03 DECEMBER 2015
Futuro House, Central Saint Martins,
1 Granary Square, London

Bio Salon

How will the intersection of design and biological fabrication open up to new ways of ‘making’ and ‘crafting’ in the future?

Biosalon is a joint initiative organised by the Crafts Council and the Design & Living Systems Lab at Central Saint Martins, University of the Arts London.

Designers and scientists are exploring the future uses and applications of living matter, and ways to cultivate and grow new materials. Coupled with the evolution of technologies, our understanding of materiality is changing, and new perspectives on what defines a material and its critical context are emerging. Biosalon was set up to provide a critical space for designers and scientists engaged with this debate to come together and discuss the implications of biofabrications for their respective practices. This follow-up publication has emerged from the Biosalon conversations and is structured around a set of five questions. We hope it will provide an inspiring starting point for the emerging generation of future biofabricators.

Professor Carole Collet and Dr Karen Gaskill

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Natsai Audrey Chieza

Research interests

material innovation,
post-fossil fuel materiality,
future craft with
living technologies,
designing with biology,
future luxury

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Natsai Audrey Chieza is an independent design researcher and educator working at the intersection of Design and Science. Educated in Architectural Design at the University of Edinburgh and Material Futures at Central Saint Martins, Natsai considers herself a multidisciplinarian: able to mediate creative practice with a strong sensibility to materials and aesthetics, and a great sensitivity to context. She is part of a growing cohort of designers shaping knowledge around emerging technologies and living systems design for Architecture, Future Textiles and Sustainable Fashion Futures.

A Designer in Residence at the Advanced Centre for Biochemical Engineering, Department of Biochemical Engineering, University College London, Natsai's research explores how the life sciences can give rise to novel design and craft processes for a post-fossil fuel material paradigm. Collaborating with Professor John Ward, Natsai has invented an innovative process for printing and dyeing textiles using bacteria- a clear alternative to a key stage of textile manufacturing where most of the environmental harm occurs. As an educator she works across a host of institutions in London including Central Saint Martins and The Bartlett, University College London.

Natsai Audrey Chieza

Natsai Audrey Chieza
Faber Futures
2014

Natsai Audrey Chieza

01 Why making / building with biology?

How do we design with, for and against climate change?

Design is central to the pressing imperative to deal with the shifting global environmental challenges of the 21st Century. Species collapse is already underway and as volatile geopolitical trends show, we can already measure the human impact of climate change through resource scarcity. If we consider the capacity for design to drive a paradigm shift both in the way we manufacture and conceptualise consumption, and understand the link between the things we make with society, economics and environment, then we begin to recognise the capacity we have as designers to take ownership of a systems change that is driven by a more nuanced understanding of sustainable practice. Designing with biology offers an important premise to interrogate whether or not systems of design more in-tune with biology, by their very nature, bring us closer to living systems that are responsive, efficient and highly specialised to function in certain environments better than autonomous and wasteful man-made solutions to design problems.

02 How do we best make and build with biology?

We can begin to answer this question by acknowledging that work in the field is multidisciplinary by nature, and so the peer group consists of engineers, scientists, designers, artists, ethicists, etc, but importantly, investors ready to inject significant capital to realise the inherent potential of the bioeconomy. Thus, a commitment to open practice is fundamental to allow research to be open to critique and evaluated collectively.

For example, there is much to be adopted from peer-to-peer networks of digital software environs: a digitised biology can be an open-source biology, one where a shared common interest gives rise to collaborative innovation practice. If we can share the tools of making, perhaps we can catalyse innovation around the application of biological technologies, thus supporting the development of a protected commons around the technology.

Education is an important factor that determines who has the opportunity to learn about building with biology and when in their educational trajectory this occurs. If we consider that children are learning the fundamentals of programming through learning aids and toys in their early years, then we can extrapolate that formalising knowledge around building with biology should perhaps occur much earlier than it currently does. Both creative and scientific institutions should also be able to recognise the pressing need to commit to more long-term and meaningful partnerships, as well as implementing an enhanced curriculum so that knowledge and tools can be shared and transferred across a broader range of practitioners

03 What could we or should we make with biology, what is the blue-sky scenario?

The choices designers make should be understood as the choices about the kind of world we want to live in. Our current environmental and social contextual paradigm should be part of the motivation to explore biotechnology and design. For me, alternatives to petro-chemicals and slow consumption are really interesting parameters to consider. Biofabrication in design terms is a new field, so we should also exercise caution from putting it on a pedestal, as a so-called 'silver bullet' against environmental catastrophe. Though it offers promising potential, so far few solutions in practice have emerged.

But in the interest of blue sky thinking, let's imagine a world where we are at the precipice of discovery of materials derived from bacteria. Already we can dye fabric with dyes derived from bacteria. What are the market impacts of such a process? What new stakeholders emerge in such a market? These are a few speculative tweets I've authored that give a picture to what our biological material futures might engender:

"#FutureCraft: Hyper-specialist hybrid technology signals the rise of the niche biofabricator. #DIYbio #BioMakerSpace"

"#ServiceDesign: Who owns your wardrobe? #NikeForPhilips"

"#Convergence: Digitised biology has democratized the creation of hybrid biological consumer products #Autodesk #Synbio #AI #BiologicalSensors"

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

For me, designing with biology is designing with water, energy, salt, yeast, agar (from algae), temperature and time. It is thinking about where these life-giving elements come from, and how they are part of an existing ecosystem that is also open to environmental and market shocks. Designing with biology is to also design the vessel to contain life. How does the form of that vessel give rise to a highly functional living system or an effective process? What is an architectural detail if we can grow a load-bearing beam from fungi? Add to that, design-led interventions like form, colour, depth and the emotive qualities of a heavy piece of lustrous silk. It is a highly process-driven endeavour that is producing new ways of thinking around notions of both craft and highly industrial chemical processes.

To teach biodesign in the visual and technical arts, we must understand that the theory is as important as the practice. In most cases the 'doing' is much harder to accomplish within academic timeframes at graduate and postgraduate level- given how novel so many of these processes are- so it is crucial that the theoretical framework about why we are contemplating designing with biology is fully appreciated and evaluated as an intrinsic component to doing biology and design.

05 In your opinion, what questions should we ask / address about biodesign?

How do we better formalise designing with living systems in education?

Is an introduction to biodesign at Masters level too late, given the time-based parameters of growing new systems of making vis-à-vis understanding the theoretical framework?

How do we maintain a culture in design of collaboration and exchange whilst insuring that graduates can be certain that they can protect their intellectual property?

Designing with biology is a political statement. Discuss.

Professor Carole Collet

Research interests

sustainability, future design, disruptive technologies, design-science collaborations, biomimicry, biology, botany, horticulture, synthetic biology, biomaterials, biofabrication, living systems, textile futures, planetary boundaries, climate change, 2050 and beyond

designandlivingsystems.com

arts.ac.uk/research/ual-staff-researchers/a-z/professor-carole-collet/

Carole Collet is Professor in Design for Sustainable Futures and Director of the Design & Living Systems Lab at Central Saint Martins, University of the Arts London. Collet set up the Textile Futures discipline at Central Saint Martins where she worked as a post-graduate course director from 2000 to 2010. She was then appointed Reader in Textile Futures before becoming Professor in 2014. Collet operates within the fields of textile futures and biodesign and has contributed to the production of new knowledge as a designer and curator at international level since 2008. Collet's research focus is to explore biology, synthetic biology and living technologies as a new toolkit for sustainable design and manufacture. An indicative example is the project Biolace which has been features numerous international exhibitions. Her recent curation of 'Alive, New Design Frontiers' at the EDF Foundation in Paris has also been critically acclaimed and clearly establishes a new original framework for designing with the living. Her design work has been exhibited at the Science Museum, the ICA and the V&A and she has contributed to conferences worldwide on the subject of design-science collaborations, textile futures, biodesign, biomimicry, synthetic biology, future manufacturing, sustainable design and climate change.

Professor Carole Collet

Strawberry Noir
Part of the Biolace series
Photography by Carole Collet
2012

Professor Carole Collet

“If designers are to conceive new materials and products to be grown, they need to understand how biofacturing works, and will need to be able to engage in informed conversations with biologists. Reuniting the teaching of science and the arts is more crucial than ever.”

01 Why making / building with biology?

Natural ecosystems have evolved a co-operative model of existence where species co-exists as a means to sustain future generations. The human species is the only one that pollutes and threatens its own livelihood to a point of no return. Today, human activities are responsible for the 6th extinction of species in the history of the planet, and this biodiversity loss will have a dramatic impact on our future survival. It is therefore urgent to rethink our energy-hungry and polluting manufacturing systems and move towards natural biofabrication processes which are more respectful of their environment. In short, building with biology can lead us to better sustainable models of production.

02 How do we best make and build with biology?

First of all, by questioning what we want to build and why, but also by gaining a thorough understanding of the natural organisms we want to ‘build’ with. The best scenario is to create multidisciplinary teams of biologists and designers, which combine scientific biological knowledge together with design thinking tools. But if biofabrication if a positive step forward in terms of sustainability, we also need to address the mindset of overconsumption which remains a driver for current global economic models.

03 What could we or should we make with biology, what is the blue-sky scenario?

For me, the blue-sky scenario is one where we have managed to retro-engineer our polluting production systems with biological sustainable processes. Transitioning to a bioeconomy will allow many new design opportunities, and I am particularly interested in two different possible futures:

Bio-engineering smart responsive materials, such as a chameleon skin.

Revisiting traditional living craft and horticultural techniques to ‘grow’ products of our everyday.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

Building with biology means working with living matter. Unlike a traditional factory, a biological cell can die. So biofacturing means learning to maintain living technologies and is by default closer to agricultural and horticultural models than to manufacturing. If designers are to conceive new materials and products to be grown, they need to understand how biofacturing works, and will need to be able to engage in informed conversations with biologists. Reuniting the teaching of science and the arts is more crucial than ever.

05 In your opinion, what questions should we ask / address about biodesign?

How can we ensure that more sustainable biofabrication models of production do not simply endorse the current over-consumption mindset?

How do we integrate thorough ethical principles into the biodesign curriculum?

What becomes of IP when working with the living?

Amy Congdon

Research interests

tissue engineering, craft, cross-disciplinary, textiles, biofabrication, biodesign, bioinstructive, tissue culture

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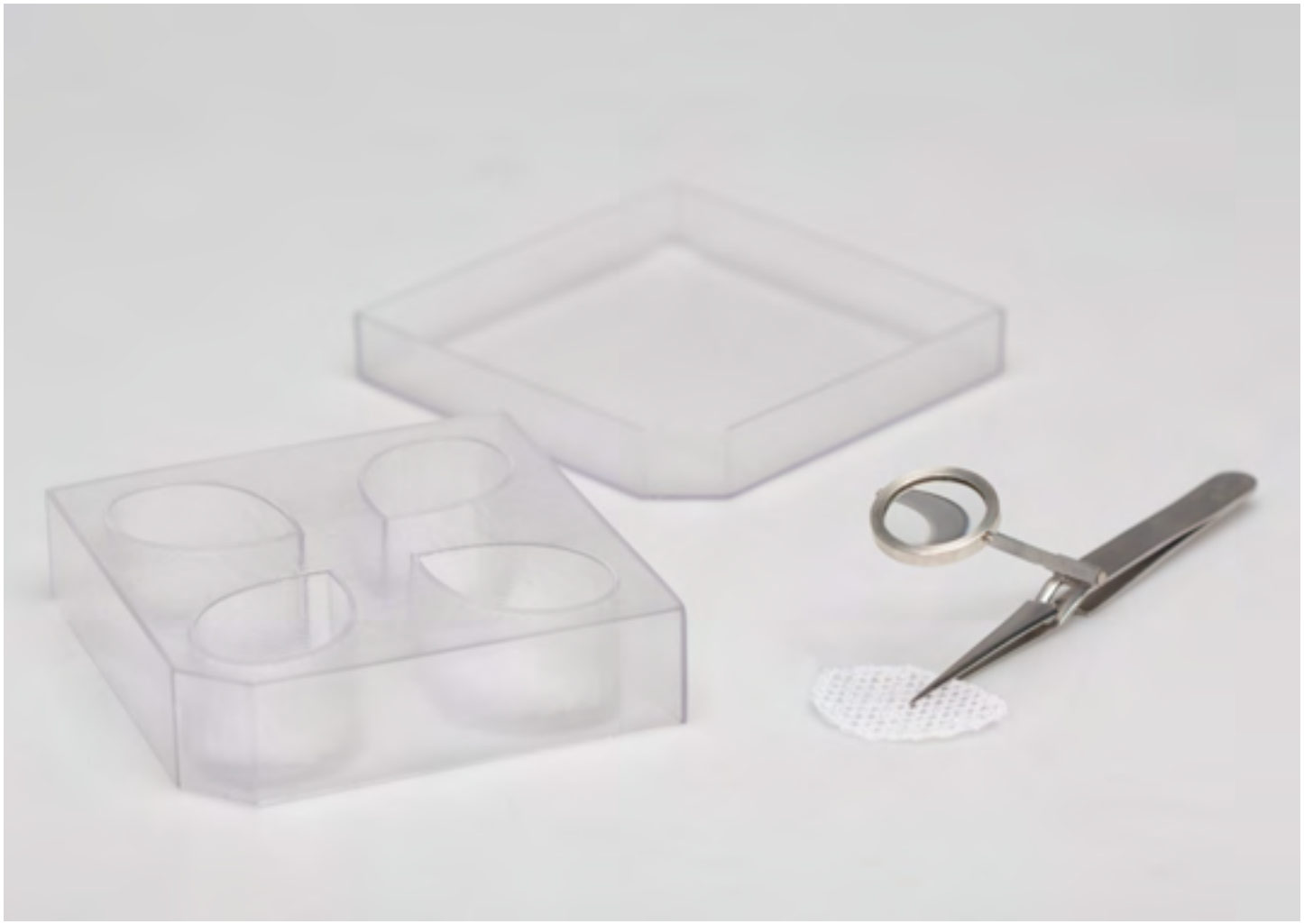
Amy Congdon is a designer, researcher and critical thinker who explores the boundaries between design, science, and technology. In her work Amy is driven to investigate the crossovers between textile craft and tissue engineering through a highly experimental and research driven practice. She has worked within laboratories with existing life science technologies, in particular tissue engineering, to further her research and understanding of the current capabilities of these technologies. Amy has exhibited and presented her work internationally in venues such as Microsoft Times Square Headquarters New York (Biofabricate), EDF Fondation Paris, Salone De Mobile Milan, Protein London and the Victoria and Albert Museum London. Amy has worked on projects for companies including Microsoft, Nissan, WGSN, Future Filter and Central Saint Martins. Since early 2014 Amy has been Senior Design Researcher (freelance) at Biocouture, the world's first bio creative consultancy, and is involved in the organisation of the Biofabricate conference in New York. She has also worked as Acting First Year Tutor for the MA Material Futures course at Central Saint Martins, and is currently undertaking a part-time PhD with the Design and Living Systems Lab at Central Saint Martins in collaboration with the Tissue Engineering & Biophotonics department at Kings College London.

Amy Congdon



Tissue Engineered Haute Couture
Photography by Amy Congdon
2015

Amy Congdon

"Just because we can, should we?"

01 Why making / building with biology?

For me building with biology becomes most interesting when it looks at developing/ going beyond what already exists in nature – what is the point in simply replicating? With this in mind the goal, and promise, of growing future materials and products is to do so much more sustainably than current models do. Also it's important to look at the idea in context. Making products using living systems is not new, as Andras Forgacs argued at the recent Biofabricate conference "agriculture is the original technology that manipulated life". So whilst many argue that growing materials using biology is not a radical departure, perhaps the scope and the implications of these rapidly developing technologies are. As Oron Catts put it "if we choose to do something to life, we end up doing something to ourselves".

02 How do we best make and build with biology?

I think the most important thing to do when thinking about how best can we make with biology is to involve designers from the start in the laboratory. It is much more difficult to work with things that have already been developed, designers understand the end application of materials – what qualities they need and how they will be used. Alongside this, having varied inputs is really valuable – designers and scientists are both good problem solvers in different ways as they come from differing perspectives. In my work I don't need to be a tissue engineer, I know enough to have a conversation, but that naivety gap, i.e. not knowing too much, allows me to ask the "stupid" and perhaps spark an idea of how to do things in another way.

03 What could we or should we make with biology, what is the blue-sky scenario?

For me the question of what we could make and what we should make is vital, because as biotechnology continues to advance there will be a lot of things we will be able to make, but not all of them are automatically a good idea. We need to carefully assess what we are capable of making and with that in mind I think that the blue-sky scenario ought to be going beyond replicating nature (what's the point) – growing biologically smart materials that are zero waste and have additional properties built in, for example health benefitting. However its also key to look at our current models – how and why people consume the way they do and at such a pace. We need to be careful not to just replicate and try to meet current demand, but explore ways to create new consumption models as well as growing more sustainable products.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

One of the key things I think we need to readdress is how we separate subjects in schools. As a student you're traditionally either "creative" or "scientific" and as you progress through education these subjects can often be presented as mutually exclusive, that you are good at either one or the other, or at the least you should choose between them for university. If creatives and scientists continue on this trajectory of working with one another, readdressing this is really important so that each discipline has a better understanding of the other. Whilst I think it's important to be trained in a field, after all we can't become experts in everything. I think if basic science courses were offered as part of the curriculum to design students, and vice versa, this would allow for greater understanding and help facilitate more in depth collaborations.

05 In your opinion, what questions should we ask / address about biodesign?

Just because we can, should we?

How can we grow new sustainable materials and products whilst also remaining critically aware of their wider implications?

How do we develop a new material vocabulary to accommodate these radically different materials?

Can we, and should we, better what exists in nature?

Professor Marcos Cruz

Research interests

advances in computation,
bio-technology,
synthetic biology,
architecture, living matter,
bacteria, fungi, algae and
bryophytes in buildings,
neoplasmic architecture

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architecture/programmes/
postgraduate/labs/march-
architectural-design/biota

Marcos Cruz is Professor of Innovative Environments and Director of BiotA Lab at the Bartlett where he is developing Bio-integrated Design research.

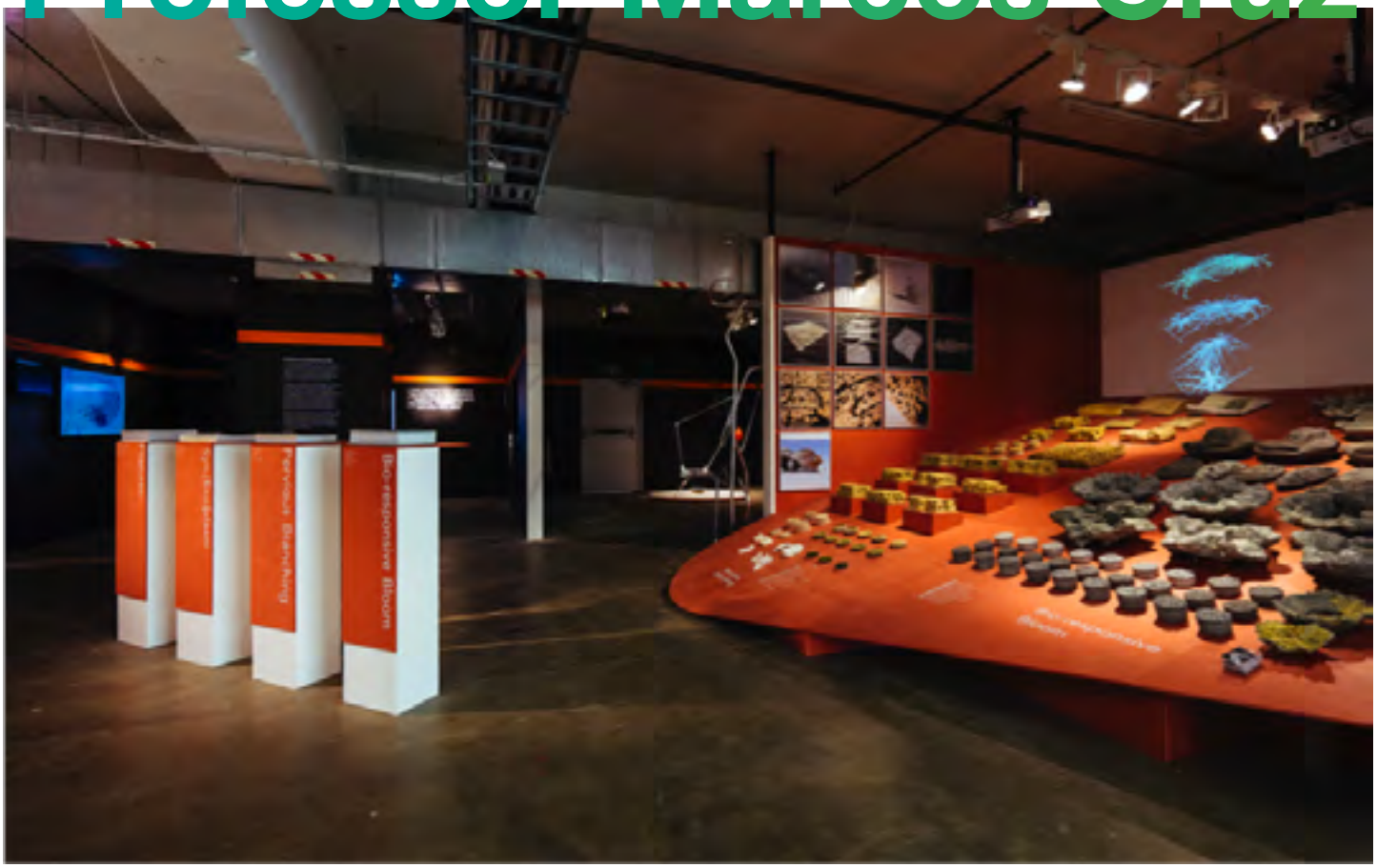
In addition to the Bartlett directorship (2010-2014), where he has been running Unit 20 for 16 years, he has also carried out teaching activities at UCLA, University of Westminster, and presently at IaaC Barcelona.

Cruz is author and editor of The Inhabitable Flesh of Architecture (Ashgate, 2013); AD – Neoplasmatic Design (John Wiley & Sons, 2008); marcosandmarjan – Interfaces/ Intrafaces (SpringerWienNewYork, 2005) and Unit 20 (University of Valencia/ACTAR, 2002), amongst several others.

In 2000 he was part of the Kunsthaus Graz competition (Cook/Fournier - first prize). In the same year Cruz co-founded the studio marcosandmarjan with Marjan Colletti, having built numerous projects that include the Lisbon Book Fair (2005), the Alga(e)zebo for the London Olympics (2012) and Algae-Cellunoi for Archilab (2013). marcosandmarjan work has been extensively published and exhibited, including the Sao Paulo and Venice Biennale, along with solo exhibitions in Hamburg and Braunschweig. Their work is also part of the permanent collection of the FRAC in Orleans.

Cruz is currently Principle Investigator of an EPSRC ‘Design the Future’ research grant in the UK.

Professor Marcos Cruz



BiotA Lab exhibition at B.Pro show
Bartlett School of Architecture 2015
Photography by Shawn Liu

Professor Marcos Cruz

“future cities will embrace a much softer edge that delves into what we would call bio-ornamental aesthetics.”

01 Why making / building with biology?

As architects, engineers and environmentalists continue the drive towards "greening" our cities, the huge production of imagery created in both professional practice and academia suggests a far greener paradigm of cities in the future than is currently achievable. The current approach of growing vertical gardens on buildings has proven expensive to implement and intensive to maintain, so its impact to date has been limited. In response, our work at BiotA Lab explores alternative ways of shifting buildings to embark on much more radical green and biologically intelligent agendas.

02 How do we best make and build with biology?

Richard Beckett and I set up BiotA Lab as a new design research platform that merges expertise in architecture, biology and engineering. We are currently focusing on Bioreceptive Design as a novel and multidisciplinary approach to environmental design. The result of our teaching and research suggests a new sense of hybrid materiality, new technologies and unprecedented living forms that merge nature with architecture, redefining not only building design, but also our whole built environment.

03 What could we or should we make with biology, what is the blue-sky scenario?

We envision Bioreceptive Design to be applied in various urban contexts, including so many blank and rather ‘wasted’ building facades that could be covered with growth, also small house extensions or retrofits. Pavements, as well as furniture in public spaces will benefit, as well as large-scale retaining walls, elevated railway lines, embankment walls and other infrastructural projects. In summary, any ‘empty’ surfaces in cities offer the potential opportunity for growth to happen. However, this has not only environmental benefits; rather than the hard-edged traditional city, future cities will embrace a much softer edge that delves into what we would call bio-ornamental aesthetics.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

In BiotA Lab we develop design work between the studio and the laboratory, where innovative building systems are developed with the help of advanced computation. Modelling and simulation tools are implemented in parallel to material testing and organic growth in real laboratory conditions, providing feed-back and data for the fabrication of construction components and prototypes.

Students and researchers design, grow and build bio-digital prototypes that explore a new ecological model for architecture, responding to specific climates based upon the relationship between environmental conditions and the interfacial properties of materials with micro-organisms. In opposition to the traditional complexities and highly costly ‘green architecture’, BiotA explores an alternative symbiosis between buildings and nature that is more computationally sophisticated, and far less costly for buildings in high-dense cities.

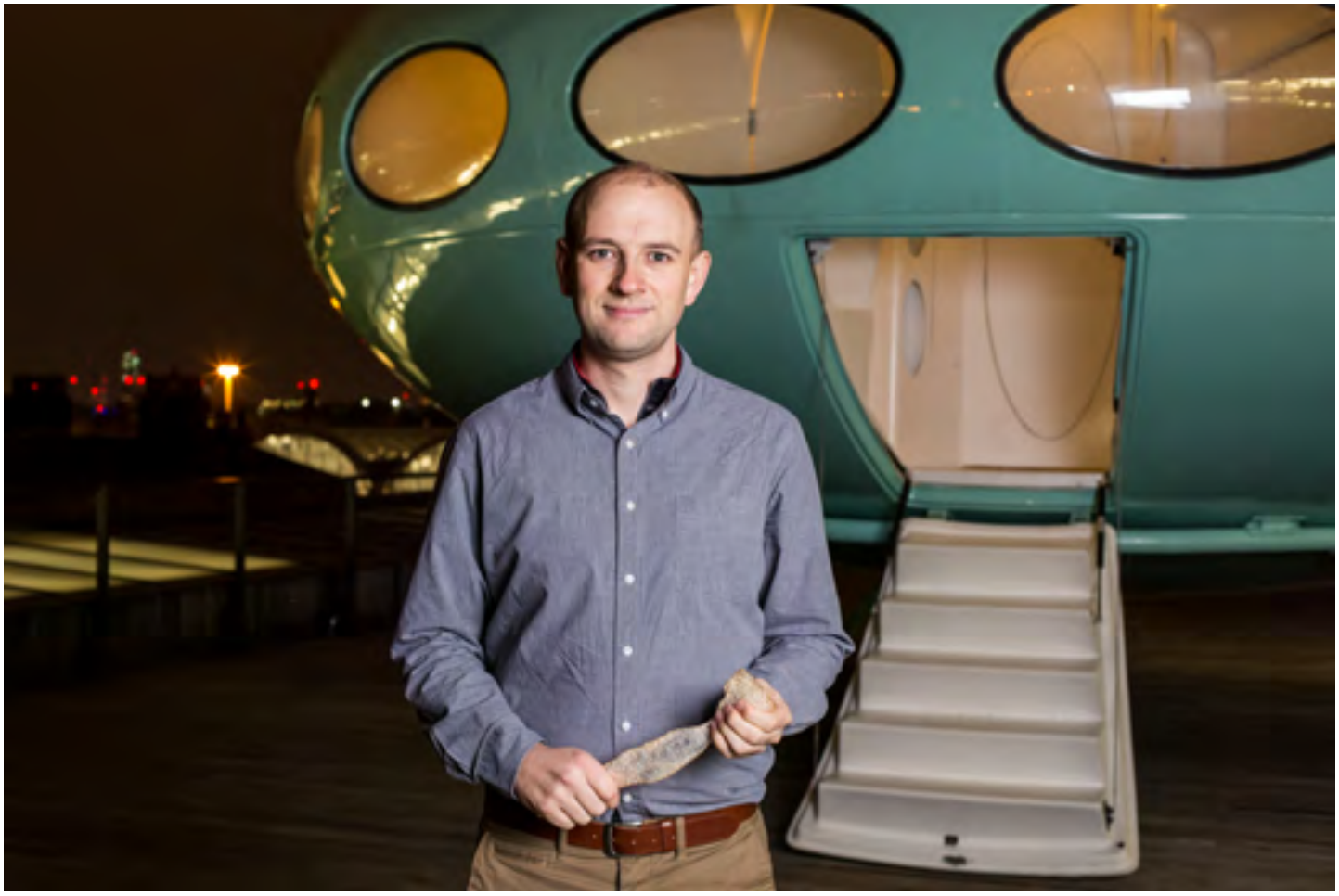
05 In your opinion, what questions should we ask / address about biodesign?

How can we integrate and make use of advances in biotechnology and synthetic biology in architecture to create a new generation of bio-architectural design?

How can we apply commonly small-scale bio-technologies to large-scale constructions in architecture and the built environment?

How can we achieve new bio-ornamental aesthetics in architectural design?

Dr Tom Ellis



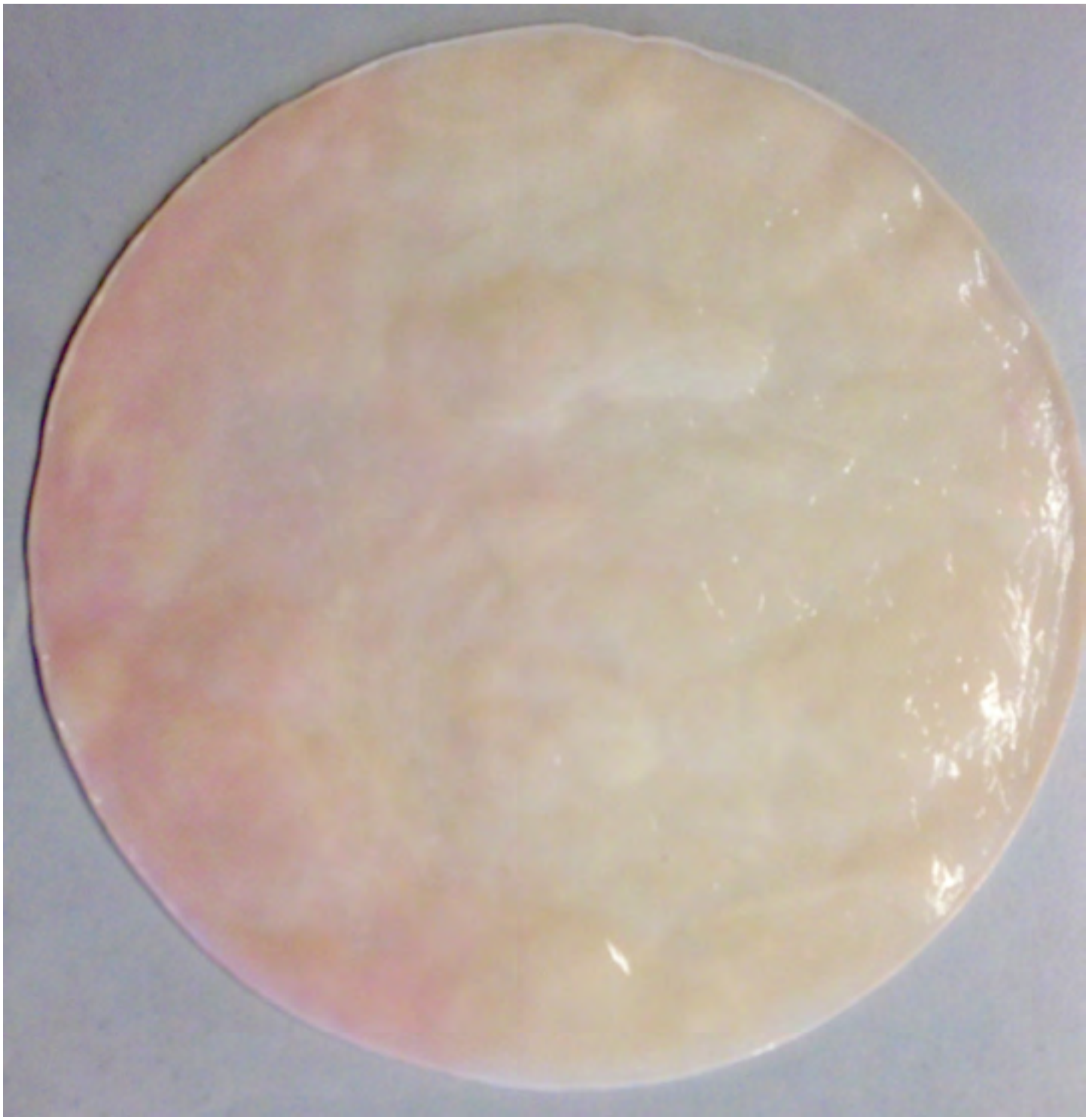
Research interests

synthetic biology,
genome synthesis,
biomaterials,
DNA design,
genome engineering

Tom Ellis is a senior lecturer in the Department of Bioengineering at Imperial College London working on synthetic biology in the Centre for Synthetic Biology and Innovation (CSYNBI). Dr Ellis has track record in synthetic biology, being author of over 20 publications in synthetic biology including work in Nature Methods, Nature Biotechnology, PNAS and Nature Reviews. Before joining Imperial in 2010, he was a PhD at Cambridge and postdoc at Boston University, USA, in one of the field's founding groups under Professor James J. Collins. Dr Ellis is leader of the UK-funded project to build a synthetic yeast chromosome for the international synthetic yeast project (Sc2.0). He co-leads the teaching of Imperial's synthetic biology undergraduate module and has supervised 4 of the UK's most successful iGEM teams. His research focuses on developing the foundational tools for accelerating and automating design-led synthetic biology, focusing on research projects in yeast (S. cerevisiae) and E.coli model organisms, as well as industrially-relevant interesting microbes such as Acetobacter, Geobacillus and Bacillus.

tomellislab.com

Dr Tom Ellis



Michael Florea
DNA-programmed patterning of red fluoresence on one side of a growing bacterial cellulose pellice
Photography by Tom Ellis
2015

Dr Tom Ellis

“The dream is to be able to code in the DNA and have it return the material properties that we want, whether they are the iridescence of butterfly wings, the adhesion of gecko feet or the strength of spider silk.”

01 Why making / building with biology?

We are biology and most of the world we interact with is biology so it makes sense that we should try to learn how to make with biology, so that we can integrate ourselves better within our environment and understand how natural processes can be appropriately exploited.

02 How do we best make and build with biology?

By understanding how biology makes and builds itself, we can learn how to tailor biological processes so that materials of use to both us and nature can produce the designs that we desire. The ideal scenario is a cycle of learning by deconstruction and reconstruction, where we determine how the DNA code of living cells instructs them to make and build, we engineer new DNA code to tailor this process to our needs and we learn how to do this best by understanding which changes worked and which didn’t.

03 What could we or should we make with biology, what is the blue-sky scenario?

Biology already makes most of our materials for clothing and many of our materials for construction. These are then manipulated to have the properties we want by chemical and mechanical processes that are crude and often polluting. Having control over the way biological systems produce materials will allow us to tailor their properties as they are grown. The dream is to be able to code in the DNA and have it return the material properties that we want, whether they are the iridescence of butterfly wings, the adhesion of gecko feet or the strength of spider silk.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

Those making with biology will need to better use variation and uniqueness within their crafts, as biological materials show individual variation and living organisms are dynamic systems. Making with biology will require less standardisation and have to be able to incorporate and use materials that change over time with their environments.

05 In your opinion, what questions should we ask / address about biodesign?

How to enable communication, training and co-operation between the diverse range of expertise that is interested in contributing to this area?

What is the way that ecologists, scientists, designers, artists and manufacturers can come together to drive this subject forward?

Dr Karen Gaskill

Research interests

curatorial cultures,
materials, process,
collaboration,
anti-disciplinary practices

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Karen Gaskill is a director and curator working across the fields of contemporary art, craft, technology, science and innovation. Until December 2015, she was Head of Innovation at Crafts Council, UK, delivering a programme that explores where materials practice crosses with science, technology and engineering.

She is currently external examiner at The University of Plymouth on the 3D Design course, and previously at Liverpool John Moores University for the Digital Media Design Course International Programme, Malaysia. Previously she held academic posts at Sheffield Hallam University as a Senior Lecturer and Researcher in Photography and Curatorial Studies, and at the University of Huddersfield as a Lecturer in Fine Art Media.

She was the founder, co-director and curator of Interval from 2005-2009, an arts organisation based in Manchester, UK, which provided a critical forum and exhibition platform for emergent to mid career artists working with technology.

She has a PhD in Curation, which considered the curation of process over object, referencing contexts of performance art, digital practice, and contemporary spatial works. She also writes about curatorial culture, contemporary art and technology for academic papers, critical journals and online platforms.

Dr Karen Gaskill

Make:Shift 2014, Materials Session
Photography by Tas Kyprianou

Dr Karen Gaskill

“Designing with nature means dealing with complex living systems, not ones that we can always control.”

01 Why making / building with biology?

I’m particularly interested in how pushing our knowledge of biology and testing its limits for new uses, equally challenges our role and responsibility as humans within these processes. Through making and building with biology we are opening up multi-disciplinary dialogues where new kinds of thinking about design and making can emerge. Cybernetics, the 1940’s cross-disciplinary study of systems, is now re-emerging after years of being split into separate design disciplines. Design thinking was just one of its legacies, and we are now growing beyond that to consider how we don’t just grow the science of design, but also the design of science, and the relationship between the two.

02 How do we best make and build with biology?

From a materials perspective, making with living systems or natural materials is inherently more complex, and we have only just begun to develop a dialogue to critique biological practices. Design teams that bring together a number of voices, including science, design, philosophy, ecology, will evolve new ways of thinking about what we make, and continue to simultaneously assemble and dismantle what we know and consider to be best practice.

03 What could we or should we make with biology, what is the blue-sky scenario?

Science fiction and speculative fiction have long given us narratives about biological warfare, genomic engineering, so we all have perspectives on what could be bad ideas. But in context many of these scenarios underpin what it means to be able to evolve, replicate, synthesize, and engineer living systems.

In starting to design our future we should be asking all these questions and more but through a number of lenses. As makers we are concerned with the integrity of the material, process, outcome and concept, but lack expertise in other areas, so in working collaboratively we can evolve a much more rounded and well-positioned product.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

Designing with nature means dealing with complex living systems, not ones that we can always control. So the protocols require a breadth of expertise in order to be timely and relevant. As a curator, my interest is in how we embed expertise in our design and making processes, and how this then manifests in smart and sustainable outcomes. Expertise comes from being well informed about all aspects of what biodesign draws from and contributes to, and then considering the human role in these processes. So perhaps how to teach characteristics such as integrity, sustainability, playfulness, and resourcefulness through the use of materials, will make for better-informed future thinking.

05 In your opinion, what questions should we ask / address about biodesign?

How do we as designers, curators, biologists, artists, scientists, researchers lead by example as to how we want our collective endeavours to evolve?

How do we make transparent the new languages we are forming together, how do we share the value of our combined thinking and the importance of our new knowledge?

How do we continue to critique and reflect on why we are doing what we are doing and its purpose in the world.

Andy Gracie

Research interests

biotechnology,
synthetic biology,
space research,
astrobiology,
experimentation,
biosemiotics, gravity

hostprods.net

Andy Gracie works across various disciplines including installation, robotics, sound, video and biological practice. This work is situated between the arts and the sciences, creating situations of exchange between natural and artificial systems which allow new emergent behaviours to develop. The underlying focus of his activities has often involved a study of organic intelligence, emergence and the placing of technological agents in situations where they are able to network with natural systems. More recently his work involves reactions to the science of astrobiology — notions of the origins of life coupled with a re-examination of its boundaries. His practice employs scientific theory and practice to question our relationships with environment and the notion of the 'other' whilst simultaneously bringing into focus the relationship between art and science.

His work has been shown internationally and has included several special commissions for new works. He has also presented at numerous conferences and seminars internationally and has written and published a number of articles and papers. His work has also been featured in books by Stephen Wilson, Linda Weintraub, William Myers and Dmitry Bulatov.

His large scale installation 'Autoinducer_ph-1' has received honourable mentions from VIDA and Ars Electronica in 2007. The ongoing project 'Drosophila titanus' received an honorary mention from Ars Electronica in 2015.

Andy Gracie

Deep Data Prototype
Photography by Marco Antonio Lara Martinez
2014

Andy Gracie

“We have to ensure that we establish the mindset that organic matter isn’t just another cool material, and that it has deep reaching significance and implications.”

01 Why making / building with biology?

There was always an inevitability that technological advances and understandings would be applied to the built environment. What is surprising is that biomimetic processes and applied biology have taken so long to manifest on any scale. The paradigm changing merger of organic processes and engineering thinking have now made this approach irrevocable.

02 How do we best make and build with biology?

Carefully and with forethought. I think it is arrogant to assume that living material will always and repeatably bend to our will and follow a clearly predictable course. Therefore, until we know more, I would be inclined to restrict the application of biological principles to biomimetics or to material science in which the living aspect is removed before application.

03 What could we or should we make with biology, what is the blue-sky scenario?

The blue sky scenario is almost impossible to predict, but given enough time I see no reason to not believe that we could eventually inhabit truly living buildings as envisaged in much science fiction. If we could harness the positive life capacities of these environments – respirability, self-cleaning, self-organisation, motility – then we might be on to something.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

We have to ensure that we establish the mindset that organic matter isn't just another cool material, and that it has deep reaching significance and implications. Therefore, the approach to building and making with such materials should be very different to that using 'traditional' building approaches. We have to find ways to understand what it means when our products and buildings aren't 'in' the environment but actually form part of it and its processes.

05 In your opinion, what questions should we ask / address about biodesign?

Are we doing this because it advances us as a species and improves our living experience, or are we doing it just because we can?

Science fiction is fun, but we probably don't want to live in many of the futures we have read about, do we?

Guillian Graves

Research interests

industrial design, product design, sustainability, bio inspiration, biomimicry, biomimetics, bio-manufacturing, bio-hacking, life science, bio-engineering, synthetic biology, new practices, new methodologies, new technologies, biotechnologies, new materials, computer science, generative design, additive manufacturing

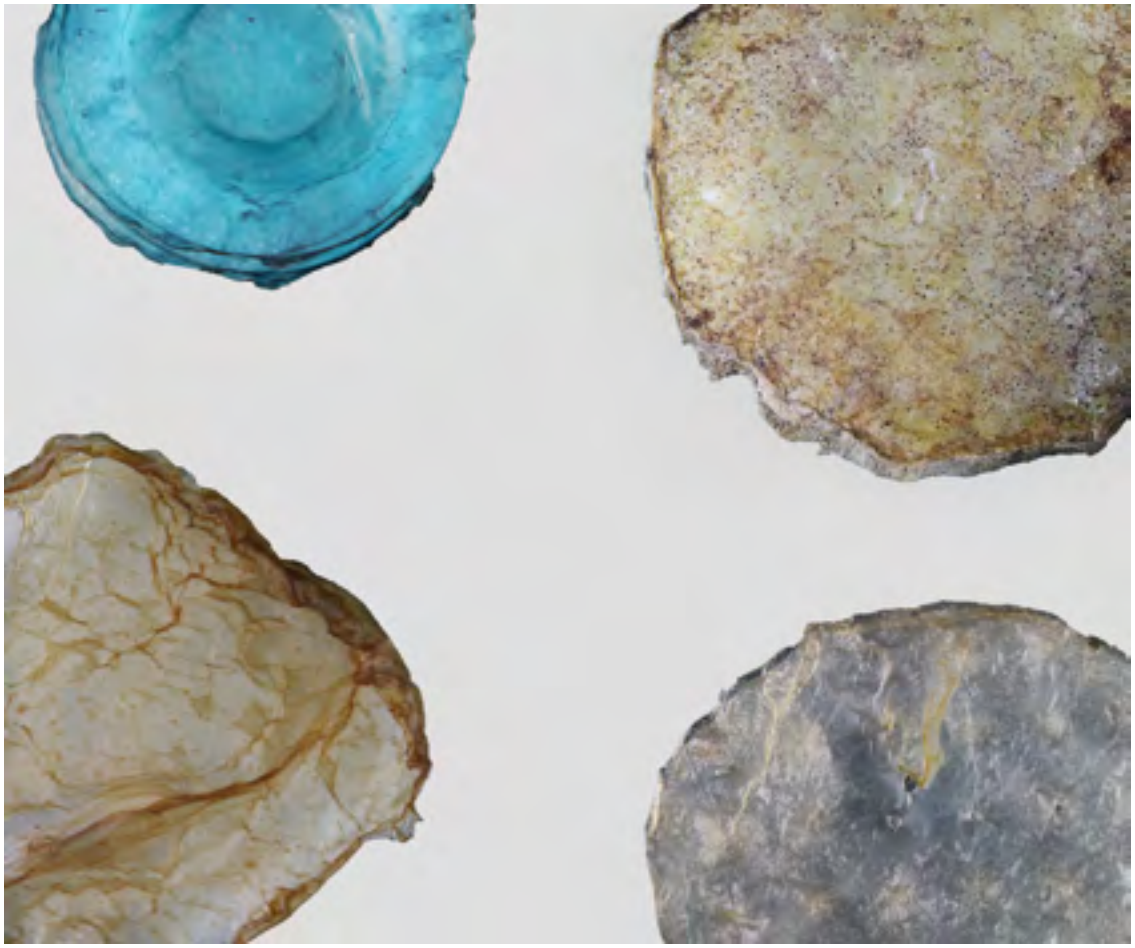
guilliangraves.com

Guillian Graves is a French designer based in Paris. Guillian studied craft and design at the Fine Arts School in Rennes for five years. He then built his own design practice at the edge of life sciences and new technologies at ENSCI-Les Ateliers in collaboration with other partners, such as EPFL (Swiss Federal Institute of Technology in Lausanne)

Having been trained in new technologies, Guillian consults for businesses, start-ups, laboratories, research centres. His recent partnerships have allowed him to explore the potential of living sciences, bio and nano-technologies, digital technologies, digital manufacturing, big data, collaborative and open source practices for many different fields, such as environment, mobility, energy, agribusiness, health, well-being, entertainment, or even space conquest.

Guillian is also a lecturer who shares his original methodologies, where design meets science, through lectures and workshops.

Guillian Graves



Nautile, sustainable and bio-inspired kettle
Photography by Maria Graves
2012

Guillian Graves

"We should also look to Nature to seek solutions to fix environmental damages."

01 Why making / building with biology?

Today, we are faced with great environmental challenges. It is now proven that our current industrial model, built on processes that are devastating for our environment, and combined with the over exploitation of our limited natural resources, has deeply disturbed our biosphere. Yet without a biosphere, neither human activity nor industry can subsist. We need to imagine alternative models, able to break with the industrial reasoning and today's way of life, in order to build more sustainable and more desirable future societies. In this quest for a new model, biology seems to have an essential part to play. Over 3.8 billion-years-old, our living world has never stopped developing innovating strategies to evolve and survive, and may be the perfect model for sustainability and inventiveness. In fact, the natural world has always been both a model and a resource for humans. Bird flight inspired the first flying machines, cows provide milk and leather, bacteria and yeast are used to make cheese and beverages. Today, our understanding of biological systems, combined with innovative technological advances is leading to a new industrial revolution based on biology. The emergence of this new paradigm based on mimicking the living world can bring new solutions for tomorrow's environmental issues.

02 How do we best make and build with biology?

New approaches aim to reproduce biological principles, collaborate with natural organisms, or even hack nature. The imitation of the mechanisms of the 'living' requires observation, comprehension, and reproduction of natural principles as well as technologies that can operate from the nano to the macro scales. Recent collaborations between naturalists, biologists, bio-engineers and designers have led to the development of new cross-disciplinary methodologies. Whether it starts by the need to solve a problem, or whether the project emerges from a new biological discovery, the process of biodesign is a joint adventure of the world of design and the life sciences.

03 What could we or should we make with biology, what is the blue-sky scenario?

Working with biology will allow us to counteract the development of our human activities and will foster a transition towards a more sustainable society. The priority should be to develop innovating bio-informed alternatives for industries with a high sustainable impact such as the energy sector, the textile industry and the built environment. We should also look to nature to seek solutions to fix environmental damage. We must invent ways to clean up the sea and decontaminate toxic soil and polluted air. However, before we achieve such results, it is up to designers, scientists and bio-engineers to demonstrate the potential of biology through prototypes, as well as short and long-term design fictions.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

We certainly cannot work with living materials the same way we do with wood, plastic or metal. The use of the 'living' as an inspiration, a material or a process impact not only on aesthetics but also on methods of creation, as well as on time and space of production. The scope of bio-manufacturing requires the development of new protocols which combine skillsets in design, biology and engineering. Currently, these respective fields use very different methodologies and we need to experiment with a trans-disciplinary practice of biodesign that sits at the borderline between laboratories and design studios. The sharing of knowledge and tools between the different experts (such as industrial designer, molecular biologist, bio-engineer, mathematician, coder, bioethicist) may produce a common methodological basis which can address all the dimensions of biodesign both in terms of practice and teaching.

05 In your opinion, what questions should we ask / address about biodesign?

In France, besides the increasing interest generated by biodesign and the emergence of new research programs in the field, financial investments remain insufficient. A useful question would be a practical one: who/what structure would want to invest in these innovating and promising approaches?

Marlène Huissoud

Research interests

nature, making, innovation, sustainability, challenge, bees, insects, co-working, mechanism, diversity, processes, materiality, biology, language, system, balance, craft, imperfection, function, perception, production, experimental, unusual, external, happy accident, honeycomb, structures, raw, volatile, human, organisms, artefacts, serendipity, wrong-right, accidents, black sheep

marlene-huissoud.com

French-born and British-based, Marlène Huissoud is an experimental designer. Marlène works as a freelance Designer for different companies alongside the art & design areas, and created her own company in 2013. In 2014, she graduated from the MA Material Futures (then known as Textile Futures) at Central Saint Martins' College of Arts and Design in London where she developed the project From Insects, an exploration of insect materials from the common honeybee and the Indian silkworm. Her work is a co-working experience with nature by exploring the potential of using elements from insects or industries in the making of future artefacts. She believes in the value of the concept, not only with an outcome but with the complete creative process.

She has been awarded the Product Design Award Design Blok Diploma selection 2014, named as one of the UK's top 70 rising design stars representing the future of British design by the Design Council, selected Talents for Ambiente, nominated for the MATERIALICA Design + Technology Student Award, nominated for Design Parade 10 and Winner of the Make me! award during Lodz Design Week 2015.

Marlène Huissoud

Marlène Huissoud

“Designing and making with biology can help us design artefacts that evolve with time, but also save energy and find new alternatives to the use of chemicals in our cities.”

01 Why making / building with biology?

Biology is one of the most inspiring sources of creation that we have available around us. We can learn as designers and researchers from its structure, its process, its complexity and diversity. Natural materials are available and can be recycled, we can use them again and again. Biology can help us rethink our entire supply chain and help us to find rapid solutions for new material performances. The biggest innovations will come from biology as it is one of the most complex structural mechanisms that we have available today.

02 How do we best make and build with biology?

Imitating nature, co-designing with nature, hacking nature…best practices and new methodologies…

The best way to work with biology is by co-working. Listening to it and challenging it. Biomimicry has the potential to reconstruct our vision of making and building new materials for architecture, fashion, design, aeronautic engineering…

Taking a human problem and asking nature how we could improve our system is the key for a sustainable future.

03 What could we or should we make with biology, what is the blue-sky scenario?

Biology gives us new potential scenario that can help us to develop new strategies for a sustainable future. I think we should look at nature as a form of inspiration, and ask how we could build everything from it as the organisms and eco-systems have know-how to live on our planet for millions of years and all the genius of creation is based around it.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

Making and building with biology is definitely a way to challenge our practice as makers and can push our perception of a material or a mechanism.

Designing and making with biology can help us design artefacts that evolve with time, but also save energy and find new alternatives to the use of chemicals in our cities. The best way to learn from it is to analyse how the system works, and from there we can begin to mimic and interpret it. A new design practice has evolved in the past years about how a strong story telling process inspired by nature can reveal the strength of it. The communicative tools of those projects allow access to complex mechanisms to a large audience. I think it is a key element in a design practice to give an easy access to those new design protocols.

05 In your opinion, what questions should we ask / address about biodesign?

What is the future of sustainability, and what is a sustainable approach in design practice?

Kieren Jones

Research interests

amateurism,
reverse-evolution,
socially motivated design,
self-production,
social sustainability,
scarcity, materiality,
future craft

Kieren Jones is an award-winning designer, maker and artist based in London, producing small-scale architecture and design interventions in response to the built environment. Through his work, Kieren is particularly interested in exploring the notions of amateurism, industry, production and the position of craft in the 21st Century. Kieren is also the Acting Course Leader and Senior Lecturer for MA Material Futures at Central Saint Martins.

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Kieren Jones

Ernst Haeckel, Kunstformen der Natur, 1904.
Plate 49. Actiniae by Ernst Haeckel.
Public domain photo, Wikimedia Commons.

Kieren Jones

“I would like to see such technology integrated as simply another tool in the designer's toolkit, and explored in much the same way that any other new science or piece of equipment would be.”

01 Why making / building with biology?

I am interested in the potential to reverse engineer man’s evolution. Working on a biological or cellular level has the potential to radically change how we might exist, survive and adapt to our future climate and needs. From what we eat to how we could adapt our bodies accordingly could be the key to our future survival as a species, and I believe that this is only possible on a biological level.

02 How do we best make and build with biology?

I believe that besides the physical technology or science that allows us to build with this technology, on which I am no expert, there is a more fundamental question as to how we should embed the principles and intentions behind this technology into the public’s conscience, as I believe that currently it is the ethical, moral and public opinion around such technologies that is really preventing these technologies from becoming widespread. I would like to see such technologies not only explored in education more broadly, but also the possibilities really made available to the public.

03 What could we or should we make with biology, what is the blue-sky scenario?

Re-engineer our environments to better suit our needs and desires for the future. This should be done both on a personal level, as well as on a broader environmental one. Being able to feed all societies, adapt to future climate changes and increasingly hostile environments as well as reverse our physical climate is really key to our future survival on this planet.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

This technology has huge moral, ethical and physical consequences for the our environment, and whilst it is crucial that we explore and discuss these potential risks, it is also really important that we don’t allow our immediate fears cloud our longer term, perhaps more worrying future concerns and judgement. I would like to see such technology integrated as simply another tool in the designer's toolkit, and explored in much the same way that any other new science or piece of equipment would be.

05 In your opinion, what questions should we ask / address about biodesign?

The ethical and moral questions about what is ‘natural’ and ‘synthetic’ need greater exploration as well as what the widespread implications would be if such technologies and sciences were widespread or mainstream. Is it better to reconsider what is ‘natural’ than allow the consequences of climate change to take hold?

Professor Rob Kesseler

Research interests

contemporary microscience,
molecular biology,
plant science,
electron microscopy,
botanical art and
illustration, applied art

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vimeo.com/102108678

vimeo.com/59733758

mipattern.tumblr.com

Rob Kesseler is a visual artist, Professor at Central Saint Martins and Chair in Arts, Design & Science at the University of the Arts London. A former NESTA Fellow at Kew and Research Fellow at the Gulbenkian Science Institute, Portugal, he collaborates with botanical scientists and molecular biologists to explore the living world at a microscopic level. Reflecting the way in which the natural world migrates into many aspects of our daily lives, his images are translated into a wide range of contexts and media. Kesseler's work reveals a hidden world lying beyond the scope of the human eye, producing work that lies somewhere between science and symbolism, in which the many complexities of representing plants are concentrated into mesmeric visual images. He exhibits internationally and has published an award winning series of books on Pollen, Seeds and Fruit with Dr Madeline Harley and Dr Wolfgang Stuppy of Kew published by Papadakis. In 2010 they also published a monograph of his work, Rob Kesseler Up Close. He is a fellow of the Royal Microscopical Society, The Linnean Society and The Royal Society of the Arts.

Professor Rob Kesseler

Medicago minima, Bur medick, fruit.
Hand coloured micrograph
2013

Professor Rob Kesseler

“Work with nature to make what is needed, make what is useful, make to sustain, make to communicate, make to inspire, make to include, make to change.”

01 Why making / building with biology?

Making = play + creative risk. Biology is life and life is evidently more fragile. We are the creators of the fragility and so must be the creators of the remedies and reversal of that fragility, to design new aesthetic paradigms based on functional sustainability rather than cyclical visual style.

02 How do we best make and build with biology?

Together, across disciplines and cultures, with deep knowledge and broad horizons. Observe and learn from nature. Fusing craft skills, manufacturing technologies, bio-chemical engineering. Involving and informing business managers and financial gatekeepers that biodesign is not just a passing fashion but an essential imperative of life.

03 What could we or should we make with biology, what is the blue-sky scenario?

Understanding the differences between departures, destinations and multiple points of arrival. Work with nature to make what is needed, make what is useful, make to sustain, make to communicate, make to inspire, make to include, make to change. Make in such a way that what remains at the end of the process replenishes rather than denudes the environment. Remember to smell the flowers on the way.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

Start young, consider how one subject relates to and informs another, value every approach. Emulate how biological growth adapts, rejects, seeks opportunities, shifts and adapts. We must observe, test, develop and promote.

Accept Open source.

Explore new research funding streams from the sciences that could become more available to collaborative projects.

Understand that is easier for designers and artists to enter biology speculatively. Scientists have less flexibility to shift beyond their specialism so we must be prepared to learn something of their languages and we must communicate the values and philosophies of design to the scientists.

05 In your opinion, what questions should we ask / address about biodesign?

Are our current educational structures within higher education currently flexible enough to enable deep subject knowledge with opportunities to exploit these with other disciplines?

How can we develop products that are economically more competitive and less environmentally impacting than other products?

How can biodesign be seen to be relevant to all disciplines?

How do we make politicians and stakeholders look beyond qualifications and targets to recognise the potential and value for biodesign?

Claudia Pasquero

Research interests

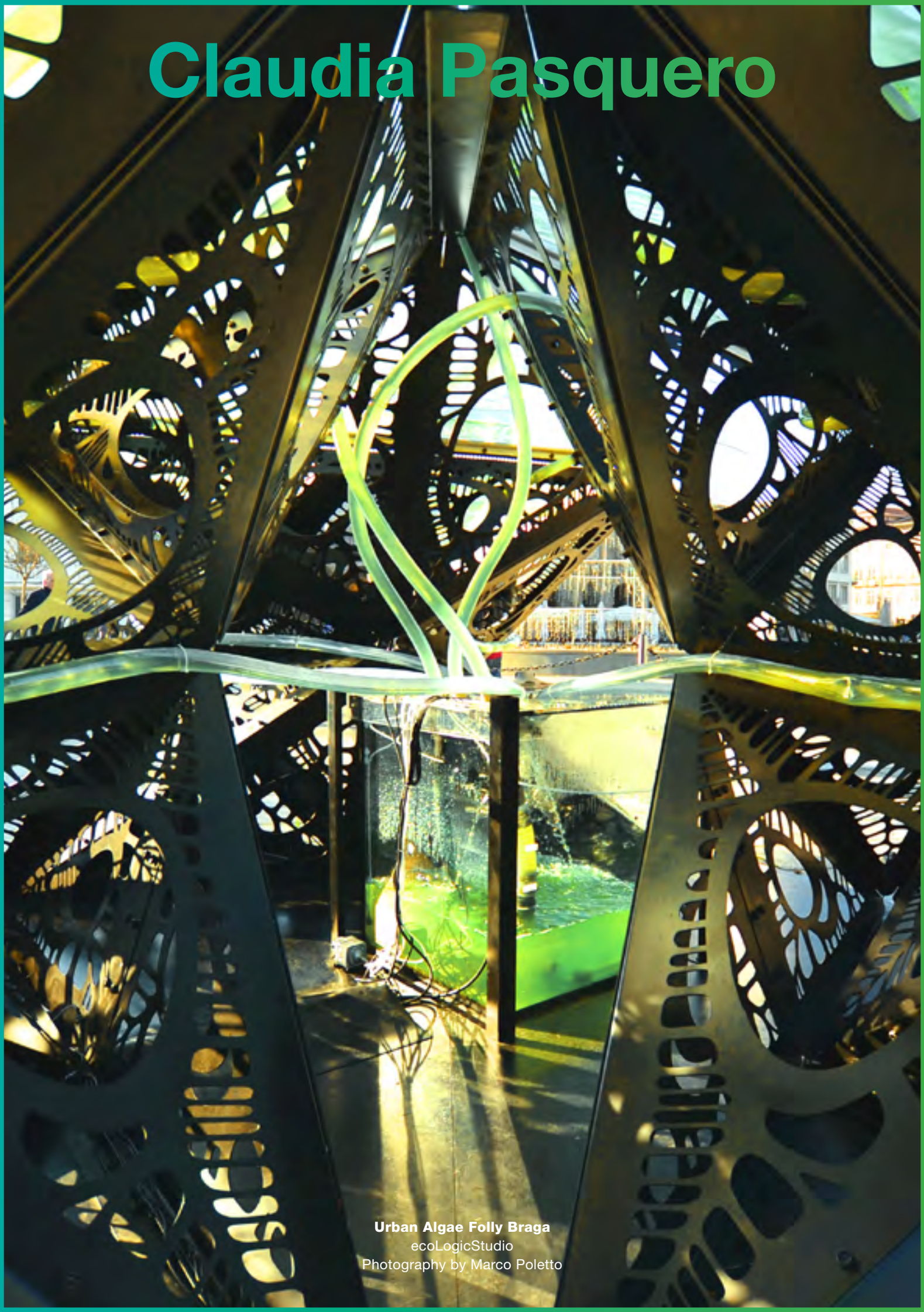
eco-machines, systemic thinking, ecology, urban morphogenesis, cyber gardening the city, bio-computing, urban algae farm, meta language, chlorella, spirulina, physarium policefalum, interaction, pattern reading, material computing, urban landscapes, productive landscapes, environmental psychology, algorithmic logics, fabrication ecologies, the third industrial revolution, internet of energy, catalytic cells, self-organisation, resiliency, stigmergy, collective intelligence, swarm behavior

ecoLogicStudio.com

Claudia Pasquero is an architect, author and educator. Claudia is director and co-founder of ecoLogicStudio in London, director of the Urban Morphoegenesis Lab in UCL, senior staff at IAAC in Barcelona. Over these past few years Claudia has been Unit Master at the Architectural Association in London, Visiting critic at Cornell University in Ithaca-NY, Visiting critic at the Angewandte amongst others.

ecoLogicStudio is an architectural and urban design studio involved in digital design and architecture research for the definition of a new ecology of space and behaviour. Founded in London, the studio has built up an international reputation for its innovative work on systemic design, a method defined by the combination and integration of systemic thinking, computational design, bio-hacking and digital prototyping. This broadened approach to design – ranging from the micro to the macro and from biotechnologies to urban networks – is embodied into an experimental practice, where projects and installations become laboratories of interactions. Claudia's work has been published and exhibited throughout the world, in particular in Karlsruhe (Globale Exibition - ZKM Museum, 2015), Milan (EXPO2015, 2015), in Orleans (9th Archilab - FRAC Collection, 2014), in Paris (EDF Foundation, 2013), in London (Architectural Association, 2011 and London Biennale, 2006 and 2008), in the Venice Art as well as Architectural Biennales (STEM, 2006, STEMv3.0 the lagoon experiment, 2008, The Ecological Footprint Grotto, 2010, HORTUS.venice, 2015), in Seville Biennale BIACS (STEM-cloud, 2008), Istanbul Garanti Gallery (Fibrous Room, 2008) and Milan Fuorisalone (Urban Algae Canopy, 2014 – NABA jewel, 2008 - Aqva Garden, 2007). She is co-author of "Systemic Architecture - Operating manual for the self-organizing city" published by Routledge in 2012.

Claudia Pasquero



Urban Algae Folly Braga
ecoLogicStudio
Photography by Marco Poletto

Claudia Pasquero

“ultimately the potential is to turn users into designers, consumers into producers.”

01 Why making / building with biology?

In my practice ecoLogicStudio and in the Lab Urban Morphogenesis which I direct in Bartlett, UCL we are particularly interested in processes of material as well as bio-computation and how those can have a radical effect on the way we can re-conceive contemporary cities.

On a scientific/technical level the study of these process of material computation enables designers to go beyond descriptive computation, typical of digital design; from the socio/cultural perspective the possibility to engage the evolving processes of living matter enables a deeper form of interaction with our surroundings. Ultimately the potential is to turn users into designers, consumers into producers.

02 How do we best make and build with biology?

Methodologically we would like to claim a new centrality for the notion of gardening, as a design practice as well as modus operandi in the transformation of the urban environment.

Gardening is now not only related to tending plants and vegetables, but, as prefigured by architect Frei Otto, to a more expanded field of dynamic material and digital processes which will redefine our cities and our urban landscapes (also see cyber-Gardening the City); as such gardening also acquires critical relevance in reframing our relationship to emergent digital design practices.

03 What could we or should we make with biology, what is the blue-sky scenario?

One of our latest projects, the Urban Algae Folly (UAF) in its Milan and Braga instances explores the morphological as well as environmental and social integration of micro-algae cultivation in public spaces. At the same time the UAF propose a transformation of public space from place of encounter to place of production.

The UAF is an interactive pavilion integrating living micro algae cultures. Microalgae, in this case chlorella and spirulina, are exceptional photosynthetic machines. They contain nutrients that are fundamental to the human body, such as minerals and vegetable proteins. Microalgae also oxygenate the air and can adsorb CO2 from the urban atmosphere ten times more effectively than large trees.

The innovative architecture of the UAF originates from the evolution of the well-known ETFE architectural skin system. In this case it has the ability to provide the ideal habitat both to stimulate micro-algae growth and to guarantee visitors’ comfort.

We aim at a future when bio-digital urban machines will be able to change the way we leave and produce in city and therefore have an impact on the contemporary socio-political scenario.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

Working with biologists enables us to prefigure alternative models of the city represented as a complex dynamic system. It would be important to stimulate a transdisciplinary discourse that reaches wider academic research networks and scientific organisations involved in the study of the city as a living system, and to develop future bio-digital technologies.

We adopt computational, analogue, biological and digital design methods to draw terrains of negotiation between strategic and tactical forms of intervention. Algorithmic coding enables the study of biological models and the testing of iterative, adaptive and resilient design solutions applicable to a broader eco-social domain. It generates a multiplicity of responses and effects at scales ranging from the molecular to the territorial, from the quasi-instantaneous to the geological.

05 In your opinion, what questions should we ask / address about biodesign?

My favourite question is: Can the convergence of information and biological technologies conjure the possibility of a new industrial revolution that is harvesting the potential of emergent collective intelligence in breeding future bio-cities?

Jane Scott

Research interests

biomimicry, responsive and programmable textile systems, knit technology

responsiveknit.com

tfrc.org.uk/author/jane

design.leeds.ac.uk/people/jane-scott/

Jane Scott is a constructed textile designer working at the intersection of biomimicry and responsive textile systems. She is a Senior Teaching Fellow in The School of Design at The University of Leeds and currently completing a PhD through the Textile Futures Research Centre, Central Saint Martins College of Art and Design, London. Jane's PhD research uses biomimicry to inform the design of environmentally responsive, knitted textiles. This work re-examines the constituent components of knit fabrics to engineer smart behaviours without using electronics or smart synthetic materials. A fascination with materials is fundamental to her work, and current research explores the responsive behaviours inherent to natural fibres. Her work integrates all levels of knit technology combining the programming knowledge required for computerised knitting machines with the practical experience of hand knitting. Previous funded research includes novel applications for seamless knit technology, using Shima Seiki technology. Her work has been published widely as research papers and exhibition work. Recent UK exhibitions include Colonise, at Leeds Dock (2015), Research Through Design at The Microsoft Research Centre in Cambridge (2015) and Restless Futures, part of the London Design Festival 2014. She has presented research papers at international conferences on these areas of interest.

Jane Scott

Programmable Knitting
Environmentally responsive, shape changing knitted fabric constructed from 100% linen
Photography by Jane Scott
2014

Jane Scott

“Biomimicry has been described as imitating nature, however I think of biomimicry as a way to translate how nature functions through specific examples and use this to create innovative design outcomes.”

01 Why making / building with biology?

My research focuses on responsive textile design. Biomimicry has allowed me to reposition my work and see design problems from a new perspective. One positive thing about biomimicry is that it offers a precedent to see how a problem can be solved. I have been investigating how to make responsive knitted fabrics that change shape autonomously, once I understood how this occurs in plants I realised that the principles could be transferred to knit design.

02 How do we best make and build with biology?

I think that there is huge potential in biomimicry. Biomimicry has been described as imitating nature, however I think of biomimicry as a way to translate how nature functions through specific examples and use this to create innovative design outcomes. Whilst individual models from nature can inform particular innovations, the underlying principles of the natural world should also guide designers to apply cyclic processes and carefully consider the quantity and types of materials used. My particular interest is in embedding responsive behaviours so that textiles can sense and respond to the environment in the same way that plants and animals do. There are exciting possibilities for both fashion and architectural environments now this can be achieved in textiles that are constructed from low impact natural materials such as linen or wool.

03 What could we or should we make with biology, what is the blue-sky scenario?

Designing with biology asks us to think about problems differently and this could be transformative within many sectors. If we think about how nature grows materials or responds to environmental change these are critical issues that designers are trying to address.

Nature uses models of manufacture that are highly efficient, and additive processes where functionality can be incorporated during construction. Consider the impact on the fashion industry when a garment form is programmed into the textile as the material is made, or in architecture if a responsive skin can sense and adapt to changes in temperature, moisture or pollution without the need for complex electronic systems. These are the current questions in my research and biomimicry provides elegant models that have already been fully tested in nature.

04 How does making and building with biology change the design protocols – and how do we best learn and teach biodesign in art, architecture, design, craft as well as in biology courses?

Designing with nature is inherently interdisciplinary and requires knowledge and experience from a number of specialist areas. In order to learn and teach biodesign, collaborative practice needs to be embedded into the student experience. Teamwork is essential, however it remains critical for the designer to have a deep understanding of their own discipline so that shared knowledge can lead to greater understanding.

05 In your opinion, what questions should we ask / address about biodesign?

The question that I find myself asking of biology repeatedly, is how does that work?

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Organisers

Dr Karen Gaskill, Head of Innovation, Crafts Council (to December 2015)

The Crafts Council's innovation programme explores how advances in materials, processes and technologies are driving innovation in craft practice and how makers are catalysing innovation in the fields of engineering, science and technology.

It draws together leading practitioners and experts through interdisciplinary projects and events to showcase innovative thinking, support new practices, and investigate what a future landscape for craft might look like.

Professor Carole Collet, Director Design & Living Systems, Central Saint Martins, University of the Arts London

The D&LS lab was set up in 2013 at Central Saint Martins to explore the interface of biological sciences and design to challenge established paradigms and envision new sustainable materials and forms of production for the future. The Lab has grown out of eight years of Professor Carole Collet's research activities at Central Saint Martins.

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