-fertilizing aesthetics, media and performance theory, as well as science and technology studies, microperformativity(Hauser, 2014b; Hauser & Strecker, 2020) has been coined as a concept to describe and contextualize the recent attention paid to these other-than-human agencies, biological and technical ones alike, which challenge and subvert the mesoscopic tradition within which human phenomenological considerations are, still, rooted. Microperformativity questions the human scale (both with regards to space and time) – philosophically, politically and aesthetically – as a crucial point of reference (Hauser, 2020). Such techno-science inspired artistic practices aim at increasing awareness not only for the invisibility of the microscopic but also for the incomprehensibility of the macroscopic. Consequently, art in this field displaces the focus

from its mesoscopic actions to its microscopic functions, from physical gestures to physiological processes, and from staged diegetic time to real performative time, even of an experimental setting in a Petri dish.
While performativity often appears to be a proxy of agency and aliveness, it can also manifest itself in natural-cultural hybrids (such as experimental systems of natural sciences) or technical forms (e.g. algorithms or neuronal networks), linking the organic and mechanical. This prompts the question of how to achieve progressive acceptance by audiences, and asks for strategies of how the retreat of human performers can be compensated by inventive aesthetic solutions to create encounters with, and experiences for perceivers. Given the resulting hyper-medial interweaving in contemporary strategies to stage 'aliveness', phenomena that once assumed the form of artistic images are being translated, scattered, and fragmented, here, into a variety of instances of biomediality – not just as a means to an end, but as fully integrated elements of the aesthetic object.

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is a Paris-based media studies scholar, writer, and art curator focusing on the interactions between art and technology. He is currently a researcher and has been a Professor in Art History at the Karlsruhe Institute of Technology (KIT) since 2022. He is also a researcher at the University of Copenhagen's Medical Museion and a distinguished faculty member of the Department of Art, Art History and Design at Michigan State University, where he co-directs the BRIDGE artist in the residency program.

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Three Laboratories as One

Jurij Krpan

The Kersnikova Institute in Ljubljana hosts three interconnected laboratories—BioTehna, Vivarium, and Rampa—that support artistic research at the intersection of life sciences, technology, and society. As an integral part of the Kapelica Gallery, these labs form a unique ecosystem where artists, scientists, and engineers collaboratively explore living systems, robotics, and artificial intelligence. BioTehna focuses on biotechnology and educational workshops, Vivarium investigates coexistence between living organisms and machines, while Rampa develops mechatronic and AI-based tools for creative use.

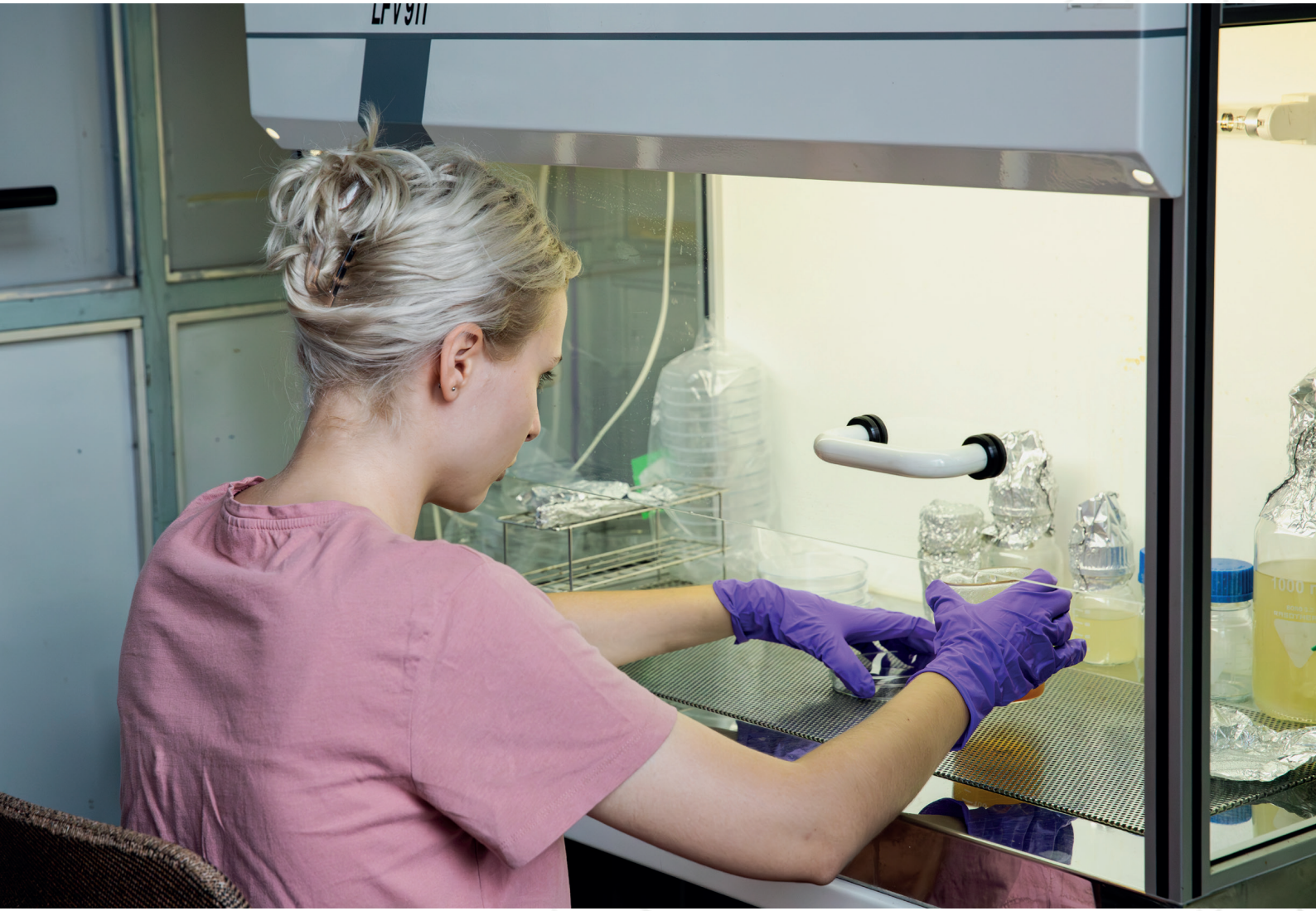
The idea to establish a laboratory for the artistic research of living systems was born from the challenges encountered while presenting complex art projects in the Kapelica Gallery. Between 2010 and 2013, German artist Stefan Doepner initiated a series of workshops and hackathons in Ljubljana, bringing together artists, scientists, and engineers. These one-week "social sculptures" encouraged collaboration across disciplines, using open hardware and discarded electronics to create innovative tools for art production. They demonstrated the necessity of cooperative, interdisciplinary work for artistic research in life sciences and technology.

These early workshops attracted participants from Hackteria, a global network led by Marc Dusseiller, a nomadic scientist and informal learning expert. Together with him, we secured support from the Swiss mechanism in 2012 and founded BioTehna, the first dedicated space for artistic research in life sciences under the Kersnikova umbrella.

Initially equipped with only basic furniture, BioTehna hosted workshops for all generations and incubated early art projects. However, as we began to work with more demanding bio-media, it became clear that the DIY infrastructure was not sufficient for reliable, sustainable artistic production. As a result, BioTehna's development took shape through two core practices, education and artistic creation. This dual model became the blueprint for future Kersnikova labs.

Educational activities are based on hands-on, do-it-yourself or do-it-together workshops, in which participants assemble relatively simple technological prototypes in a hacking-oriented way. The primary aim of these workshops is to transfer knowledge related to scientific inventions, engineering practices, and substantive solutions, focusing on their creative and often unexpected applications. In addition to solving technical challenges, participants also develop values that foster community dynamics, mutual support, and solidarity.

Study visit as part of the Bio Awaking project at the Institute Kersnikova, Ljubljana, Slovenia, June 2024. Photo: Mojca Gorjan.



Study visit as part of the Bio Awaking project at the Institute Kersnikova, Ljubljana, Slovenia, June 2024. Photo: Mojca Gorjan.

As a rule, workshops are developed as content extensions of specific artistic projects, in which artists use advanced technologies to express their imaginary worlds. The conceptual foundation of each workshop lies in the narrative of the artwork itself, while the materials, technologies, and procedures used in its creation offer diverse approaches and solutions. Through them, the boundaries of science and the potential for alternative, non-productivist uses of technology become visible. The knowledge and inspiration drawn from these artistic processes are then translated into workshop formats by the artists themselves, or by the mentors and hackers with whom we collaborate.

To support and sustain this creative ecosystem, we employed a biotechnologist and a producer who now serve as permanent collaborators in the lab. They help translate artistic visions into feasible biological experiments, while also fostering partnerships with external scientific institutions and experts. Over the years, BioTehna has expanded in response to the increasing complexity of the projects it supports, evolving into a nearly self-sufficient production unit, less dependent on outside institutional favors. Today, even researchers from scientific institutes have suggested conducting joint projects entirely within BioTehna.

In 2017, we launched a second lab, Vivarium, designed for work with model organisms and somatic cells. Operating under less rigorous hygiene constraints, Vivarium focuses on coexistence between living systems and machines. It serves as a space for exploring interactions among humans, animals, plants, and robots—investigating new hybrid forms of life and alternative technological futures. This research is especially relevant in the context of the ecological crisis and the ongoing sixth mass extinction. Vivarium's core mission is to imagine non-extractive, non-anthropocentric ways of living and relating to the world.

Vivarium complements BioTehna and connects it closely with our Rampa Laboratory, which focuses on mechatronics and artificial intelligence. Rampa explores the evolving relationship between humans and machines, especially in the context of labor and creative production. While the gallery has worked with electronics and programming since the 1990s, recent advancements in robotics and AI have prompted us to invest in more advanced hardware (3D printers, CNC machines, laser cutters) and to initiate new educational programs focused on cyber-physical systems and machine learning.

Rampa encourages tinkering and hacking while also addressing the complex ethical and technical challenges posed by autonomous robotic systems and the energy consumption required for computational needs. By equipping artists with tools and knowledge, we empower them to engage critically and playfully with emerging technologies.

Together, BioTehna, Vivarium, and Rampa form an interconnected system that supports artistic research and production across biology, technology, and artificial intelligence. Their synergy enables artists to imagine new forms of life—non-anthropocentric, hybrid, and symbiotic—and to critique the dominant paradigms of the Anthropocene. This ecosystem challenges scientific determinism and explores alternatives to the data-driven, biopolitical logic that reduces life to quantifiable metrics.

Our artistic explorations are increasingly informed by posthumanist and ecological thinking. In this context, artistic projects become platforms for imagining co-evolutionary relationships between species and systems. The idea of the holobiont—a host and its many microbial companions—is extended here to include not only biological but also technological and digital "organisms."

Currently, our collective artistic research is turning toward quantum biology—a field that tests the limits of sensory perception and rational understanding. Quantum phenomena, while elusive, may radically complicate how we define life and matter. These explorations demand hybrid intelligence—an entangled, creative reasoning that goes beyond pure science or pure art.

Artistic research within our labs embraces forms such as hybridization, symbiosis, parasitism, and cohabitation—concepts that emerge from life sciences yet stretch into philosophical and political realms. Many of our projects attempt to break free from the intellectual and legal frameworks that dominate institutional thinking.

Kersnikova's three laboratories—BioTehna, Vivarium, and Rampa—offer a unique infrastructure for experimenting with life, matter, and machines. They operate not in isolation, but in synergy with the Kapelica Gallery's curatorial vision and Kersnikova's educational outreach. Together, they form a powerful platform for investigating the political, ecological, and existential questions of our time—questions that cannot be answered by science alone, but require the speculative, poetic, and critical potential of contemporary art.

Jurij Krpan (SI)

In 1995, Krpan conceived the Kapelica Gallery - Gallery for Contemporary Investigative Art as a non-governmental and non-profit organisation. Since then, he has been its senior curator. As a curator and commissioner, he has contributed to both national and international exhibitions and festivals. Since 2012, he has been the artistic director of the Kesnikova Institute. He is a member of the National Council of Culture of the Republic of Slovenia from 2019 to date.

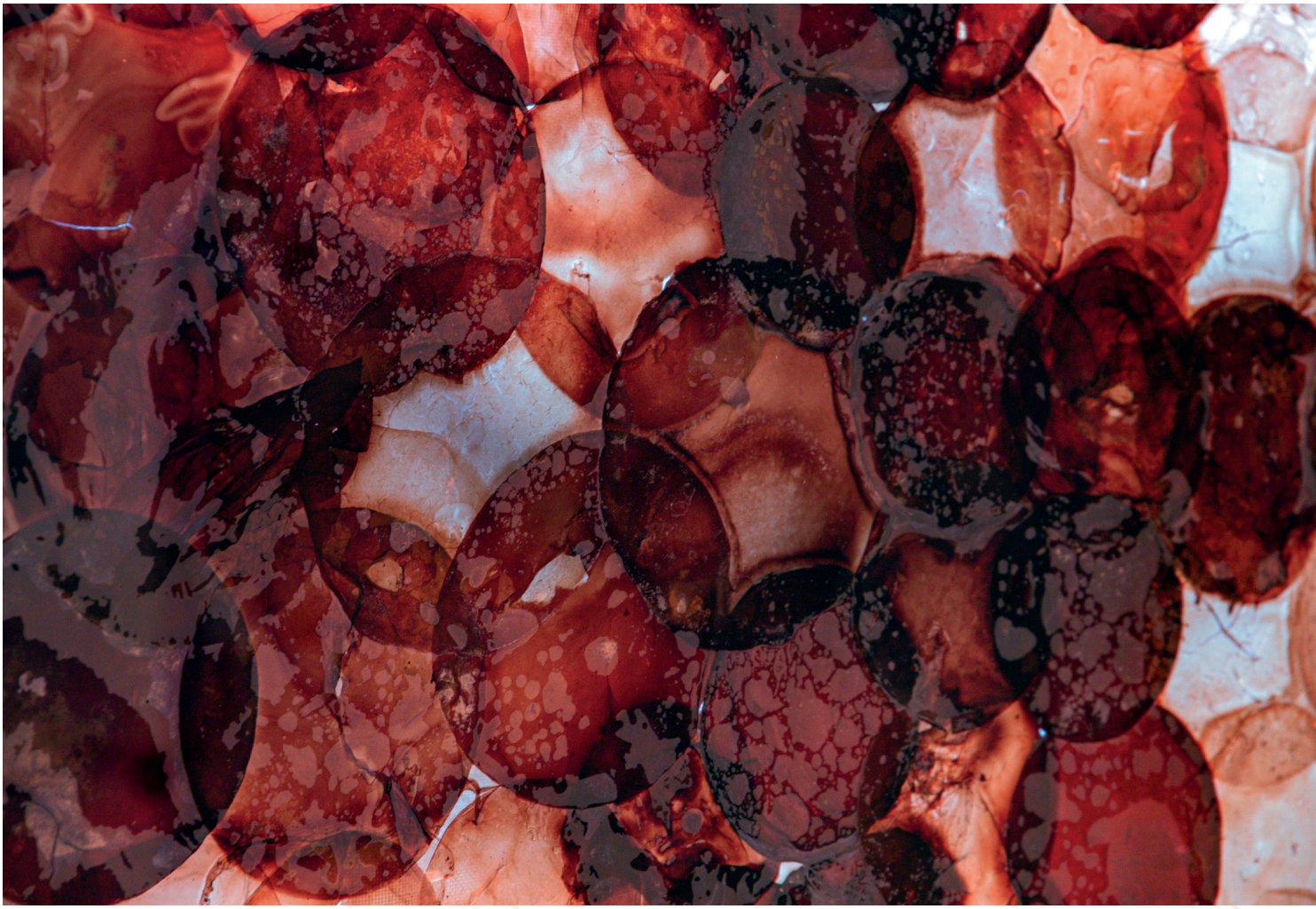
Interwoven Threads of Life: Bio Art in Interdisciplinary Practice

Adrienn Újházi

Bio art has rapidly evolved over the past two to three decades, increasingly merging with scientific research and engaging with diverse fields such as biotechnology, genetics, synthetic biology, ecology, anthropology and many more fields. The practice involves not only artistic creation but also a deep exploration of the intersections between life, technology, ethics, and beyond—such as biotechnology, artificial intelligence, ecology, and human-machine interactions. (Mitchell, 2010). As an emerging artist hailing from Serbia and working in this field, I have observed the shifting boundaries between art and science, where laboratories have become both workspaces and conceptual mediums internationally (Reichle, 2009). However, despite growing institutional recognition, significant challenges remain, particularly in accessing specialized laboratory spaces, which can be difficult for independent artists. Ethical and biosafety regulations could further complicate the process, requiring an in-depth understanding of biological research practices and their implications (Zurr & Catts, 2003). Within this field of research and artistic production, it is highly recommended to have consultations with an expert with a scientific background.

In Serbia, bio art practices and institutional collaborations are still in their early stages. While some curators and coordinators in cultural institutions support innovative ideas and are open to collaborations with scientific institutions or individuals. In this case, the initiative mostly comes within a cultural sector to a science institution who are open to supporting creative ideas and collaborating with artists. These opportunities remain relatively rare since challenges such as limited funding and the multidisciplinary nature of bio art, often spanning art and science, necessitate hybrid financial strategies. Nevertheless, some artists engage with bio art through partnerships with organizations of cultural or scientific background or local labs, particularly those that maintain DIY bio labs or collaborate initially with experienced mentors. These collaborations often focus on topics such as microbial and ecological art, biofabrication, biomaterials, and speculative thinking on bio art practices. These topics mostly

Adrienn Újházi and her work Stowaways. art+science festival in the Botanical Garden Jevremovac, Belgrade, September-October 2024.
Photo: Marko Risović



Adrienn Újházi, installation
You Make Me: La-La (detail), 2023.
Photo: Nemanja Mićević

cover the usage of bacteria, fungi, or ecosystems as artistic media, also growing artworks from biological substances like bacterial cellulose, mycelium, or lab-grown tissues by addressing ethical and philosophical questions about biotechnology, life sciences, synthetic biology, and so on.

My personal artistic work has always engaged with the tactile and ephemeral qualities of biological life. From microbial cultures to

speculative tissue shaping and decomposing organic matter, I have explored the aesthetic and conceptual dimensions of living processes, using fermentation and biofabrication as artistic tools.
My experience in collaborating with scientific institutions has been transformative, and one of the most recent collaborations is part of the 9th art and science festival in Belgrade, where I collaborated with the Center for Promotion of Science from Belgrade, and the Institute of Botany, the Jevremovac Botanical Garden, and the Faculty of Biology at the University of Belgrade. This project within the festival is titled Stowaways (linkovati http://adriennujhazi.com/stowaways-2024/), which focuses on the adaptation and migration of plant species within an artificial habitat, highlighting their ecological and sociological significance.
Stowaways' maps and archives 25 selected plant species within the Jevremovac Botanical Garden greenhouse, exploring their origins, natural habitats, and survival strategies.
The project also investigates the symbiotic relationship between plant cellulose and scoby (a symbiotic culture of bacteria and yeast), which develops under controlled conditions. Through an interactive installation, Stowaways invites visitors to engage with the resilience of plants and the dynamic interplay between natural and artificial environments. The project emphasizes the importance of plants within their ecological context, encouraging reflection on their role in a rapidly changing world.
In addition to the aesthetic and scientific exploration of living systems, bio art also raises critical questions about ethics and responsibility. The use of living organisms in artistic frameworks challenges our understanding of biopolitics, agency, and ecological impact (Zurr & Catts, 2003). Collaborating with scientific institutions and experts in bio labs has allowed me to access methodologies and technologies that are not typically available in traditional artistic settings. However, these collaborations require renegotiating artistic autonomy, as scientific protocols and different working environments influence creative processes.
One significant lesson I have learned through these collaborations is the necessity of patience. Working with living materials demands time, care, and adaptability, and unpredictability becomes an integral part of the artistic outcome. This challenges traditional notions of control in artistic practice.
Furthermore, interdisciplinary dialogue has been crucial in expanding my understanding of the intersections between art and life sciences. Engaging with biologists, engineers, and theorists has enriched my perspective and broadened the conceptual scope of my work. These exchanges not only provide technical knowledge but also deepen the conceptual foundations of artistic practice within the evolving field of bio art (Haraway, 2016).
Overall, bio art continues to challenge conventional artistic paradigms by offering new ways of thinking about life, technology, and creative expression. As the world continues to evolve, so too do the ideas, ethics, and practices surrounding bio art. By embracing interdisciplinary collaboration, material unpredictability, and ethical considerations, the bio art practitioners and bio labs will remain at the forefront of contemporary art and scientific inquiry (Mitchell, 2010).

Acknowledgments

I sincerely thank the institutions, scientists, and curators who have supported my practice. Special appreciation goes to the Center for Promotion of Science, the Institute of Botany and Jevremovac Botanical Garden, and the Faculty of Biology, University of Belgrade, for their collaboration on Stowaways. I also thank my colleagues from the Citizens' Association "Reaktor" for their support and openness to interdisciplinary collaboration, as well as all those who have shared insights and encouragement, embracing dialogue between art and science.

Adrienn Újházi (RS/HU)

Completed her BA in 2018 and her MA in 2020 at the Academy of Arts in Novi Sad, Department of Painting. Since 2021, she has been a freelance artist and, starting in 2024, a collaborator and member of the presidency of SULUV. Also, she continues to share her knowledge and experience in alternative artistic production through various initiatives which involve initiatives for projects like BIOFACTORY (2022), BIOCODE (2023), and BIO AWAKING (2023-25). She has received scholarships and awards, with her works featured in private and institutional collections. Her art has been showcased at various domestic and international cultural events. Adrienn fuses art, science, and technology to explore human-nature relations and public health, presenting her experimental work through exhibitions, projects, and talks.

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Recalcitrant Practices

Margherita Pevere

Art practice with ecology and biotechnology can reveal hidden aspects of relationships between humans, living matter, biotechnology, and also institutions. This short contribution offers a critical and queer perspective on how living matter sometimes seems to 'misbehave', or at least does not comply with the intention of artists and researchers. For this purpose, I adopt the concept of 'recalcitrance', i.e., the resistance to control or authority. Starting from my body memory of horses, I reflect on my artistic work with living and biotechnological matters to reflect on aesthetics and ethics.

Recalcitrance: body memory

My first experience with the word was during my youth with horses. A horse can suddenly pull back and refuse to follow instructions. It stops, its body mass contracting backwards. As a young person growing up in a semi-rural context, I learnt about relations from animals of different species and domestication levels as much as humans in my community. Animals taught me things I could not learn from words. This is how I learnt about recalcitrance and a few other things.
I clearly remember the haptics of 'my' horse suddenly stopping and refusing something, the animal's body pulling away from my teenager

Margherita Pevere, Hlymia (2024). A devotional diptych reflecting on the artist's autoimmune condition. Photo by Author.

Margherita Pevere, Lament (2024). Performance and installation exploring post-wildfire ecologies, more-than-human grief, and the role of moss in processes of restoration. Photo by Author.

muscles. It feels like an interference in the smooth attunement of movements, balance, and non-verbal communication that shapes horse-human co-evolution. In terms of physics, it is a counterforce acting against the motion that enfolds both human and animal, often resulting in the two bodies moving in diverging directions: the animal pulling backwards, the human propelled forward, losing balance, and sometimes falling.

I also remember adults imposing their authority on animals with questionable methods based on force and pain. My teenage body size would just not allow the same methods. I had to find other ways of convincing the animal. I had to learn to 'invite' the animal to trust me. I then understood that assertiveness does not equal forcing someone else to do something. For instance, I would get off the horse, pat it, and walk with it along a different way. Of course, such a strategy did not always work, but it worked often enough to teach me that trust is valuable and recalcitrance has a cause. With my horses, the cause could be an unrecognizable object, a sudden noise, or an unknown situation scaring them off. By starting from this understanding, I could find ways to communicate with the horse.

This is how I learnt about the word 'recalcitrant': a horse that refuses is recalcitrant. It does not matter the reason, recalcitrance is a behaviour, the act of refusal. Recalcitrant means also resisting authority or control; not obedient or compliant; refractory, but also resistant, rebellious, and therefore hard to manage or deal with (sic). In science, it is said of experimental matters that offer resistance. Generally, it implies a negative connotation.

When seen from the perspective of the recalcitrant one, however, things may look different. Fear or discomfort may be good reasons to be recalcitrant. Injustice can fuel rebellion. Conditions may be unsuitable for complying with instructions.

Recalcitrance: desires, protocols, and attunement of lab ecologies

The feeling associated with recalcitrance has resurfaced in my art practice with non/living[1] entities such as slugs, bacteria, cells, soil microbiome and various kinds of biotechnology. I have created performances, installations, and writings starting from the hands-on manipulation of life processes. This transdisciplinary experience has allowed me to observe how creative desires unfold through materialities, protocols (experimental set of instructions), contexts, and affordances. While each of these factors can influence the artistic outcome, here I am interested in materialities. My experience of materialities acknowledges the capacity of matter to influence its surroundings (Bennet, 2010). It also taught me to challenge classical Western divides like nature/culture, art/science, life/death. In this approach, 'to queer' becomes an active verb that acknowledges the primary focus on gender but further erodes Western binaries and normativities (Mortimer-Sandilands & Erickson, 2010; Radomska, Mehrabi, & Lykke, 2020).

1 The concept of non/living (Radomska 2020) indicates entanglement of the processes of living and dying beyond classical Western binaries

The idea of recalcitrance of non/living matter can thus help articulate how matter behaves beyond classical normativity.

Manipulating life processes for art and research comes with intersecting layers of ethics towards research, organisms, and the audience. One of these layers is research integrity, which is relevant considering how art may contribute to research or may be realised in collaboration with scientists. Beyond the differences between art and science and maintaining artistic freedom, aligning with good practices makes artists trustworthy and respectable. Another layer is the relationship with the non/living entities, which has been explored by artists in terms of aesthetics (Gessert, 2011), intentionality (Schubert, 2018), vulnerability (Pevere, 2022 & 2023), among others. A further important layer is the relationship with the audience. Art may intentionally provoke discussion on taboos or complex scenarios, and the manipulation of organisms amplifies society's sensitivity surrounding life and its politics (Vaage, 2016). An aesthetic experience can unsettle to illuminate hidden aspects of human relationships with the living and its ecologies.

Considering these ethical and philosophical frameworks, recalcitrance may become a concept through which to look at art practice and its meanings. It can happen that, during the creative and research process, something does not go as expected. Bacteria grow 'too little', soil substrate does not activate, experiments 'fail'. Something happens that interrupts the desired unfolding of things. Reasons may vary: sometimes protocols were not adequately implemented, a switch not activated, a 'wrong' bioreagent used. Yet, sometimes protocols are followed and nevertheless, there is a resistance: this is exactly where recalcitrance came to my mind.

Of course, a horse is different from bacteria, a companion animal enjoys a different status than a lab animal, and a whole organism has a different degree of autonomy than a cell line. There are material, evolutionary, and social factors that determine these differences, and a comprehensive discussion exceeds the scope of this short article. It may suffice to mention how artists have beautifully explored the status of cell lines (37°C by Polona Tratnik), compassion towards lab animals (Embracing Animal by Kathy High), inter-species kinship (K9 Topology by Maja Smrekar) or chemical ecologies (Phytoteratology by Špela Petrič and Wombs by Margherita Pevere).

Instead of flattening such differences, I intend to acknowledge how none of the mentioned living matters (a horse, a cell line, a bacterial culture...) are not intrinsically 'made' to comply with human desires. A domestic horse accepts riding after long co-evolution and breeding. A cell line would not survive without complex machinery and bioreagents, and bacterial colonies behave differently outside the calibrated ecologies of a biolab. Some animal species or bacterial strains have become 'model organisms' after being used in research often enough to optimise their growth requirements. What emerges is an ecology of slow, non-linear taming and sometimes adaptation. Living matter is laboriously brought to compliance. Working with non/living matter and biotechnology, I understand my practice as requiring technical skills but also a sort

of attunement or taming. While it is true that following protocols is key for complex procedures, there is also a need for intuition and openness. For instance, the smell of a growth medium may tell you when a bacterial colony is not doing well, even if protocols have been followed. In times of increasingly automated procedures, 'sensing' matter may be a useful skill to keep a connection with the process and react accordingly. 'Sensing' matters and processes can thus help understand when things are not going as expected and why.
My intuition here is that, rather than seeing things as 'not working', a perspective shift may allow a deeper understanding of the biotechnological process and the artistic work itself. Recalcitrant horses taught me to see the world from their perspective and attune my desires to their needs. In a similar manner, cell lines or bacterial cultures that 'misbehave' may result in an invitation to perceive the surroundings from their perspective, or at least try to. While it may be unfeasible for a whole human organism to perceive its surroundings as an epithelial cell, to attempt such a leap may reveal aspects that remain concealed in anthropocentric approaches.
Adopting recalcitrance as an analytical and artistic approach is a queer move: going beyond the negative connotation if its underpinning binary (compliance/refusal) may help understand better how non/living matter behaves, its relationalities (ethics) and context (ecology). In other words, recalcitrance can be seen as the moment where clashing desires and needs reveal further layers of meaning, ethical perspectives and aesthetic possibilities.

Margherita Pevere, PhD (IT/DE)

Known for her otherworldly work with living matter, ecology, and biotechnology, Dr Margherita Pevere is an artist and researcher addressing taboos like death, sex, and vulnerability. Her practice embraces object-making, installation, performance, and writing, which she weaves seamlessly thanks to her transdisciplinary background. Her project Lament on wildfire ecologies was awarded the COAL Prize Transformative territories mention 2024, and she was nominated for the Falling Walls Awards Category Art and Science 2023 for the body of work around her concept 'arts of vulnerability'. She co-founded the artists' group Fronte Vacuo and is a member of the Finnish Bioart Society and The Queer Death Studies Network.

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Possible Applications of Mushroom Mycelium in Art

Nenad Krsmanović

Humans have used mushrooms in a variety of ways for thousands of years, and they were present on the planet long before the emergence of the human species. Today, it is estimated that the Fungi kingdom consists of about 1.5 million species, of which around 70,000 have been described so far. Among them, some 14,000 mushroom-derived products are known, and about 650 species possess pharmacological characteristics (Blackwell, 2011). Fungi appear in nearly all art forms, including literature, paintings, and graphic arts; and more recently, contemporary art, music, photography, comic books, sculptures, video games, dance, cuisine, architecture, fashion, and design. The filamentous, fast-growing fungi (like molds) in suitable conditions and growth media often makes perfect subjects for time-lapse photography. Beyond physical applications, fungi have also inspired artists conceptually—whether through substances like psilocybin that alter perception, or through themes of decay and renewal, transformation, or cycles of matter. Interestingly enough, it has been proposed that the consumption of hallucinogenic substances of fungal origin might have contributed to the advancement of knowledge throughout history long before the recreational use of fungal-derived drugs like LSD in the 1960s (Meyer, 2020a).

Recent scientific research has demonstrated the potential of fungal mycelium to produce economically viable, environmentally friendly, biodegradable packaging materials as a substitute for polystyrene. Due to their low density, impact resistance, low thermal conductivity, and low cost, these materials are starting to impact several diverse fields such as construction industry (materials for packaging, insulation panels) engineering, architecture (building blocks, environmental restoration materials), interior design (acoustic and floor tiles, paneling, furniture, decking) and even the arts (leather and textiles) (Krsmanovic et al., 2024). Artist Aniela Hoitink investigated the use of pure fungal mycelia as dresses while reducing cost, waste, and labour intensity of cut & sew operations; her project MycoTEX - Mycelium Textile could replace plastics and leathers with compostable materials and improve the comfort and fit of fashion products. The fungal mycelia in MycoTEX is modular and dynamic and can be rebuilt upon necessity, but is also produced without waste and is fully compostable. Material is, therefore, grown and not manufactured in a traditional sense (NEFFA, n.d.). In Sweden, Amanda Selinder's work at Uppsala Art Museum, in cooperation with scientists transformed the biodiversity of fungi living inside tree leaves into visible artwork. They isolated numerous endophytic fungi from different plant leaves and then sub-

FunGArt – from isolation and manipulation to inspiration and installation, workshop led by Dr Milana Rakić, within the Kaleidoscope of Culture festival, SKUP venue, Novi Sad, Serbia, October 2024. Photo: Aleksandar Danguzov

cultured those fungi that excrete pigments into the media. The artist then used the fungal pigments to dye silk panels (Lundberg-Felten, 2022).

Enterprises like Mycoworks or Ecovative investigate the commercial production of materials of fungal origin. Characteristics like water repellence, buoyancy, strength, and elasticity might lead mycelium-based products to replace leather, clay, wood, or some type of plastics (Yin et al., 2025).

Mycelium bricks have been used to build architectural structures since 2009, when mushroom species G. lucidum and sawdust were combined to produce a structure called Mycotectural Alpha. The piece was commissioned by Düsseldorf Kunsthalle for the 25th anniversary of the Eat Art exhibition, after which it was brewed and served to museum guests as herbal tea (Ross, 2009).

The tallest known mycelium-based architectural installation to date remains Hy-Fi, a 13-meter tower built in 2014 by The Living at MoMA PS1 in New York. It won the Young Architects Program Award and consisted of over 10,000 compostable bricks made from agricultural waste and mycelium, developed in collaboration with Ecovative Design (Holcim Foundation for Sustainable Construction, n.d).

As a mycologist, my first encounters with mycelium were purely scientific—petri dishes, growth media, and microscopy. Yet, over time, I began to see it not just as a biological network but as a living collaborator, capable of shaping form, texture, and even narrative. The experience of working with mycelium often feels like navigating between two worlds—one rooted in the precision of laboratory science, the other in the fluid, unpredictable nature of art. Working with mycelium is unlike working with inert materials; it breathes, grows, and changes in response to its environment. That vitality is precisely what draws me to it as an artistic medium—it transforms the creative process into a dialogue with nature. Each project becomes an experiment not only in material form but in collaboration—between disciplines, between human and organism, and between tradition and innovation. In that space of uncertainty and growth lies the real magic of mycelium: its ability to connect seemingly separate worlds into one living, evolving structure.

In the Balkans, the exploration of mycelium as a medium comes with both opportunities and challenges. On one hand, we have a rich tradition of mushroom foraging and an intuitive cultural connection to fungi through folklore and cuisine. On the other hand, the infrastructure for bio-based materials research and large-scale artistic production is still developing. Access to controlled growth facilities, funding for interdisciplinary projects, and a wider public understanding of mycelium's potential remain limited. Despite this, local interest is growing, particularly among younger artists and designers eager to merge sustainability with creativity.

Plastic has become an inseparable part of modern life, embedded in countless products and environments. Yet, its persistence in nature and harmful impact on ecosystems — from polluting oceans to threatening biodiversity and entering food chains — has made it one of the most pressing environmental challenges of our time. In response, researchers and artists are increasingly turning to mycelium as a natural and sustainable alternative to synthetic materials. Beyond its potential to reduce ecological impact, mycelium also opens space for dialogue at the intersection of art, ecology, and innovation.

FunGArt – from isolation and manipulation to inspiration and installation, workshop led by Dr Milana Rakić, within the Kaleidoscope of Culture festival, SKUP venue, Novi Sad, Serbia, October 2024. Photo: Aleksandar Danguzov

Nenad Krsmanović, PhD (RS)

(born 1983, Sremska Mitrovica) is a biologist specializing in microbiology, mycology, biochemistry, and biotechnology. He obtained his MSc in Microbiology in 2018 and completed his PhD in September 2024 at the University of Novi Sad with a dissertation on the potential of lignicolous fungi (Schizophyllum commune, Flammulina velutipes, Trametes versicolor, and Pleurotus ostreatus) for biomaterials and functional food production. Since 2019, he has progressed from Research Trainee to Research Associate, contributing to Innovation Fund PoC, EU4Tech PoC, and EIT Jumpstarter projects. He has published three first-author, five co-authored SCI papers and presented at nine international and domestic conferences. He is also active in scientific publishing and project management.

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Living Art – the art that lives, dies, and lives again...

Karolina Żyniewicz

I am not a big fan of the term bio art, although I understand that people need terms and labels to put some order to reality. I prefer to say that I perform living art. It is also a term, but, in my opinion, much more voluminous. Every form of art is living, containing the life of its creator and entering a dialogue with various contexts. Recently, I have often referred to the „storied matter" concept by Oppermann and Iovino, explaining that every form of matter plots a story by its very existence. Stories are based on processes and processes on changes. Art is a matter in constant flux, building different relations on every stage of its existence. Destruction can be perceived as the death of an artwork, but the afterlife is possible thanks to documentation and written discourse. Bio art is a living art based on building specific relations between living beings. Bio art artworks have a rather short lifespan, dictated by the quality of relations and the specifics of collaborators; the afterlife comes faster than in any other kind of art production. Since the relations and exchange are the essence of living art, it is crucial to care about their quality by acting respectfully and responsibly.

Karolina Żyniewicz, Safe suicide. First step – taking artist's blood, at Institute of Genetics and Biotechnology, Warsaw (2016). Photo by Author.

The matter of terms and definitions

Art is a complex phenomenon that resists a single, fixed definition (obvious but necessary). Throughout history, both art theory and related disciplines have proposed various definitions and categories to frame it. As humans, we naturally create labels to bring order to a chaotic and unpredictable reality. These labels also serve as tools for communication. Bio art (or bioart, or bio-art) is one of the categories defining a sector of artistic creation related to biology. I am simplifying here because even within this category, we have various ways of describing it (considering, for instance, the Bio Art Manifesto (Kac, 2017), Mitchell's classification (Mitchell, 2010), or Bardini's concept (Bardini, 2011)).

I prefer to say that I perform living art—another label, yes, but one that feels more expansive.

In a sense, all art is alive: it has a lifespan, often connected to the life of its creator, and exists in continuous dialogue with shifting cultural and social contexts. The physical destruction of an artwork may be seen as its death, but it can live on through documentation (photo, video, audio) or the stories told about it, both spoken and written. Bio art directly engages living organisms and often has a far shorter lifespan than new media works or traditional art forms like painting or sculpture. The life conditions of the organisms involved determine its longevity. In this context, the afterlife—the way the work continues through documentation and discourse—is not just important, but essential.

I created my first living/dying piece, Non Omnis Moriar (a polyester "body" with a meat interior), during the third year of my master's studies (Żyniewicz, 2023). The piece continues to decay, and I continue to document its transformation. Bojana Kunst, in her writing on art in late capitalism, observes that contemporary practice increasingly centers on ephemeral processes and their documentation (Kunst, 2015). This fundamentally challenges the traditional art market, which is built around the collection and preservation of objects. Would a museum or gallery purchase a work that changes unpredictably over time and disappears eventually? Unlikely. Would they buy the documentation of the process? Perhaps. I embrace this challenge. I'm at peace with the fact that most of my works aren't marketable, and truthfully, I wouldn't sell them anyway. I live through and with my projects—I'm not interested in selling my life.

In a dialogue with matter

Art is a specific form of matter, even if that matter is purely conceptual. Matter itself isn't just physical; it carries meaning and significance. Artistic technique alone is not enough without the message it conveys. Lately, I've been drawn to the theory of "storied matter" developed by Turkish scholars Serpil Oppermann and Serenella Iovino (Iovino & Oppermann, 2014). They propose that all matter tells a story simply by existing. By extension, every artwork tells a story, too. As an artist, I see it as my responsibility to care for that story and nurture its dialogue with the audience.

It's easy to recognize when an artwork lacks a deep understanding of its materials. Bio art, by most definitions, is rooted in relationships and exchanges between human and non-human living beings. Every participant in that collaboration—every agent—brings their own story.

The artist becomes a facilitator who fosters relationships and weaves intersecting narratives together. This kind of practice cannot exist without responsibility, response-ability (Haraway, 2016), and

Karolina Żyniewicz, Non Omnis Moriar. Wytwórnia, Łódź (2008). Photo by Author.

respect. These values form the ethical foundation of bio art. At present, there are no formal bioethical guidelines specifically tailored to the intersection of art and biotechnology. As a result, each practitioner must rely on their own internal ethical compass.

There is nothing worse than "cool"

Alongside responsibility and respect, authenticity and honesty are essential, especially in my personal framework of what matters in art. I can sense when a work is authentic. That's when I can truly connect with it. I know, then, that the artist understood how to cipher and decipher matter. I look for an invitation—an entry point into the network of relationships the artist has initiated through the work. When I began my experimental practice during my master's studies (2004–2009), bio art was still a niche field, represented by just a handful of artists like Joe Davis, SymbioticA, or Kathy High. Of course, I refer here to the emergence of the term bio art, knowing that art engaging with embodiment, nature, and the environment has existed for centuries.

At the time, projects based on biotechnology felt radically innovative and progressive. What I appreciated most was their critical and courageous nature. Some works even involved real personal risk for the artist, such as May the Horse Live in Me by Art Oriente Object. I grew up in Poland in the 1980s and 90s, and the Polish Critical Art movement (Kowalczyk, 2006) has always served as a key reference point for me. I've long sought out art that communicates through direct, radical messages.

A core principle of bio art—highlighted in the Bio Art Manifesto—is the artist's genuine engagement with scientific methods and the formation of dialogues with scientists. Beyond the financial demands of producing this kind of work, the greatest challenge is often finding scientific collaborators and gaining access to a lab. In my view, this challenge is vital. It demands strong social skills and a willingness to step outside one's comfort zone. Collaborating with scientists—many of whom may not be familiar with art—requires clarity of intention. This stage alone often filters out those whose motivation boils down to "I want to work with bacteria because it's cool." There's nothing less convincing than "cool" as a motive. To move beyond this stage, the artist must know exactly what they want to do—and why. Scientists need to see that the artist is serious and professional. It may seem obvious, but too often, it isn't. Scientific labs are not playgrounds. I'm often asked how to approach a lab, and my answer is simple: have a good reason.

"Cool" has a double meaning. It can suggest something playful or trendy, but it can also imply something average and superficial. When I encounter a "cool" project, it often feels flat and empty, lacking emotional depth or intellectual resonance.

Late capitalism tempts artists to focus on entertainment and technological spectacle. But this is a dangerous trap. Now more than ever, we need to remain sharp, critical, and reflective.

Relate, not illustrate

Knowing who you are—and where you stand—is essential when building relationships with scientists. It helps prevent you from losing your footing within the collaboration.

Bruno Latour observed that a sociologist entering a scientific lab must contend with the "study up" effect (Latour, 2010)—where the social position of the environment is perceived as higher than their

own. The same dynamic applies to artists entering laboratories. It's always, to some degree, a game of power. Each time I've entered a new lab, I've felt a mix of deep appreciation and ecstatic fascination. Compared to my fellow scientists, I felt small—even naïve. This is a normal, even healthy, phase—as long as it remains just that: a phase. Eventually, it must evolve into a sense of belonging, into the ability to position yourself within the space.

Respecting scientists doesn't mean the artist should surrender or deny their own role. If that initial awe persists too long, it can reduce the artist to the role of a scientific illustrator—and that's not the point of this practice. There's nothing wrong with science communication—it's valuable and necessary.

I've never shied away from educational activities connected to my projects. Still, artistic self-esteem must be preserved. When you're grounded in your core artistic intent, it's easier to take on side roles without compromising your identity or purpose. The challenge is that maintaining self-esteem—and having the courage to be critical and discursive, even toward the lab hosting or supporting your work—requires a certain level of experience and maturity.

I entered my first professional lab at age 32, with 17 years of self-directed, biology-related practice behind me. That entry point was also tied to my PhD project. Of course, I couldn't predict every step of the collaboration, but I was clear about what I needed to learn—and fully committed to giving the process my time and undivided attention.

Whenever I teach bachelor's or master's students, I often sense they're not quite ready for this kind of engagement. They would benefit from a mediator or facilitator—someone to help navigate the complexities of collaboration with scientists.

Teaching bio art

Since I first encountered it, the field of bio art has evolved significantly. It's now far more visible and widely practiced—even to the point where dedicated laboratories exist within art schools, such as Aki Biolab in Enschede (Netherlands), Biofilia at Aalto University in Helsinki, or the Coalesce Center for Biological Art in Buffalo, New York.

While the field is becoming well-established in the art world, it's still relatively new in art academies and universities—and that raises complex feelings for me. On the one hand, it's encouraging that students are being introduced to the possibility of working with non-human living beings. On the other hand, many of these academic labs are quite basic and not equipped to support more ambitious or technically demanding projects. I believe art schools should focus on preparing students for life beyond the institution, encouraging them early on to seek collaborations, build meaningful relationships, and approach their practice professionally.

Artist-focused bio labs can spark curiosity and introduce new possibilities, but they should be just the starting point. What must follow is transdisciplinary training. Today's art production demands a wide range of skills beyond creation, such as project planning, budgeting, and grant writing.

I was once one of those students, graduating with distinction and romantically believing that the world was waiting for me. But the truth is, nothing is waiting. After completing my master's degree, I was hit with a harsh dose of reality. I do whatever I can to help younger colleagues avoid that same cold awakening.

Karolina Żyniewicz, PhD

is a Berlin-based artist&researcher&educator, a liminal being, existing and performing between various contexts and disciplines. She is a graduate of the Faculty of Visual Arts of the Strzemiński Academy of Fine Arts in Łódź and holds PhD in cultural sciences (obtained in the transdisciplinary program Nature-Culture at Artes Liberales Faculty, University of Warsaw). While executing art&research projects based mainly on biotechnology and medicine, she also conducts ethnographic and autoethnographic observations. The topics of her work are related to broadly understood life and death. Her work is strongly process-oriented, she often participates in residencies, and group research projects.

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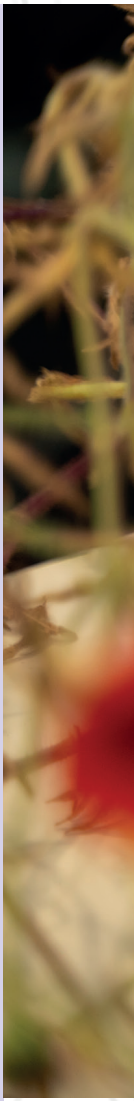
Bio Art as a Medium for Science Communication

Bojan Kenig and Đorđe Petrović



Bio art is broadly understood as a contemporary art direction that incorporates and manipulates living materials and biological processes into artistic production (Kac, 2007). It is not simply art that illustrates biological concepts, but art that works directly with life. We acknowledge that the classification and delimitation of bio art are frequently debated topics. Artists themselves use varied terms for it, engaging in individual actions and practices rather than adhering to a single, unanimous movement (Byerley & Chong, 2014). Bio art may involve the use of cells, proteins, genes, or entire organisms as its medium; it may grow tissues in laboratories, design synthetic organisms, or create semi-living sculptures (Kac, 2007). In doing so, this type of art confronts and complicates questions of life, ethics, control, and identity in an era of rapidly advancing biotechnology.

As such, bio art is not just materially novel; it is conceptually radical. It occupies the borderlands between science, art, ethics, and philosophy, challenging distinctions between the natural and artificial, the human and non-human (Gonzales Valerio, 2012).

This unique integration of artistic inquiry and biotechnological tools positions bio art as a novel medium not only for aesthetic and philosophical expression but also for science communication. We want to explore how this approach can enhance public understanding of life sciences and biotechnology, while also acknowledging its limitations and challenges.

Interactive session: New Reproductive Technology and the Human Germline Commons (Dr Adam Zaretsky) at Bio Art Forum, Novi Sad, May 2024. Photo: Elvira Kakuszi

Practice-based session I: Transformative relations – intertidal moment (Gjino Šutić & Filip Grgurević) at Bio Art Forum, Novi Sad, May 2024. Photo: Elvira Kakuszi

Bio Art as Science Communication

Science communication is the practice of informing, educating, and engaging the public with scientific knowledge, with goals ranging from raising awareness and fostering understanding to supporting critical thinking, democratic participation, and ethical reflection on science's role in society (Burns, O'Connor, & Stocklmayer, 2003). Emotional engagement and personal relevance are increasingly recognized as

essential for building public trust and motivating action (Communicating Science Effectively: A Research Agenda, 2017). In this context, bio art offers a unique contribution by visualizing and materializing complex, often abstract biotechnological processes in ways that are emotionally resonant, ethically charged, and publicly accessible (Thacker, 2007). Through multisensory, experiential approaches—sometimes described as "aesthetic cognition" (Root-Bernstein, 2002)—this kind of artistic practices provoke dialogue, raise awareness of ethical dilemmas, and invite broader participation in debates about the futures shaped by biotechnology.

By revealing the mechanisms of synthetic biology, genetic engineering, or tissue cultivation in forms that can be touched, seen, and emotionally felt, bio art demystifies the scientific process and makes it more accessible to non-specialist audiences (Segarra et al, 2018). A strong and well-known example of such artwork is "Victimless Leather" (2004) by Oron Catts and Ionat Zurr, founders of the Tissue Culture & Art Project, which powerfully illuminates tissue cultivation while inviting viewers to reflect on the implications of synthetic biology intellectually, while at the same time experiencing them viscerally.

Crucially, this kind of artistic approach makes room for ambiguity, relationality, and hybridity. As already mentioned, it resists clear categorization, and in doing so, mirrors the messiness of real-life ethical dilemmas in life sciences. Many of these artworks evoke unease, wonder, or ambivalence, which are feelings essential for grappling with the ethical gray zones of genetic manipulation, animal experimentation, or ecological intervention. Rather than reducing the complexity of life, bio art embraces it, urging society to re-evaluate relationships between humans, nature, and machines.

In educational contexts, it can help students and the public develop empathy for non-human entities, including cells and unicellular organisms. Such empathy is not sentimental, but philosophical: it invites reflection on the agency, value, and vulnerability of different forms of life. In doing so, bio art cultivates a sensitivity to the radically Other and nurtures openness to bioethical reflection and more responsible scientific engagement. This sensitivity is exemplified in Maja Smrekar's performance series K-9_topology (2014–2017), which explores the deeply entangled relationships between humans and dogs. By enacting interspecies intimacy, her work challenges anthropocentric hierarchies and demonstrates what it means to take another being's needs seriously, both emotionally and biologically.

Bio art also challenges the legitimacy and goals of science (Tratnik, 2023). It questions assumptions about progress, objectivity, and utility (González Valerio, 2012). Some bio artworks act as counter-narratives to the optimistic, sometimes uncritical, rhetoric of techno-solutionism that often accompanies advances in biotechnology. By exposing the material fragility, unintended consequences, and ethical dilemmas of bioengineering, artists can deflate the myth of technological omnipotence (Vaage, 2016; Catts & Zurr, 2020). Špela Petrič's work Confronting Vegetal Otherness: Skotopoiesis (2015) is a strong example of such a counter-narrative: instead of presenting

technological mastery over life, it highlights slowness, care, and the ethical ambiguity of human–nonhuman entanglement, opening space for democratic, embodied contemplation.

Critiques and Challenges

Despite its transformative potential, bio art also face important critiques and limitations that affect its efficacy as a medium for science communication.

First, this kind of art is often situated within elite institutional or gallery settings, which can alienate the very public it seeks to engage.

While it moves life science out of the laboratory, it sometimes merely relocates it to another specialized space, often out of necessity, as maintaining living organisms requires controlled environmental conditions (Kera, 2020).

The effectiveness of this approach as public engagement depends significantly on context — whether it is shown in museums, schools, community labs, or digital platforms — and on how much it fosters interaction rather than spectacle.

The allure of novelty and technical virtuosity may tempt artists to prioritize what is scientifically possible over what is conceptually or ethically necessary. This can lead to artists being perceived as advocating for advanced biotechnology as the solution, a phenomenon labeled "technophilia" (Thacker, 2003; Byerley & Chong, 2014).

Access is another issue. The tools of biotechnology, PCR machines, sterile environments, and cell cultures, are costly and often restricted. This can limit bio art to well-funded artists or institutions, excluding more grassroots or activist-oriented practices. Relatedly, bio art can be perceived as elitist or exclusionary (Kera 2020), particularly when it does not share its tools, knowledge, or space with a broader public. These challenges are increasingly being addressed through Do-It-Yourself (DIY), Do-It-With-Others (DIWO), and Open Science approaches that empower individuals to engage directly with biological processes, fostering a more inclusive and accessible form of bio art that moves beyond institutional constraints. A notable example is the Hackteria network, an open-source platform where artists, scientists, and activists collaboratively build low-cost bio-labs and experiment with microbiology and environmental sampling.

Moreover, some audiences may be disturbed by the manipulation of life forms, even when done for critical or artistic purposes. Bio art evokes strong affective responses—sometimes fascination, sometimes revulsion (Catts & Zurr, 2020). These responses are part of its communicative power, but also present ethical dilemmas, as the boundary between artistic representation and the instrumentalization of life becomes fragile, demanding a careful balance between critical provocation and ethical care.

Final reflections

Bio art is a compelling and disruptive force in contemporary science communication. By working directly with the materials and processes of life, it offers a unique platform for engaging the public in complex biotechnological debates.

It provokes ethical questioning and cultivates a more involved, responsible relationship between science and society.

At its best, bio art illustrates, questions, moves, and transforms. It illuminates how biotechnologies work while exposing their ethical, social, and political dimensions. This approach invites us to develop a new language, sometimes provocative and explicit, sometimes visually stunning, for talking about life in the age of biotechnology. By highlighting ambiguity and empathy, it challenges the illusion of scientific neutrality and human mastery. It also offers an inclusive, affective, and philosophical approach to understanding the variety and manipulation of living in the contemporary world.

Yet bio art's effectiveness is contingent. It must overcome challenges of accessibility, institutional co-option, and ethical ambiguity. For bio art to realize its communicative potential, it must remain reflexive, participatory, and attuned to its social and cultural environment. It must cultivate humility as much as critique, and openness as much as provocation.

Bojan Kenig, PhD (RS)

is a science communicator, curator, and researcher. His practice bridges scientific research, artistic experimentation, and public engagement, with a focus on how art can foster ecological awareness and democratize knowledge. He has coordinated numerous art+science exhibitions, initiated Serbia's first Open Call for Citizen Science Projects, and co-founded the Bio2Arh association dedicated to exploring relations between organisms and environments. At the Center for the Promotion of Science, he develops participatory formats such as forums, installations, and workshops, and promotes responsible research and science communication in the age of ecological crises.

Đorđe Petrović (RS)

is a science journalist and communicator whose work explores the intersections of science, technology, and art. At the Center for the Promotion of Science, he writes for the online platforms Elementarium and art+science, and serves as assistant editor and contributor to the popular science magazine Elements. His writing aims to bring complex scientific and technological developments closer to wider audiences through critical reflection and engaging storytelling.

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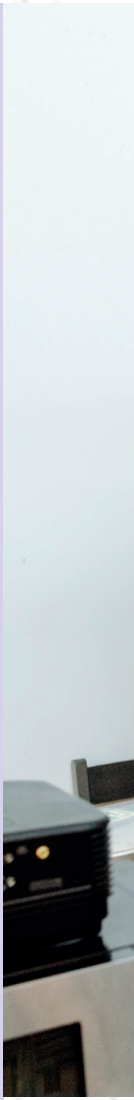
Beyond genes – the Second Wave BioArt

Gjino Šutić



Introduction and definition

In the early twenty-first century, a quiet yet radical movement began to pulse through the veins of contemporary art. Artists no longer sought only to represent life, but to work with it. Within Petri dishes, bioreactors, and makeshift laboratories, a new kind of creative dialogue unfolded – one that questioned where art ends and life begins. This is the realm of BioArt, and within it, the second wave marks a profound cultural and philosophical shift.

BioArt is not merely a practice; it is an act of reimagining humanity's entanglement with living systems. The second wave of BioArt, the focus of this essay, brings forth a democratisation of biotechnology, the birth of new ethics, and the expansion of creative agency to include the cellular, microbial, xenohuman, and (bio) synthetic. It is a movement that dissolves the sterile walls of the laboratory and invites life itself into the cultural sphere.

The question "What is BioArt?" resists a single, unified answer. Each practitioner brings unique methods and intentions, often blurring disciplinary boundaries. Broadly speaking, BioArt can be described as art that employs biotechnology as its medium. According to IUPAC (1992), biotechnology is "the integration of natural sciences and engineering sciences in order to achieve the application of organisms, cells, parts thereof, and molecular analogues for products and services" (p. 148). Extending this logic into the aesthetic domain, BioArt can thus be defined as the integration of art, natural sciences, and engineering to create living works and processes of artistic value.

This definition carries both technical and poetic weight. It recognizes that biological matter – cells, tissues, and DNA – is not merely a tool and/or a medium but also an active collaborator in the creative process.

BioArt transforms the laboratory into a studio, and science and (bio)engineering into a form of storytelling.

First and Second Wave of Bio Art

The first wave of BioArt (early 1990s – mid-2000s) emerged amid the digital and

Intro to BioLab work (DIY & professional settings), workshop led by Gjino Šutić (Universal Research Institute – UR Institute) & Kristijan Tkalec (Kersnikova Institute), within the Kaleidoscope of Culture festival, SKUP venue, Novi Sad, Serbia, October 2024.
Photo: Aleksandar Danguzov

biotechnological revolutions of the 1990s.
As genetic engineering, hacking culture, and cybernetic philosophy intertwined, artists began to explore life as code and the body as a programmable medium. The Human Genome Project, the cloning of Dolly the sheep, and the rise of transhumanist discourse provided fertile ground for this exploration. Eduardo Kac's (US/BR) Genesis (1999) and GFP Bunny (2000) epitomised this era – playful yet provocative gestures questioning the sanctity of life and authorship.
We could postulate that the second wave (mid-2000s – 2020s) arose from both consumer technology evolution, sustainable development crises, and related cultural angst. As affordable prototyping tools — such as Arduino, Raspberry Pi, and 3D printing — entered the mainstream, artists gained direct access to experimentation once reserved for industrial or academic settings. Parallel to this, the Anthropocene narrative and sustainability concerns reoriented attention from the genome to the ecosystem, from genetic to epigenetic.
Second-wave BioArt shifted from the fascination with genetic manipulation towards ecological interdependence, hybridisation, and the ethics of coexistence. Biohackers, DIY biologists, and open-science practitioners transformed kitchens and garages into laboratories of living inquiry. Artworks became habitats – systems that breathe, mutate, and respond.
Among the turning points that marked this transition were Victimless Leather (2004) by Oron Catts (AU) and Ionat Zurr (AU), a living leather jacket grown without killing animals; Ear on Arm (2006) by Stelarc (CY/AU), a daring exploration of body augmentation and identity; and Creative Biotechnology: A User's Manual (2004) by Natalie Jeremijenko (AU) and Eugene Thacker (US), which functioned as both an early manifesto and a practical handbook for participatory, hobbyist biotechnology.

Second Wave scope and definition of the BioArtist

The second wave of BioArt unfolds through artists who merge scientific precision, poetic vision and Do-It-Yourself (DIY) biotech techniques – transforming living matter-cells, organisms, and ecosystems into both material and co-authors. This movement reflects a profound shift from merely representing life to collaborating with it, blending biotechnological research, ethical inquiry, and DIY artistic (bio) experimentation. The second wave brings a plethora of topics and DIY techniques. Artists such as Polona Tratnik (SI) and Marta de Menezes (PT) define the use of human cells and tissues as artistic media, while Ai Hasegawa (JP) and Jaden J.A. Hastings (AU) explore the intersections of biotechnology, identity, and speculative futures. Anna Dumitriu (UK) and Karolina Żyniewicz (DE/PL) engage in exploration of pathogens; meanwhile, artists such as Margherita Pevere (DE/IT), Paula Pin (ES) engage in (transhack) feminist and ecological discourses through biotech practices. In Slovenia, a group of artists has collectively shaped a strong regional network of BioArt practice in its diversity; Špela Petrič – with plant-human topics, Maja Smrekar – with human-canine equality and post-Anthropocene topics, Saša Spačal – with fungal and Earth narratives, and Robertina Šebjanič – with water ecology-related topics. Gjino Šutić (HR) and Marc

Dusselier (CH) incubate BioArt development through setting up fully open-access Biotech/BioArt laboratories (both permanent and pop-up) where they themselves and most of the abovementioned artists, with their support, create innovative BioArt pieces. Using open-source, DIY, and community-engagement approaches, democratizing biotechnology and focusing on collaborative knowledge exchange, the second wave BioArt scene is unified. Together, these artists – alongside many others contributing to the evolving field – form an interconnected creative ecosystem, where art and science coalesce into acts of curiosity, resistance, and care. The important note that also distinguishes the abovementioned second wave BioArtists is their mastery of the BioArt techniques and biotechnology knowledge, no matter if it comes from a formal background (scientists turned artists) or DIY learning (artists turned scientists), which enables them to be true and complete authors of their BioArt work. Thus, the "artist in BioArt" is defined as a person who has a full mastery of (bio)techniques to create their own BioArt work. Accordingly, the proper fusion – an amalgamate of science, engineering, and art is achieved in individuals and their work, merging borders indistinguishably.

Centers of Creative Fermentation

While the first wave has been historically rather well-documented and US-centric, the second remains more elusive due to being decentralized and dispersed, avant-garde and experimental, while mostly European in its philosophical texture and diversity of practices. It thrives in residencies, collectives, and self-organised laboratories that dissolve the old hierarchies of science and art.
Europe has, relatively unnoticed, become the gravitational center of second-wave BioArt – home to interdisciplinary ecosystems that nurture experimentation and public dialogue, with several key hubs and institutions serving as incubators for influential BioArt practices and schools of thought, including:

Ars Electronica (Austria) – with its ecosystem of festival, center, and related labs – pioneers in showcasing new media art (including BioArt) since the rise of technology-related art as early as 1979. Next to gathering a global scene at the annual festival showcase, it conducts production and offers insight into BioArt through its BioLab at the Ars Electronica Center.

Bioart Society (Finland) is an association working at the intersection of art, science, and society. Established in May 2008, committed to developing, producing, and facilitating activities around art and natural sciences with an emphasis on biology, ecology, and life sciences. Incubating BioArt through production and residencies, such as its "Ars Bioarctica" program.

Microphoto safari – hunt for water bears, workshop led by Gjino Šutić & Paula Garbin, (Universal Research Institute – UR Institute), within the Pecka Outdoor festival, Pecka, Bosnia and Herzegovina, July 2025.
Photo: Adrienn Ujhazi

Cultivamos cultura (Portugal), incubating BioArt productions through Summer schools since 2013, and residencies since 2015.

Hackteria.org (globally, with a base in Switzerland) web platform and collection of Open Source Biological Art since 2009. serves as a virtual lighthouse and community of BioArt-related practitioners. Notable global events that highly contributed to the global BioArt scene development include Hackteria labs held over the globe (2010–), which gathered global practitioners and sparked further development through knowledge sharing, open sourcing, and collaborations.

Kersnikova Institute (Slovenia) and Kapelica gallery – hosting and producing numerous BioArt pieces since the birth of BioArt practices, with its "BioTehna lab" setup in 2013, as a dedicated BioArt production incubator.

Symbiotica (Australia) laboratory was launched in 2000 by artists Oron Catts and Ionat Zurr, biologist Miranda Grounds, and neuroscientist Stuart Bunt. Pioneering organisation that both redefined BioArt into the second wave, and became the illustrative example of great practice in BioArt education formalisation.

Universal Research Institute (Croatia) is a non-profit applied science research institute focused on biotechnology and the development of related culture. Since 2013. nurtures open lab door policy, bringing continuous BioArt research, productions, residencies, and related educational programs – such as Bioelectronic academy (2014–), Science Underground academy (2015–).

TABOO – TRANSGRESSION – TRANSCENDENCE in Art & Science (globally, with base in Greece) – an international conference of nomadic nature, initiative of the Department of Audio and Visual Arts – Ionian University. Geathers' global BioArt, BioPunk, and related global scene since 2016.

Waag (Netherlands) – Future lab for technology and society. Founded in 1994. Next to continuous productions, bringing notable educational programs such as BioHack Academy (2015–).

Conclusion

Second-wave BioArt signals a turning point in our collective imagination, and we could say it opens doors to change toward a better and sustainable future through critical and applied questioning. It shifts focus from the isolated gene to the planetary network of life, from control to collaboration, from representation to participation. It celebrates the porousness between human and non-human, between culture and nature. In embracing the philosophy of DIY, the ethics of openness and interdependence, this movement invites us to rethink creation itself, not as domination over life and (bio)matter, but as a dialogue with life on the cellular, organism, and ecosystem level. BioArt, in this sense, becomes both a philosophy and a practice: a meditation on bio autonomy – what it means to be alive in an age when life and biology can be subjected to techno-political control.

Gjino Šutić (CR)

is the founder of the UR Institute, a researcher and an artist with a background in biotechnology, as well as an author, producer, and expert collaborator in the field of BioArt. His notable works include the experimental use of biotechnologically produced materials such as SRCE (2012) – a 3D scaffold for cultivating replacement organs, and MeBUMZ (2013) – microbial speakers and microphones, both created in a kitchen setting. He is also known for Sushi Roulette (2015, 2016, 2019), a series of works addressing the issue of microplastics, created in collaboration with Kat Austen (UK); Aqua_forensic (2018), in collaboration with Robertina Šebjanič; and reProductive Narratives, in collaboration with Maja Smrekar.

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EcoSomatic Protocols of Kinship

Staying with the trouble and speculating on other ways of being

Sunčica Pasuljević Kandić

In the spring of 2024 in Novi Sad, a group of creatives, dramatists, dancers, biologist, artist, theorist, historians, eco researchers, engineers and managers, walked the Danube shore exploring Bećarac meanders. What have we experienced, what have we discovered, did something changed and/or transformed (us)?

During that first practice-based session:
Transformative relations – intertidal moment, we did exactly that;
stayed present with the current troubles, hopes, senses, sounds and beings;
present in the intertidal moment and zone.

Transforming is multidirectional and relational.
Walk it out, embody, explore, (un)learn, re-connects, see anew.

Scan the QR code and explore it yourself.

Sunčica Pasuljević Kandić (RS)

multidisciplinary artist whose art practice integrates curatorial and pedagogical strategies to create frameworks for collective and engaged (un)learning. Rooted in care, conversation, and collaboration, she draws from embodied knowledge, psychogeographic research, and speculative fabulation, blending somatic rituals, fluxus approaches, and non-human epistemologies into site-specific interventions. Sunčica explores how identity, knowledge, and communication are redefined by technology, environment, and community. In her decade-long practice as a cultural worker she produced and organized local and international projects in the area of art/tech practices. Her work has been presented in Brazil, Germany, Finland, France, Austria, Spain. She teaches at the Academy of Arts in Novi Sad.

Future Directions

The contributions in this white paper collectively point toward a future where bio art is recognized not as a niche artistic genre, but as an integral part of cultural, scientific, and civic life. Several emerging directions are clear:

Expanding Access and Infrastructure
There is a pressing need to establish more bio art laboratories across diverse geographic, cultural, and institutional contexts. This includes small-scale community labs, pop-up residencies, and mobile laboratories alongside permanent, well-equipped facilities. Funding mechanisms should prioritize equitable access, especially in underrepresented regions.

Strengthening Interdisciplinary and Cross-Sector Collaboration
Bio art thrives when artists, scientists, curators, educators, and communities collaborate from the earliest stages of a project. Policies should incentivize long-term partnerships, shared resources, and co-developed research agendas between the arts and sciences.

Embedding Ethical and Ecological Responsibility
Given bio art's engagement with living systems, ethical oversight and ecological care must be foundational. Guidelines should be developed for biosafety, sustainability, and the respectful treatment of all forms of life, while also supporting works that question and challenge prevailing biopolitical structures.

Supporting Education and Public Engagement

Bio art is uniquely positioned to make complex scientific processes tangible and emotionally resonant. Educational programs should integrate bio art into school curricula, museum programming, and informal learning spaces to foster public understanding and participation in the life sciences.

Encouraging Policy Recognition and Funding Integration

Bio art should be included in cultural policy frameworks, research funding calls, and innovation strategies at local, national, and international levels. Recognizing bio art as both a cultural and research practice will ensure sustained support.

Call to Action

To realize these futures, policymakers, cultural institutions, and funding bodies must act decisively: invest in infrastructure, incentivize interdisciplinary partnerships, and embed bio art in wider cultural, educational, and research agendas. In doing so, they will help cultivate a field that not only reflects our relationship with life in the 21st century, but actively shapes it toward more ethical, sustainable, and imaginative futures.

Partners

The Citizens' Association "Reactor" unites cultural managers and artists engaging with contemporary social issues using artistic and experimental practices. The current focus of "Reactor" is on collaborating with various artists exploring new forms of artistic expression, especially in biological and ethical practices. In 2022, they realized the Biofabrika project, supported by the European Capital of Culture - Novi Sad 2022, which promoted bio-art through experimenting with SCOBY biodegradable material (a symbiotic culture of bacteria and yeast). The main purpose of this material is to offer alternative solutions for environmental preservation, such as replacing plastic as the planet's biggest pollutant, but its significant potential in textile replacement has also been discovered.

The Kersnikova Institute is a cultural and educational organization and a production platform for artists and projects intersecting at the nexus of art, science, and technology. Alongside developing and exhibiting artworks in the Kapelica Gallery, the organization has an extensive program of educational activities, partly supported by a network of wet and mechatronic laboratories. With decades of experience collaborating with artists on new projects involving living systems, biotechnologies, and a recent focus on artificial intelligence, as well as new peer-to-peer, do-it-yourself, open-source, and hands-on learning approaches within educational activities, the platform has expanded through collaboration with experts, institutions, and the business sector, all integrated into the Institute's creative processes.

The Universal Research Institute (UR Institute), a Croatian non-governmental think tank organization, pioneers interdisciplinary applied scientific research and projects, advocating for STEAM (Science, Technology, Engineering, Arts, and Mathematics) in sustainable development. UR Institute is dedicated to fostering social and cultural progress, with a special focus on research, innovation, STEAM education, cultural production, and cross-sectoral cooperation. Research areas encompass biotechnology, environmental engineering, cybernetics, experimental electronics, bioelectronics/biorobotics, and art-science connections, emphasizing participatory research and socially beneficial innovations. UR Institute champions DIY and DIWO culture, knowledge freedom, and scientific inquiry.

The Center for the Promotion of Science (CPN), a public institution from Belgrade, Serbia, was established in 2010 to promote and communicate science, technology, and innovation. CPN collaborates with research and

educational institutions at all levels in Serbia and worldwide. It closely cooperates with relevant ministries, media, the private sector, and civil society. CPN's goal is to influence and adapt the general research agenda to reflect society's needs. Methodologies of citizen science research and co-creation, artistic and scientific collaboration, and various educational programs rooted in the STEAM concept are instrumental and leading approaches in CPN's work.

Greenways, a nonprofit association from Bosnia and Herzegovina, initiates social, economic, and ecological innovations aimed at sustainable development. The association's vision is to empower the community to lead prosperous lives while preserving the existing ecosystem. Greenways nurtures community dedication and value-based initiatives, drawing on diverse expertise in agribusiness, policy development, environmental advocacy, and fundraising. With extensive experience in managing international projects, including EU IPA Cross-border and Erasmus+, we strive for impactful, well-managed interventions that create economic, ecological, and social value.

The 'Novi Sad - European Capital of Culture' Foundation was established in 2017 after Novi Sad was named a future European Capital of Culture in 2016, becoming one of the first cities outside the EU to receive this title. The Foundation prepared for this significant cultural recognition, leading to other accolades, such as the European Trend Brand of the Year Award (2021), the Melina Mercouri Prize (2022), and joining the UNESCO Creative Cities Network (2023). In 2022, the Foundation hosted over 4,000 programmes and 6,000 artists and initiated the renovation of five cultural centers and the creation of new cultural spaces. With 40,000 square meters of renewed cultural heritage, the Foundation continues to develop programmes like Doček and Kaleidoscope of Culture, setting artistic standards, and becoming the leader and partner in important international projects.

Support

The Creative Europe program of the European Union supports activities that promote cultural diversity and respond to the needs and challenges of the cultural and creative sectors. The main objectives of the program are to safeguard the competitiveness and economic potential of the cultural and creative sectors, particularly the audiovisual sector. The program's new approach will contribute to the recovery of these sectors by supporting their efforts to become more inclusive, digitalized, and sustainable in their environment.

The project is co-funded by the Creative Europe program of the European Union under grant agreement No. 10112849. The views and opinions expressed are solely those of the authors and do not necessarily reflect the views of the European Union or the Education, Audiovisual and Culture Executive Agency (EACEA). Neither the European Union nor the funding body can be held responsible for them.

Impressum

Title and Subtitle:
Developing Practices Using Living Systems and Establishing Bio Art Labs: Guidelines and Perspectives from the Field

Publisher:
Lead partner: Citizens' Association "Reactor" within the project Bio Awaking (Developing Bio Art Practice in the Western Balkans)

Project coordinator: Jelena Krstanović
Production manager: Ivana Purtić
Artistic director: Adrienn Újházi

Creative Europe Project Details:
This publication is realized as part of the Bio Awaking project

The project is co-funded by the Creative Europe program of the European Union under grant agreement No. 10112849. The views and opinions expressed in this publication are solely those of the authors and do not necessarily reflect the views of the European Union or the Education, Audiovisual and Culture Executive Agency (EACEA). Neither the European Union nor the funding body can be held responsible for them.

Project Partners and Collaborators:
Citizens' Association "Reactor" (RS); Greenways (BIH); Institute Kersnikova (SI); Universal Research Institute (CRO); Center for the Promotion of Science (RS).

Editorial Team:
Đorđe Petrović, Adrienn Újházi

Proofreading:
Ivana Smolović

Design and Layout:
Ivana Đukić and Adrienn Újházi

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ISBN 978-86-904682-4-9

Publication Date:
November 2025

CIP - Каталогизација у публикацији
Библиотеке Матице српске, Нови Сад

7:004.738.5(082)

DEVELOPING practices using living systems and establishing bio art labs [Elektronski izvor] : guidelines and perspectives from the field / [editorial team Đorđe Petrović, Adrienn Újházi]. - Novi Sad : Citizens' Association "Reactor", 2025

Način pristupa (URL): http://www.reaktorngo.org. - Opis zasnovan na stanju na dan 20.11.2025. - Bibliografija uz svaki rad.

ISBN 978-86-904682-4-9

a) Уметност -- Савремене технологије -- Зборници

COBISS.SR-ID 180385545