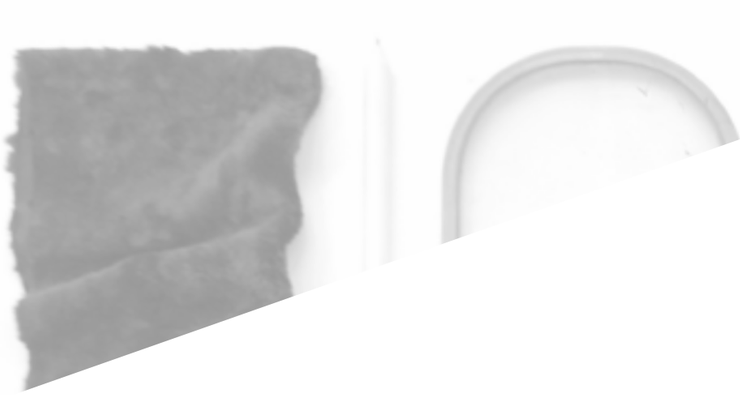
Institute of Making

Sixth Year Report

Institute of Making, UCL 2018-19



Contents

The Overview

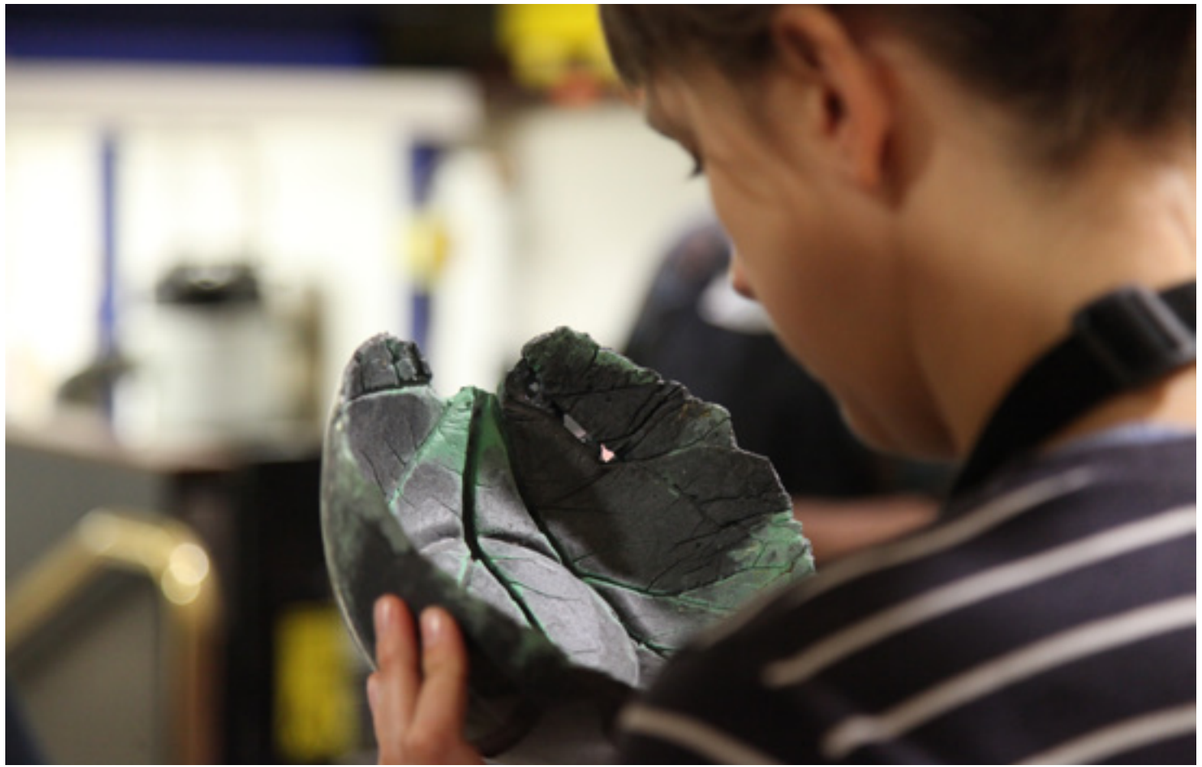
Why we do what we do...

"I can't express enough how much admiration I have for the entire Institute of Making team! It's such a uniquely creative space where just being there makes you feel inspired, which is only made possible by an amazing team of people behind it. Thank you again very much for the great collaboration and I'm looking forward to being back at the makespace soon for my next project!"

(Janneke van Leeuwen, member)

We are a very unusual research club...

The Institute of Making is a place that encourages play, research and development of materials and processes. We believe that until you make something you don't really understand it. We are a diverse multidisciplinary community whose activities support teaching and research through making. We provide a fully equipped workshop, technical training, a library of materials and most importantly, inspiration and support.

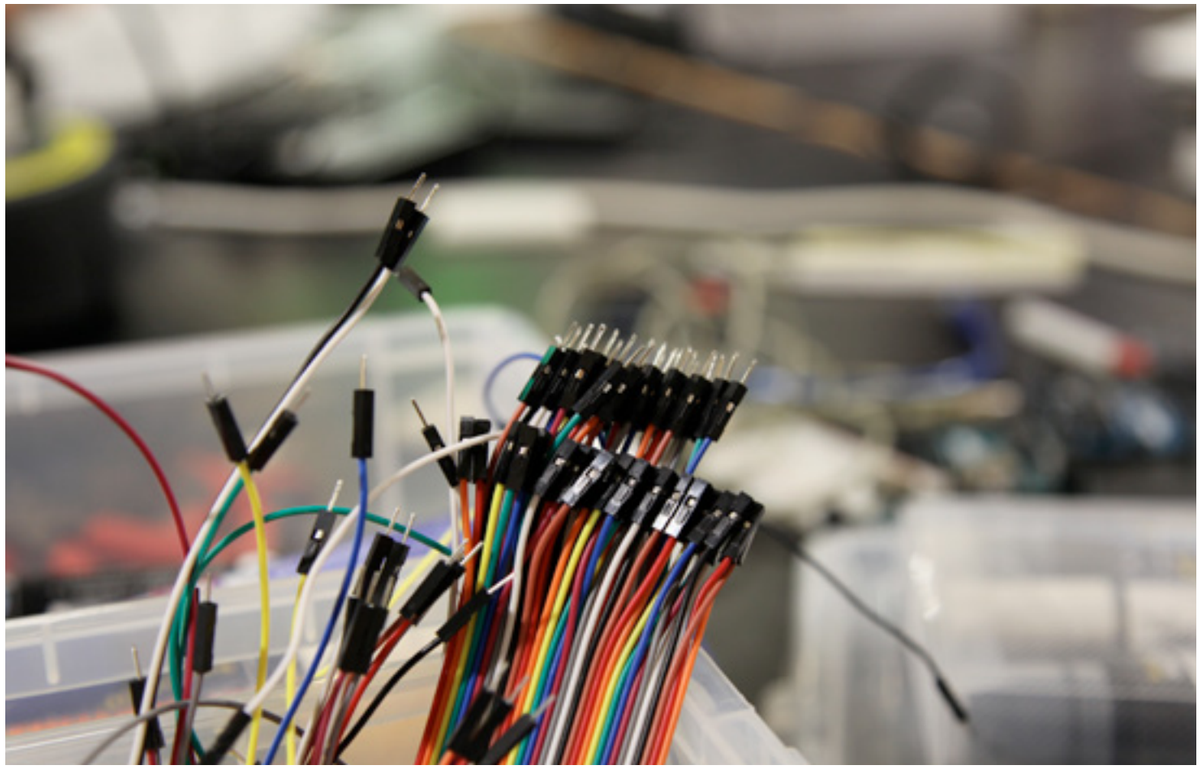


Membership is open to anyone at UCL...

We currently have 2824 active members, of whom 29% are staff and 71% are students. A further breakdown of the member demographic is as follows: female (42%), male (53%), no gender declaration (6%); undergraduates (38%), postgraduates (38%), academic staff (19%), and professional services staff (10%). The membership encompasses a wide range of specialisms and interests, from English to Engineering, Medicine to Materials Science and Art to Archaeology.

Doing is a different way of thinking...

A typical snapshot of activity at the Institute of Making is as follows: a medical student is learning about electronic wearable devices by making one; a post-doc from Chemistry is investigating new glazes for ceramics; a masterclass on concrete is attended by students and staff from all over UCL; the BBC arrives to film the product launch of a start-up company founded by an alumnus of the Institute of Making; a research workshop is held for amputees on material and sensory preference in prosthetics; a group of anthropology students are using the Materials Library to gain a deeper understanding of plastic waste; we hold an open day on the theme of 'Plastics' and more than a thousand members of the public take part.



We specialise in multidisciplinary materials research...

The Institute of Making acts as a research hub, bringing together and supporting multidisciplinary teams of researchers both at UCL and beyond. This year we secured funding for four new collaborative projects: **Designing-Out Plastic Waste** (EP/S024883/1); **Innovation hubs for assistive technology in developing countries** (part of Global Disability Innovation Hub AT2030); **The Development of a 4D printing manufacturing platform** (Dr Anna Ploszajski's EPSRC Doctoral Prize Fellowship), and **Developing bespoke breathable prosthetic liners with growth tracking & active cooling** (NIHR STWK-016).

These awards add to our ongoing funded research projects: **Self-Healing Cities** (EPSRC EP/N010523/1); **Centre for Nature Inspired Engineering** (EPSRC EP/K038656/1); **Material Anxieties** (Dr Sarah Wilkes' Wellcome Trust Fellowship 200354/Z/15/Z); **Fit-for-purpose, affordable body-powered prostheses** (EP/R013985/1) and **Food and Transformation** (Ellie Doney's PhD funded by BEKO EP/N509577/1).

Our events get fully booked in seconds...

Our event programmes aim to inspire the public about all things material and to place us at the heart of the international making community. The programme also introduces our members to new areas of interest and helps them to acquire new skills, encouraging them to engage with experts in various fields of materials and making research and allowing them to gather together research collaborators.
Last year we held 52 events: 21 member events and 31 public events (see p.142 for the full list). These included 30 masterclasses (including Coracle Making and Recycling Roman Ruins), 10 research events (including Materials Research Kitchen and Sensory Preference in Prosthetics workshops), 1 Materials Library evening, 3 large-scale public open days, 4 week-long events (including Slime Olympics at New Scientist Live and Leigh Cameron, concrete artist and maker in residence). Over the past year our events have attracted an audience of more than 12,000 people including a high representation from families and young people.

We have a wondrous collection of stuff...

The Materials Library is a collection of some of the most wondrous materials on earth, gathered from sheds, labs, grottoes and repositories around the world. It is a resource, laboratory, studio, and playground for the curious and material-minded to conduct hands-on research. We are active in collecting new materials like mycelium foam, pineapple-based leather and turtle coprolites (fossilized faeces). What makes our collection unique is the relationship between the library and making activities in the workshop. Our aim is to give members the opportunity to explore and be inspired by a diverse palette of materials, and to seek materials-related guidance from the Institute of Making team.

We have a public profile...

The Institute of Making and its team have gained a public profile as champions of making and materials, promoting them through TV, radio programmes, festivals and literature (BBC4's *The Secret Story of Stuff*; BBC2's *Big Life Fix*; BBC Radio 4's *Plastic Fantastic*, *Kitchen Cabinet*, the *PM Programme;* the *Today Programme*; Cheltenham Science Festival and the book *Liquid: the delightful and dangerous substances that flow through our lives*). We are active on social media (Twitter, Facebook, Instagram, Tumblr), and online in the form of podcasts (*The Things That Make Us* and *'Rial Talk*).

We are international...

The Institute of Making has an international reputation; we have given invited talks all around the world from Stockholm to New York on our interdisciplinary materials research and our other activities. We have active research links with the Global Disability Hub, the Materials Research Society, and Ellen MacArthur Foundation.

We interact with policy makers and industry...

Our profile has enabled us to influence funders (EPSRC, UKRI), policy makers (DFID, Mayor of London) and national academies (Royal Academy of Engineering, Royal Society), attract industrial collaborators, and inspire both current and future students and staff.

Member Profiles

Our members join the Institute of Making for a variety of reasons. Some come to learn new skills or to work on their coursework or research; some use it for elaborate personal projects or creative explorations; and some just find it a great place to meet friends and find a welcoming community within the larger university. Some members make use of the Materials Library, volunteer at public events or attend our varied and wonderful assortment of masterclasses.

Because our membership draws from both students and staff from all over UCL, our technical team is uniquely positioned to help our members respond to degree show deadlines, research briefs, outreach projects, materials explorations, medical prototypes, elaborate costume requirements and one-off personal projects.

"*Because the projects we encounter are so varied and experimental, I feel that I learn as much from the members as they learn from me. That is definitely one of the best parts of my job!*".

(Darren Ellis, Makespace technician)

Our joint staff and member team participated again this year in the Raft Race challenge between makespaces in London. Instead of a raft we built a glorious fleet of coracles. It is always fun for our members to join in representing the Institute in a London-wide event, and perhaps take an unplanned dip in Regent's Canal.

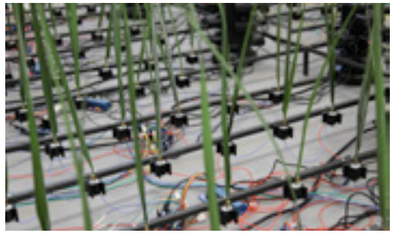
In this section we profile some of our members and their projects, which include personal research and making projects alongside their academic research activities. Feedback from members often reveals partnership and collaboration across disciplines that would never have happened if it were not for our unique community.

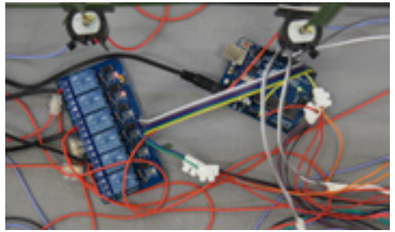
Andreea Ionascu
Slade School of Fine Art MA student

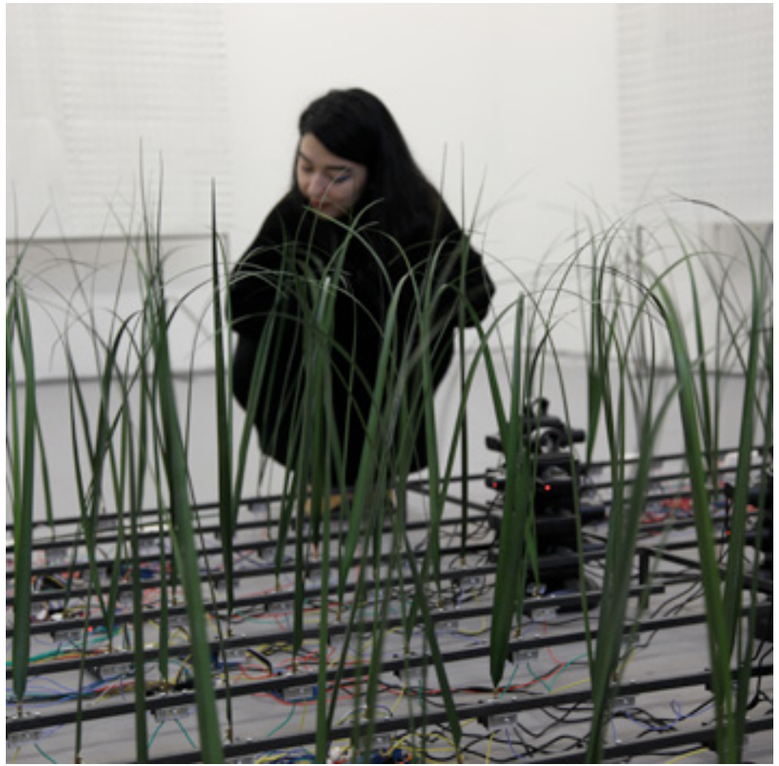
Andreea first came to the Institute of Making to make a large-scale piece for her interim show out of HDPE mesh, Fimo and powder coated steel. She then worked on another piece in laser cut wood, steel, plaster and glass wax: a material that was recommended by our technicians:
"Previously I tried to make it with putty and metal, but the result was not great; you recommended the perfect silicone to use. I also spent a lot of time here experimenting with different processes, timings, temperatures, ratios and consistencies, until I found the best method to cast a clear glass wax without air bubbles, that looked almost like resin."

She is now working with technician George on two new projects using Arduinos, DC motors and ultrasound sensors. She loves the Institute of Making because of the quality of the space and the type of things you can make here. She likes that our staff have knowledge in different fields, and always comes to ask for advice: "*You guys are so friendly*!" Even if something seems impossible, Andreea knows there will always be a way to make it happen here. She also loves the Materials Library; if she wants to work with a new material she can instantly check what it feels and looks like, and this is quite unique.

Andreea has volunteered at open days where she learned so many things about plastics, pewter casting and slime making, as well as making a lot of friends:
"I love the social aspect - I have met people like Tom, Gavin and Jakub. Actually we are setting up a new event with Gavin (PhD in Heritage Science), to bring people from the Slade and Heritage Science together. We feel that a dialogue between researchers and artists would be very useful to both groups. We already visited each other labs and studios with a small group and had so many questions to ask each other. And we are organising an event with a series of talks on sustainability, conservation, materials and techniques."





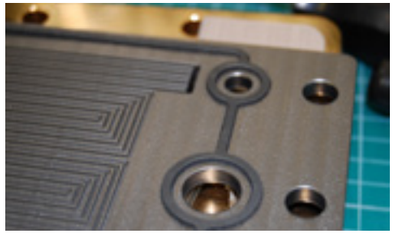


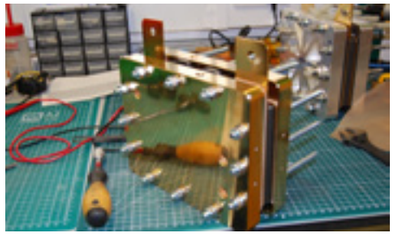
Lara Rasha
Chemical Engineering PhD student

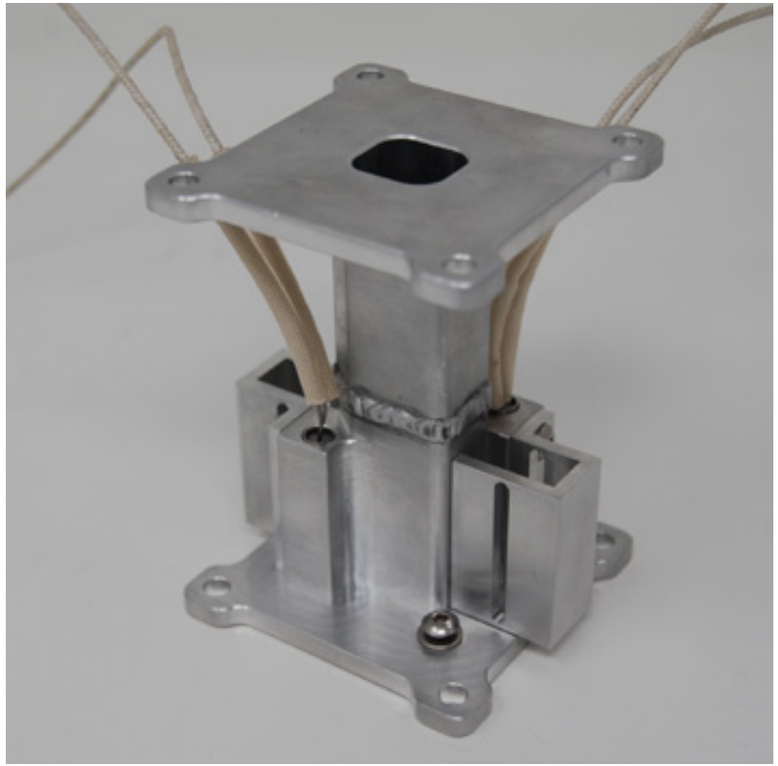
"I'd definitely be lost without this place."

As a native Londoner, Lara has always been into building stuff, and often used to walk by the Institute of Making. She finally came into the workshop when she started doing her PhD at UCL. In her research she designs and builds engines and has used the Institute of Making to help with her research and undertake other projects. For example, she used Ardunios to create a new fuel cell for the Shell Eco-marathon, and as part of her research, she wanted to blow up a battery in an x-ray machine in her lab to see what would happen when it was destroyed. She consulted with technician Darren on how to make a chamber that would contain the gases etc. from the explosion. She also makes her own gaskets with the laser cutter and this saves lots of money. In fact, she has done so many projects at the Institute of Making, it is hard to remember them all! She says that the best thing about the Makespace is the technicians, because they always have an answer. When she gets stuck, they always know what to do.

"You guys have the best stuff, I come here and it works and if I don't know how to do something I can learn. So many people are doing cool stuff here, so it's fun to chat with people who are working in the space. I love how open it is, you can literally do anything with the equipment and everyone is super friendly and helpful, which is a rare thing. The Institute of Making has made my PhD more enjoyable because I can do a lot more because of all the equipment and kit available here."







Louis Scantlebury
Slade School of Fine Art BA student

Louis is a multidisciplinary artist who creates pieces of text describing semi-fictitious situations, which are then fleshed out into real objects. He first journeyed out of his imaginary world and into the Makespace to create a puppet for a stop-motion animation film. Louis usually writes or makes videos, so learning casting techniques and how to animate helped him as he moved out of the narrative and towards a more sculptural object. He went on to make a fidget spinner commemorating a fictional future where England had won the World Cup:
"Making a craft object was important to me and I liked the idea of caring about an object that was nothing, or at best useless. I had the image in my head of it looking really shiny and perfect: that's why I used the CNC to make the fidget spinner. It's a professional machine that isn't available at my art school. It allows you to make a fictitious object that looks really real."

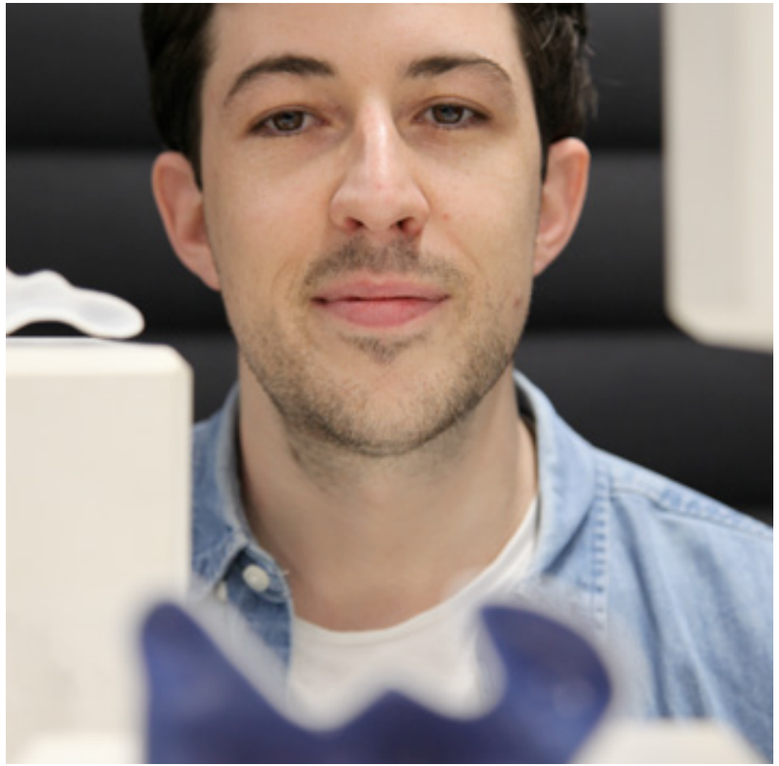
What Louis enjoys about the Makespace is the help and support on offer from staff and even other members; *"being in an environment where people are problem solving all the time makes projects seem more possible here"*. He feels the diverse nature of the Makespace is one of its strengths, and he really enjoys being around students from other courses: *"I would come in and meet someone making a bionic hand or doing something for cancer research and think, I'm making a puppet with a big willy! It feeds your mind and feels like solutions and different ways of making can be found"*.

He has noticed that members also come because they like the space and want to make friends. When he began making his puppet he met a fellow member, Tom, who was also interested in puppets and became his 'mentor for the day'.

Nick Salthouse
Bartlett School of Architecture MArch student

Nick grew up in Zimbabwe where he studied fine art, which formed the way he looked at things and taught him to use unconventional methodologies. He completed his MEng in Architecture and Environmental Design at Nottingham and three years of professional practice before coming to UCL to study at the Bartlett. At the Institute of Making, Nick made a conceptual architectural model to illustrate a set of hydrological infrastructures in the Alps. He started by digitally manipulating the geometry of topographic surveys and maps of the area, and used the digital models as a starting point to discuss how to achieve the desired aesthetic and translate the geometry into a physical form. He started working with the clay 3D printer, then created a prototype using the vinyl cutter, but because of the complex geometry, moved onto CNCing the models. Nick then used these iterations to refine the idea and methodology, and milled the models out of layers of foam. He has learned so many skills at the Institute of Making, including: manipulating digital 3D models, flattening and cutting these as 2D vinyl card to reassemble them as a physical 3D model; CNC milling finite volumes he then used to make plaster skimmed patterns; sanding and repairing them with clay; plaster slip-casting moulds; experimenting with iron oxides to colour the slip; kiln firing and glazing; and programming Arduinos.

The staff at the Institute of Making have made a big difference to Nick's work, especially the technicians who are very receptive to doing things that are not necessarily the usual way of working. For an architect, the Makespace is an extra resource at UCL, but it has become fundamental to Nick's practice: *"The Makespace is as accessible as a tool shed. Whilst other workshops are also accessible, there is so much freedom to experiment here without the pressure to predict the outcomes. It's a bit more like a studio than a workshop and I find it a very productive place to work."*



Rafat Chowdhury
Medical Physics PhD student

Rafat is doing a two-part project at the Institute of Making: making a new medical imaging device, like a new type of MRI, that will give almost instant results in order to quickly determine if tumours are growing or shrinking. This can indicate whether tumours are malignant or benign. He is also making a material that is analogous to human tissue by simulating how liquids flow within the body. Knowing whether liquids can flow into certain types of tissue will help to create better mechanisms to deliver drugs directly where they are needed.

He has learned to use the centre lathe and CNC milling machine to make components for imaging devices and used laser cutting for housing units. Just learning how to use drills and other tools properly has highlighted safe working practices. Rafat says,
"I didn't realise how important health and safety was until I came here."

The Institute of Making offers lots of one-to-one support in a space where loads of different people are here making things. Rafat finds that it is a great place to meet people and see what other projects people are working on in a great facility. It also offers great inductions and members never feel bad asking again for help.

"I've worked in a lot of labs before, but I learned a lot of new things here: Autodesk, Adobe Illustrator, a lot about safety and best practices for using a workshop. There is so much support. With this help, things actually get done here, and quickly! The Makespace is so conveniently close to where I work, but mostly what brings me back is the people and the vibe."

Research Programme

Multidisciplinary materials research is at the heart of the Institute of Making. We create new research collaborations and welcome teams of materials researchers and makers from different disciplines around UCL and beyond. This year we were successful in securing external funding for four new projects: **Designing-out Plastic Waste** (EPSRC EP/S024883/1, £1,248,910); **AT2030 – Spark: Innovation** (DfID AT2030, £10,000,000), in collaboration with the Global Disability Innovation Hub, co-led by Dr Catherine Holloway; **The development of a 4D-printing manufacturing platform** (EPSRC EP/N509577/1, £114,318.64), led by Dr Anna Ploszajski, and **Developing bespoke breathable prosthetic liners with growth tracking & active cooling** (NIHR STWK-016, £43,785).

These awards add to our ongoing funded research projects: **Self-Healing Cities** with the University of Leeds, University of Birmingham and University of Southampton (EPSRC EP/N010523/1, £5,247,017); **Centre for Nature Inspired Engineering** (EPSRC EP/K038656/1, £4,980,773) led by Prof Marc-Olivier Coppens; **Material Anxieties** (Wellcome Trust 200354/Z/15/Z, £200,556) led by Dr Sarah Wilkes; **Fit-for-purpose, affordable body-powered prostheses**, led by Prof Laurence Kenney, University of Salford (EP/R013985/1, £1,390,144). The Institute of Making is also a partner in Ellie Doney's UCL PhD research on **Food and Transformation**, funded by BEKO and undertaken in conjunction with the Slade School of Fine Art.

This year also marked the successful completion of **Developing bespoke flexible sensors for prosthetic and orthotic liners**, funded through the Medical Devices and Vulnerable Skin Network – Research Stimulus Fund (EPSRC EP/N02723X/1, £18,996); **Nature Inspired 4D printing for biomedical applications** (CNIE "Inspiration" Grant; £29,769); and Elizabeth Corbin's PhD research on

The Open Workshop Network. Liz was recently hired as a research director in the private sector. While we will miss her, we are delighted that she will be able to use her research expertise in collaborative makerspaces that she gained while at the Institute of Making.

This year we also hosted numerous research workshops, including a series of participatory workshops on **Sensory Preference in Prosthetics** and one on **Materials in Hospital Furniture**, as part of Sarah Wilkes' research (p.68 & p.70). As part of Ellie Doney's research, we also hosted a series of **Materials Research Kitchen** workshops including **How Do You Like Your Eggs?**, exploring personalisation and preference in the kitchen, and **Cupboard Love**, reimagining the pantry. Ellie also ran **Sugar: Transformation**, a workshop on sugar and its transformations in the body, in industry and historically, in collaboration with *Feast Journal*. In conjunction with the Being Human Festival of the Humanities and Beth Munro's research, we also held a public research event and member masterclass on **Recycling Roman Ruins** (p.90), which allowed participants to transform glass and pewter into new objects in a recreated ancient kiln.

Our research program is overseen by our research manager, Dr Beth Munro, who is also an archaeologist and expert in ancient materials recycling. She has helped the Institute of Making to diversify its work by shining a light on making linked to the humanities. As research is at the core of what we do at the Institute, we rely on members and academics at UCL and beyond to expand our project portfolio and push the boundaries of multidisciplinary materials and making research. We are delighted to see our research projects and interests expand every year.

Designing-Out Plastic Waste
EPSRC EP/S024883/1 (£1,248,910)

This 18-month project brings together a diverse team of UCL researchers interested in solving the plastic waste problem. Our aim is to develop ways to design out waste from plastic packaging and create new business opportunities. We believe that waste is a failure of design: whether that is failure to design plastics that are reusable, recyclable, or compostable; failure to design waste collection methods that encourage a more proactive approach to recycling; failure to design economically viable mechanical and chemical recycling processes; or failure to design the market incentives that ensure local authorities can invest in waste management technology. Each design failure compromises the whole system, leading to leakage of plastic into the environment, and creating an economic burden on the UK.

The project has three objectives: 1.) To develop new enzyme-catalysed recycling technology for laminate films using circular economy economic models, materials flow models, materials property analysis and biochemical engineering; 2.) To identify design flaws and undertake feasibility studies of design interventions in the plastics economy; 3.) To create a research interface for the public called the Plastics Waste Innovation Hub.

Led by Prof Mark Miodownik (Institute of Making), this project assembles a UCL team of experts in each part of the system: Prof John Ward (Biochemical Engineering); Prof Helen Hailes (Chemistry); Prof Paola Lettieri (Chemical Engineering); Prof Francesca Medda (Civil Engineering); Dr Teresa Domenech (Institute for Sustainable Resources); Prof Susan Michie (Behavioural Science) and artist-in-residence Ruby Wright, whose illustration features here.
https://www.plasticwastehub.org.uk

Image credit: Ruby Wright

AT 2030 – Spark: Innovation
DfID AT 2030 (£10,000,000)

We are delighted to be partners on the AT 2030 project, led by the Global Disability Innovation Hub (GDI) and initially funded by the Department for International Development (DfID). DfID's fast-start support for AT 2030 will help to lay the foundations for global Assistive Technology (AT) access through: finding evidence of what works; testing user-centred design of technology; trialing new service delivery innovation; and opening market access in priority countries.

AT 2030 is made up of six sub-programmes, and the Institute of Making are partners on one of these programmes (Spark: Innovation), which aims to improve the use of emerging technologies for accessibility and to spur on new innovations. Spark: Innovation is based at the GDI Hub and is led by Dr Catherine Holloway (UCL Computer Science) and Prof Mark Miodownik (Institute of Making).

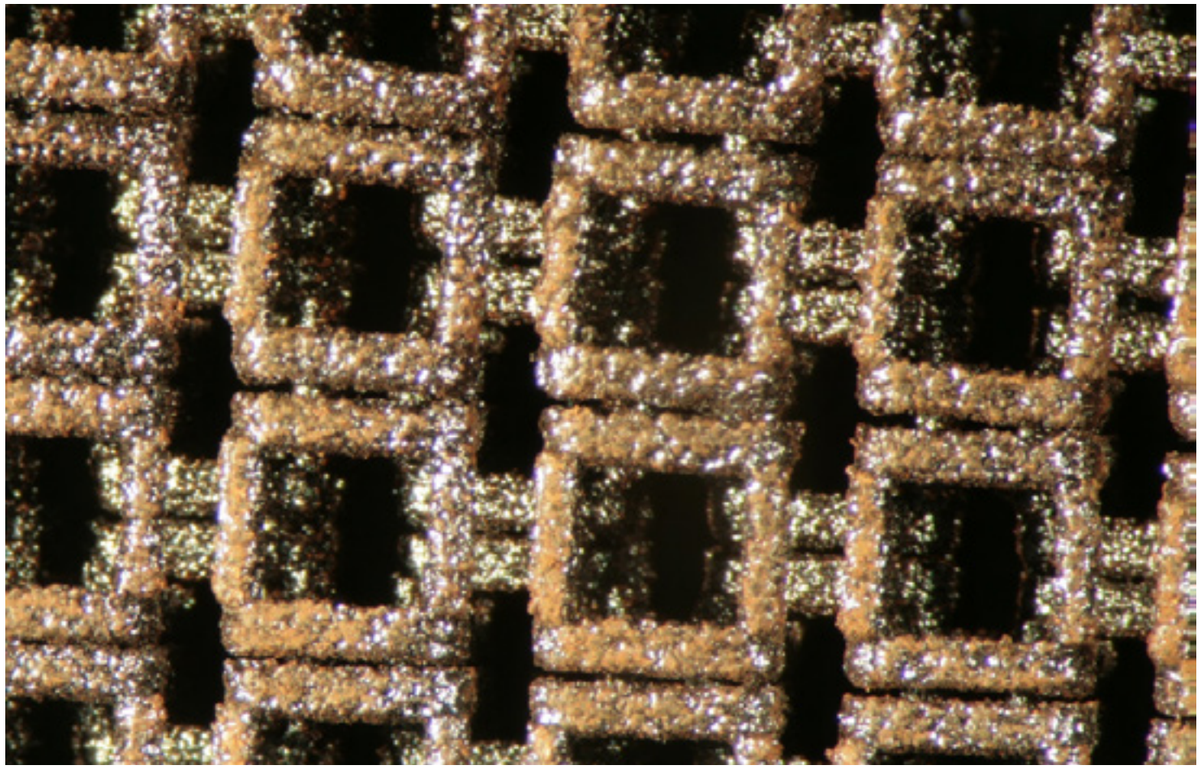
AT 2030 will reach at least 3 million people; catalyse at least 10 new disruptive technologies with potential for life-changing impact; develop at least 6 innovative service delivery models; spark 30-50 new start-ups; develop and test new methodologies for market shaping on assistive technologies; establish an East Africa AT Innovation Hub; double DfID's initial investment through partner backing; and use all of this to leverage resources from other stakeholders by informing and supporting the development of a new Global Partnership for Assistive Technology.
https://www.disabilityinnovation.com/at2030

Image credit: WHO GATE

The development of a 4D printing manufacturing platform EPSRC EP/N509577/1

4D printing uses 3D printing to produce materials and structures which move. Since being introduced by Skylar Tibbits in 2013, materials engineers have created some innovative designs for simple actuating shapes that morph in response to stimuli like moisture, light or heat. The ability to print actuating devices has great potential in soft robotics, wearable technology and biomedical devices. For example, adaptable fabrics with programmable stiffness could be used to make exoskeletons with advanced therapeutic functionality. However, this new field is in its infancy; there are limited stimuli, and the structures produced are often mechanically weak with slow response times. Researchers are struggling to create more complex designs because techniques for modelling and designing actuators lack the multiscale sophistication required.

The aim of this project is to produce a 4D printing manufacturing platform which includes new active materials, bespoke hardware, and new modelling software which will facilitate the design of complex actuating mechanical architectures.
This project is led by Dr Anna Ploszajski, who is based at the Institute of Making. Anna completed her PhD at UCL in 2017, and subsequently completed a six-month postdoc with us, on Nature Inspired 4D printing for biomedical applications (see p.64), which has laid the groundwork for this new project. This latest project is funded by a two-year, UCL EPSRC Doctoral Prize Fellowship.
www.instituteofmaking.org.uk/research/the-development-of-a-4d-printing-manufacturing-platform



Developing bespoke breathable prosthetic liners with growth tracking & active cooling. NIHR STWK-016 (£43,785)

The interface between a residual limb and a prosthetic requires a liner material that ensures the transmission of forces while ensuring comfort and preventing skin damage. This is a considerable engineering challenge because a prosthetic wearer's body changes size and shape throughout the day. In the case of children, growth over time also changes the fit of the prosthetic and the liner. Skin damage occurs due to a number of factors including temperature, exertion, hydration levels, and shear & pressure forces due to poorly fitting liners, slippage and misalignment. Our proposed solution is a bespoke silicone liner that is 3D printed, with active cooling channels that can circulate coolant to exterior heat dispersion panels, and nanocomposite stretch sensors to track growth. The liner will be designed using surface 3D scans of the child's stump. Such active, intelligent liners, managed by prosthetists, could lead to better fit and better management of comfort and skin health of prosthetic wearers.

This project is being jointly led by researchers and clinicians at UCL and the Royal National Orthopaedic Hospital. The team includes Prof Mark Miodownik (Institute of Making), Dr Catherine Holloway (UCL Computer Science), Prof Rui Loureiro (UCL Institute of Orthopaedics and Musculoskeletal Science), Dr Imad Sedki (Consultant in Rehabilitation Medicine, RNOH), Mark Croysdale (Senior Prosthetist, RNOH), and Ben Oldfrey (PhD student, UCL COMPLEX). This new research is funded by the Starworks Innovation Project; a prosthetics research collaboration which brings children and their families together with the NHS, Industry, Clinical Academia and leading National Research Centres.
www.instituteofmaking.org.uk/research/developing-bespoke-flexible-sensors-for-prosthetic-and-orthotic-liners

Self-Healing Cities
EPSRC EP/N010523/1 (£5,247,017)

This EPSRC Grand Challenge project is led by the University of Leeds and involves academics at the University of Birmingham and University of Southampton, as well as local councils and industrial partners. The project is inspired by a vision of a city where the infrastructure is autonomously and dynamically diagnosed, maintained and repaired by robotic systems.

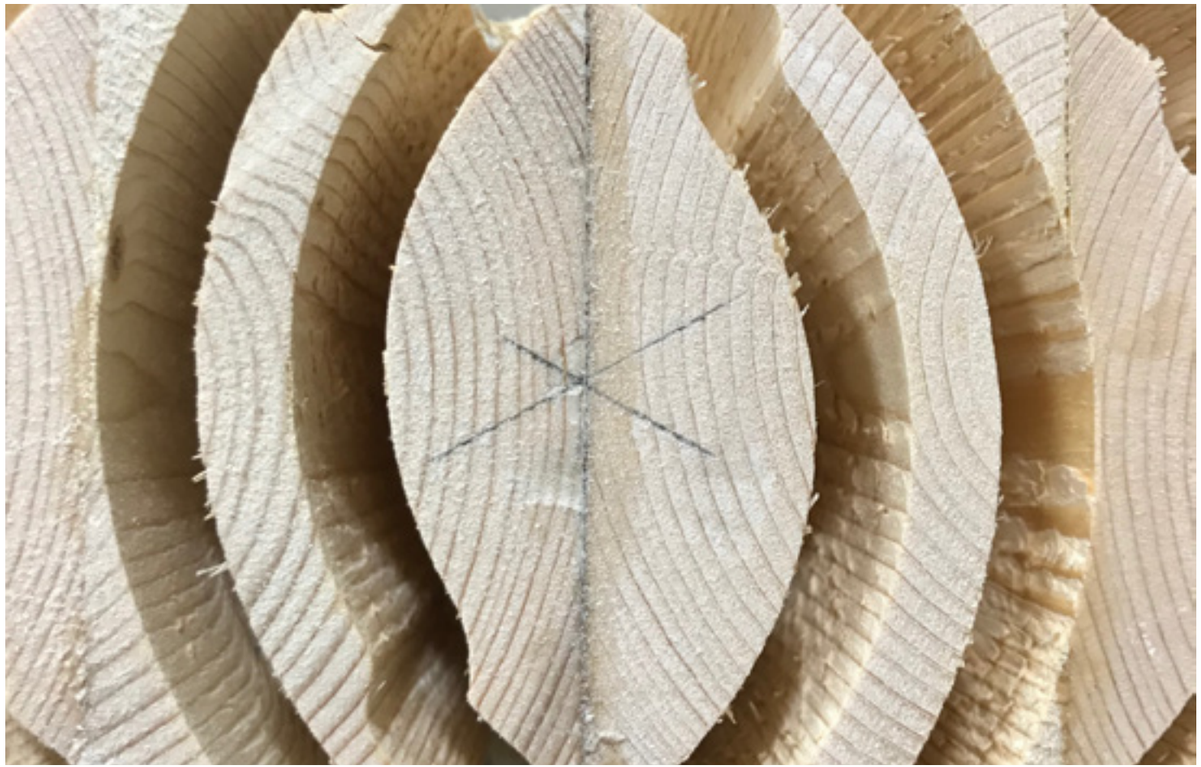
Institute of Making Director Mark Miodownik and post-doctoral fellow Dr Richard Jackson are leading on the materials aspects of this project. They are developing technologies for robotic repair and maintenance of city infrastructure. This includes assessing non-conventional materials for suitability in repair of infrastructure, and designing new 3D printing techniques for mobile robots. The ultimate aim of this project is to improve the resilience of the UK city infrastructure through materials research and engineering.

This year the project team hosted a two-day robotics challenge event bringing academics, industry, policy makers and stakeholders together to explore a future use of robots in the creation, inspection, repair and maintenance of critical infrastructure. The UCL team contributed to the 3D printing drone demonstrator for road repair.
www.selfrepairingcities.com

Centre for Nature Inspired Engineering EPSRC EP/K038656/1 (£4,980,773)

The Centre for Nature Inspired Engineering (CNIE) at UCL is now in its fourth year, and the number of researchers at the centre is growing. Rather than imitating nature out of context or succumbing to superficial analogies, research at CNIE takes a scientific approach to uncovering fundamental mechanisms underlying desirable traits, applying these mechanisms to design and synthesise artificial systems that borrow the traits of the natural model. These systems, which include desalination membranes, fuel cells, catalysts, adaptive materials or built environments, thus become endowed with the same desirable characteristic as their models in nature – cell membranes, lungs, trees and bacterial communities – with associated extraordinary performance, such as scalability, robustness, material and energy efficiency.

Institute of Making Director Prof Mark Miodownik leads one of the areas of research pioneered by CNIE: the theme of Dynamic Self-Organisation, studying self-organising, adaptive and self-healing materials that are able to adapt their structure and associated properties in response to a changing environment. An ongoing collaborative PhD project on this theme is with Richard Beckett of the Bartlett School of Architecture entitled Designing Bioreceptivity – Architectural Biofilms. Another project on this theme, Robust Self-healing Fabrics for Soft Robotic Applications, was completed by PhD student Mark Ransley, and the resulting paper has had more than 3000 downloads.
www.natureinspiredengineering.org.uk



Material Anxieties
Wellcome Trust Fellowship 200354/Z/15/Z (£200,556)

In this three-year fellowship Dr Sarah Wilkes (Institute of Making) has been using a multidisciplinary mix of methods to understand how the materials developed and selected for healthcare applications impact on patient experiences in positive and negative ways. Sarah is using this understanding to support healthcare designers, engineers and materials researchers in identifying and developing materials that better suit the needs of clinicians and patients.

This project is now in its final year, and Sarah has been using social research, design research and materials research methods to explore how materials could improve peoples' experiences of prosthetic limbs (see p.68) and high-touch hospital furniture.

In particular, Sarah has been drawing on the Materials Library and Makespace as research tools this year. Public engagement activities have also been central to this project from the start, not just in terms of disseminating its research findings, but as opportunities to engage patients and the public in directing this research. One of these patient involvement activities is featured on p.70. This project also inspired our March Delight & Disgust open day, an extravaganza of the revolting and the sublime that attracted 1661 visitors.
www.instituteofmaking.org.uk/research/material-anxieties

Fit-for-purpose, affordable body-powered prostheses
EPSRC EP/R013985/1 (£1,390,144)

Upper limb loss can have devastating results for the individual, particularly when people are already surviving at a subsistence level. Demand for upper limb prostheses due to conflict and road traffic accidents is high in lower and middle income countries (LMICs), but provision is poor. Ready-made prosthetics components and materials required are costly because they need to be imported, and maintenance is a major challenge. Body-powered (BP) prostheses have seen little development since the early 20th century, despite high rates of rejection. Nevertheless, BP prostheses are well-suited for use in LMICs, being potentially simple to manufacture and maintain. If the reasons for rejection (e.g. limited functionality, cost and heat-related discomfort) can be addressed, BP prostheses offer a potentially viable solution.

This three-year project brings together teams from across the UK, Uganda and Jordan to create a new upper limb BP prosthesis that is optimised for adoption by LMIC prosthetic services and acceptable to users. This will include establishing methods of fabrication, fitting and evaluation of the prosthesis which are appropriate to LMICs. An important element of the work will be to identify LMIC-appropriate materials and fabrication methods. The aim will be to utilise local materials, simplify manufacture, minimise cost, and enable local repair and maintenance. This project is led by Prof Laurence Kenney, (University of Salford), with Dr Cathy Holloway (Global Disability Innovation Hub), Prof Mark Miodownik (Institute of Making) and Dr Dafne Morgado Ramirez (GDI Hub) as co-investigators from UCL.
www.fit4purposeprosthetics.org

Food & Transformation: The Sausage Ouroboros
BEKO PLC EP/N509577/1 (£287,813)

Ellie Doney's PhD project is about how food serves as a method and a metaphor to gain knowledge about an expanded sense of human-material ecology. It is a research practice connected to art, materials and making, using food and its active qualities as an investigative field. The Ouroboros Sausage stands for the liquidity of subject and object in our relationship with materials, and is a medium for thinking and doing research.

The aim of her study is to develop a method, a practice of cooking and eating together, that enables embodied thought across disciplines about boundary slippages between human and non-human matter. It challenges the border between the body and its environment, asking how materials become embodied in not only our physical but also in our cognitive being, through ingestion, metaphor, and mirroring. If this method enables a growing understanding of human-material ecologies – seeing ourselves as mixed materials connected to our environment – can it change our behaviour and treatment of other matter and ecosystems?

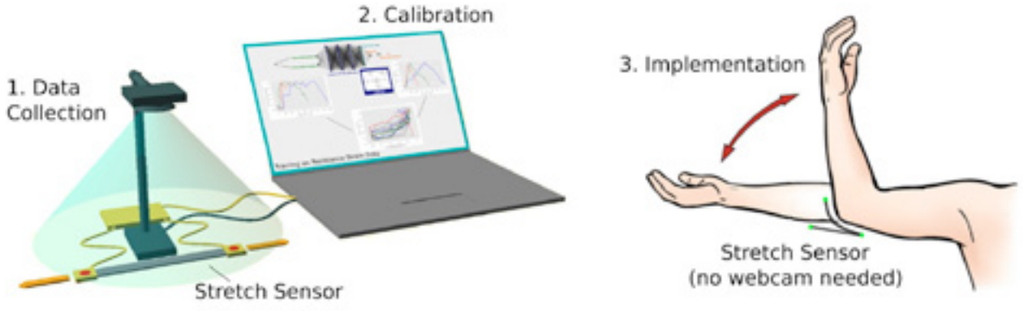
This PhD is supervised between the Slade School of Fine Art and the Institute of Making, and is funded by the UK R&D arm of BEKO Plc, a company that makes domestic appliances. Together Ellie and BEKO are investigating how the technology we use every day mediates our connection with edible materials. They are developing technologies that address food waste and childhood obesity, alongside future health concerns, such as understanding what is in our food, and the materials that it comes into contact with.
www.instituteofmaking.org.uk/research/food-transformation-how-are-materials-like-us

Image credit: © Hydar Dewachi

Developing bespoke flexible sensors for prosthetic and orthotic liners EPSRC EP/N02723X/1 (£18,996)

It is a considerable engineering challenge to make prosthetic and orthotic liner materials that ensure mechanical transmission of forces while ensuring comfort and prevent skin damage on a user. With funding from the Medical Devices and Vulnerable Skin Network – Research Stimulus Fund, this project aims to create a liner material that can sense pressure and sheer forces within a prosthetic or orthotic device, providing data as real-time feedback to the user allowing them to prevent their skin becoming damaged. Led by PhD student Ben Oldfrey (UCL COMPLEX), the project also works in collaboration with Prof Mark Miodownik (Institute of Making), Dr Cathy Holloway (UCLIC) and the Global Disability Innovation Hub.

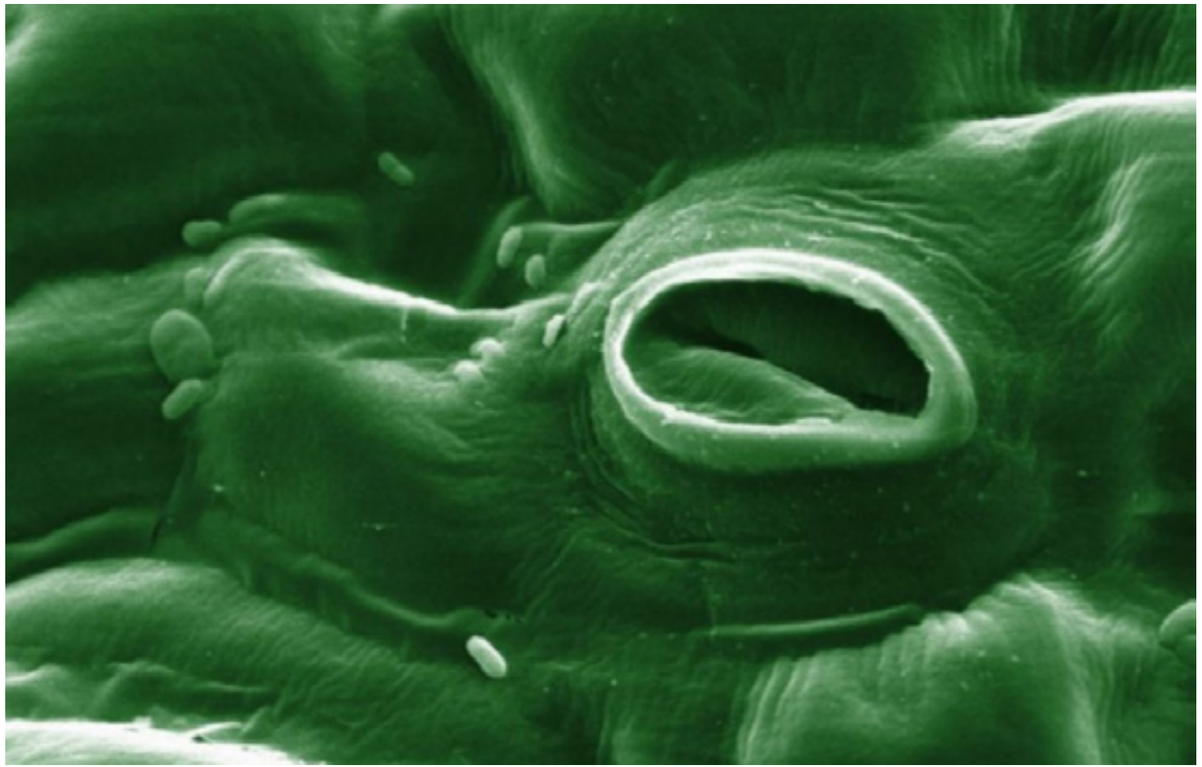
The technology combines existing stretchable sensors with computation to create an intelligent system that adapts to the user allowing them to monitor the vulnerability of their skin to damage. This project will produce a prototype of the technology and make available online a full open-source toolkit to allow others in the EPSRC Vulnerable Skin Network to build upon and apply this system to other applications.
www.instituteofmaking.org.uk/research/developing-bespoke-flexible-sensors-for-prosthetic-and-orthotic-liners



Nature Inspired 4D printing for biomedical applications
CNIE “Inspiration” Grant
EPSRC EP/K038656/1 (£29,769)

Many disabled people who wear prosthetics and orthotics on a daily basis face problems with temperature and moisture regulation where their stump interfaces with their prosthesis liner. This affects not just the person’s comfort but also their skin health. In nature, plants use millions of actuating micro-respirational pores to perform important physiological functions, such as regulating temperature and moisture level. Inspired by these functions, this project will investigate whether problems with temperature and moisture regulation in prosthetics can be solved by emulating plants’ micro-respirational pores.

Led by Dr Anna Ploszajski (UCL Institute of Making) and in collaboration with Dr Cathy Holloway (Director, Global Disability Hub), and Dr Patrick Cullen (UCL Chemical Engineering), this pilot project will lay the groundwork for the long-term aim of creating a 4D printing platform to manufacture bespoke liners with actuating pores for prosthetics and orthotics wearers to regulate their skin temperature and moisture levels. 4D printing is the process of using additive manufacturing techniques (3D printing) to produce materials with programmable functionality. This first phase of the project will create new composite smart materials which actuate in response to various stimuli and are suitable for processing into pore structures by 4D printing.
www.instituteofmaking.org.uk/research/nature-inspired-4d-printing-for-biomedical-applications

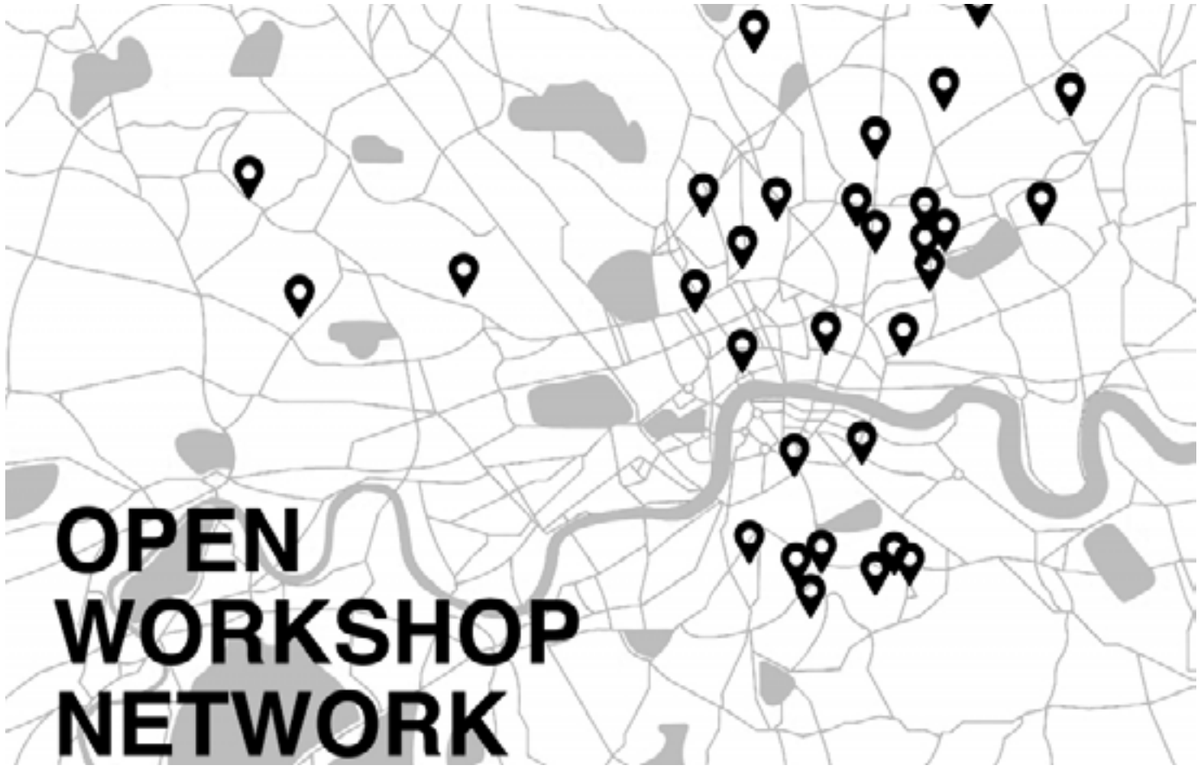


The Open Workshop Network

The Open Workshop Network (OWN) was the doctoral research project of Liz Corbin, who is currently writing up her PhD. The research looked into the larger making community of London. Research was carried out over the course of three years and done in collaboration with the 40+ makerspaces, Hackspaces, Fab Labs and open workshops that comprise the network. This project coincided with a time of increased interest and speculation into the broader "Maker Movement". The goal of Liz's PhD was to extend beyond anecdotal enquiry and to develop a rich dataset that encapsulates the material, technical, social and cultural nature of this nascent and ever fluid culture. The project identified the realities, triumphs and challenges that individuals and workshop collectives face in the day-to-day running of open-access, community-centered spaces for making.

A key aim of the project was to develop a method of research whereby respondents and participants played a more active role in plotting the course of inquiry. The workshops and individuals participating within the network collectively steer the direction of the project and hold co-ownership over the data that is produced. By adhering to this adaptable and responsive methodological approach, the project hopes to bridge the gap between academic research and the communities and individuals that are the focus of study.

A legacy of the project is a digital platform that maps the open workshops in London. From printmaking to welding, 3D scanning to plaster casting, the OWN digital platform provides a place for people to learn about and connect with the many London-based organisations that are dedicating themselves to providing publicly accessible means for making.
www.openworkshopnetwork.com

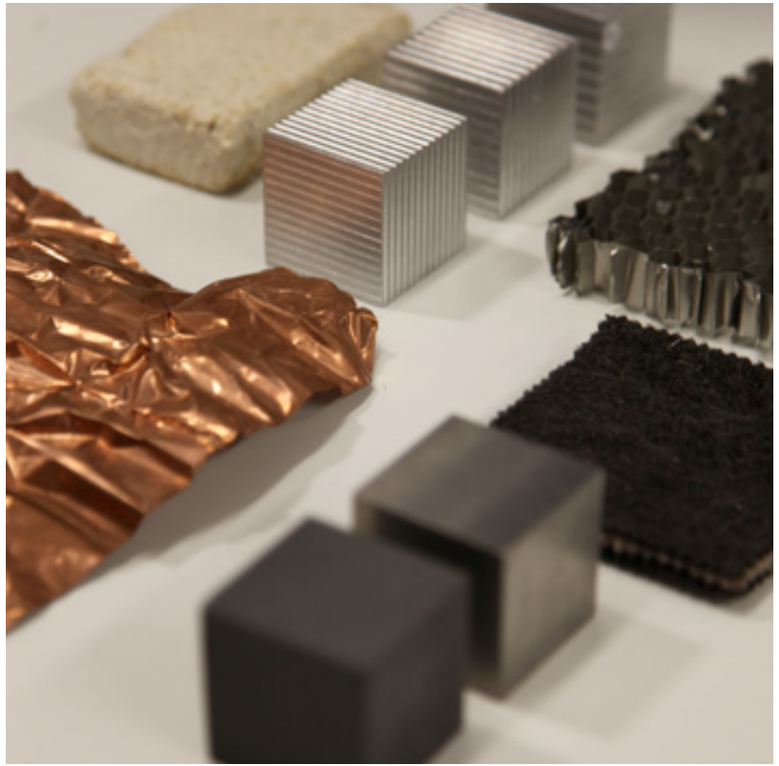


Research Workshop:
Sensory Preference in Prosthetics

"Lovely afternoon at The Institute of Making with @designfordisablity testing materials for prosthetics. Thank you for having me Caitlin & Sarah" (Participant)

Led by Caitlin McMullan, a Glasgow-based designer, researcher and below-knee amputee, and Sarah Wilkes, Wellcome Trust research fellow at the Institute, this series of participatory events in London, Glasgow and Liverpool brought together amputees and people with limb differences to talk about their material and sensory preferences in prosthetics.

Qualitative research with people who wear prosthetics has shown that there is an increasing interest in non-cosmetic and non-anthropomorphic limbs, but so far not much research has been done on wearers' materials preferences or the potential impact of materials choices on satisfaction with a limb. Using the Materials Library and specially made sets of objects that vary by one material property, Caitlin and Sarah have been running materials handling sessions and discussions with as many wearers as possible to better understand what they want prosthetic limbs to look and feel like, and why. This will be fed back to clinicians, prosthetists and prosthetics manufacturers, along with a method and set of tools for talking about material and sensory preferences in prosthetics.
https://www.instituteofmaking.org.uk/research/sensorypreferencestudy

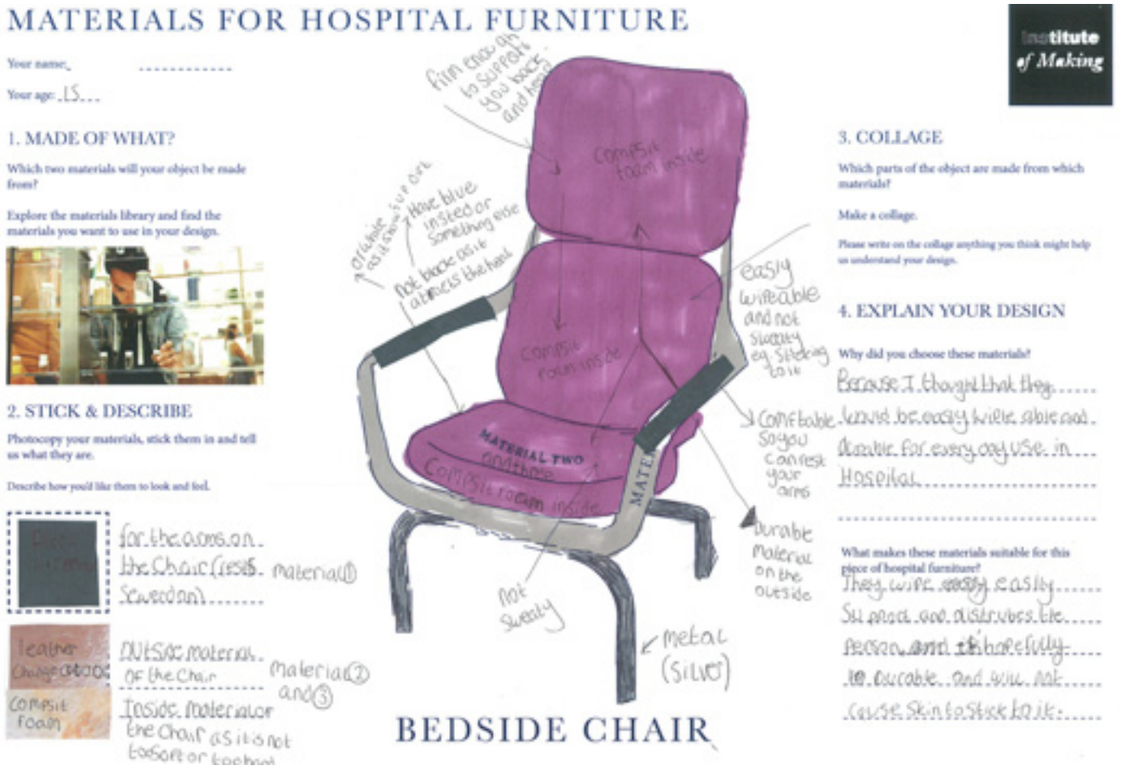


Research Workshop:
Materials in Hospital Furniture

"It was a fantastic day and all YPAG members were delighted to be there and contributing to improving GOSH. The facilitators were inspiring. Thanking you for a fabulous opportunity" (Parent)

This patient involvement activity brought children and young people aged 10 to 17 from Great Ormond Street Hospital's Young Person's Advisory Group (YPAG) to the Institute to give their opinions about materials used in an array of high-touch hospital furniture like handrails, bedside tables, nurse call buttons and toilet seats. Researchers have shown that children are particularly susceptible to the hospital environment and its sensory dimensions, and this workshop is the first stage of a broader study that aims to involve children and young people in the participatory design of hospital interiors.

Health geographers and environmental psychologists have demonstrated the therapeutic effects of nature, visual art, lighting, colour and design in hospitals, but so far little attention has been paid to the impact that materials can have on patient health and wellbeing. Preferences for 'homely', 'familiar' or 'hotel-like' hospital environments, as opposed to sterile, clinical and institutional ones, are well-documented, but there has been no systematic investigation of how specific material properties and haptic experiences contribute to this. This study aims to explore what kind of material properties patients, parents and healthcare workers at GOSH prefer in high-touch hospital furniture and hardware, whilst taking into account practical constraints like cost, sustainability, safety and, in particular, infection control.
www.instituteofmaking.org.uk/research/material-anxieties
https://generationr.org.uk/london/



Events & Public Engagement

Twelve ancient riverboats. Eight thousand slimes. Two hundred kilos of cement and aggregates. Ninety contributing makers, engineers, scientists and artists. Almost two hundred volunteers and event delivery staff. Over twelve thousand visitors.

Our sixth year of events has been truly exceptional, as we welcomed more people than ever before to the Institute of Making, more than doubling visitor numbers of any previous year. From March 2018 to March 2019 we held 53 events, 21 of which were member events and 30 of which were public (see p.142 for the full list of events). These included 30 masterclasses (including Coracle Making and Recycling Roman Ruins), 10 research events (including Materials Research Kitchen and Sensory Preference in Prosthetics workshops) 1 Materials Library event, 2 outreach events, 3 large-scale public open days, 4 week-long events (including Slime Olympics at New Scientist Live and Leigh Cameron, concrete artist and maker in residence).

Our goal in organising events – from small, specialist making masterclasses and research seminars to public festivals for thousands of people – has always been to run activities that are fun, surprising and hands-on. Events that would pique our own curiosity about the art and science of expert making and that we ourselves would like to attend. Through this we hope to expand people's vision of the made world, share our fascination with materials and cherish everyone's inner maker. And so, as the Institute of Making events proved increasingly popular, waiting lists grew and messages asking for more kept coming, rather than seeking more visitors, we planned for better access. We developed more drop-in events, like the Big Makes and planned as many Masterclasses as our small team could support without compromising on quality.

'Access' is more than a purely physical matter. For the Institute of Making events, being truly accessible also means providing a safe space for all, offering a warm welcome to

new faces as equally as to old friends, and – while retaining the Institute of Making's unique and personal sense of making and materials – thoughtfully considering what conversations and explorations the public may want to undertake with us.

For that reason we planned for two of our largest events of the year to reflect a groundswell in feeling for two material groups; the love of slime and the fear of plastics. Slime making has been improbably popular in recent years, a creative craze that has enraptured millions, particularly young people and children. We wanted to honour this experimental chemistry occurring in homes throughout the country by inviting all slime aficionados to our event. A slime lab, a wealth of slime expertise from multitudinous disciplines, and a Slime Olympics were set up. Equally important: rather than masquerade as false experts, we enlisted the real authorities on slime. Famous Instagram slimers, mostly young people between 10-14 years old, joined us to show their online slime businesses and their knowledge of these non-Newtonian fluids. The result was not only a hugely popular and lively event, but also a joyful IRL (In Real Life) coming together of a passionate online community, with a surge of visitors from across the country. One of our proudest achievements this year is to have made these thousands of young first-time visitors feel welcomed on UCL campus through the presence of their Slime Superheros, and to have made them feel valued by the Institute of Making through a common love of materials.

Our autumn open day was an entirely different beast. Plastics use has become a widespread concern and a hot topic in public discourse, but as an Institute dedicated to making and materials we sensed that there were gaps and omissions in the conversation about this black sheep of the material world. We asked the public to join us in our quest to explore plastics: discovering the miraculous material properties of this contentious group of materials; testing it physically with different hands-on

making processes; unpicking the thorny issues of current plastics use, circular lifecycles and recycling; and taking a look at plastics' remarkable cultural history. Together we discovered, through the many contributing chemists, biologists, recyclers, horn makers, historians, economists, architects and artists, that plastics use is truly a wicked problem, and that although there are no easy answers, the only way to start seeking solutions is by joining forces across sectors, disciplines and schools of thought.

In our sixth year, we have enjoyed forming relationships with new making communities in order to encourage and welcome different types of visitors to join our events. As part of developing closer relationships with our visitors, we have started to record conversations with and information about our visitors for the first time, including through a dramatic photoshoot of handmade neon 'polymorph' food tools. The success of our event ideas this year has resulted in commissions for re-running our event formulas on a grand scale for clients such as New Scientist Live at Excel Centre, which allowed us to reach even more people with our hands-on approach to making and materials.

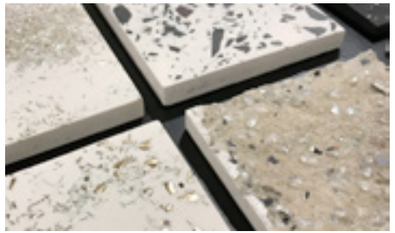
A tremendous amount of hard work goes into the events every year, from a team of only ten people, and of those, only one full-time Events Coordinator, Sara Brouwer, who oversees and delivers the programmes. The numbers speak for themselves in reflecting the remarkable level of team work that has enabled such an output, and in showing what a wonderful and rewarding year it has been.

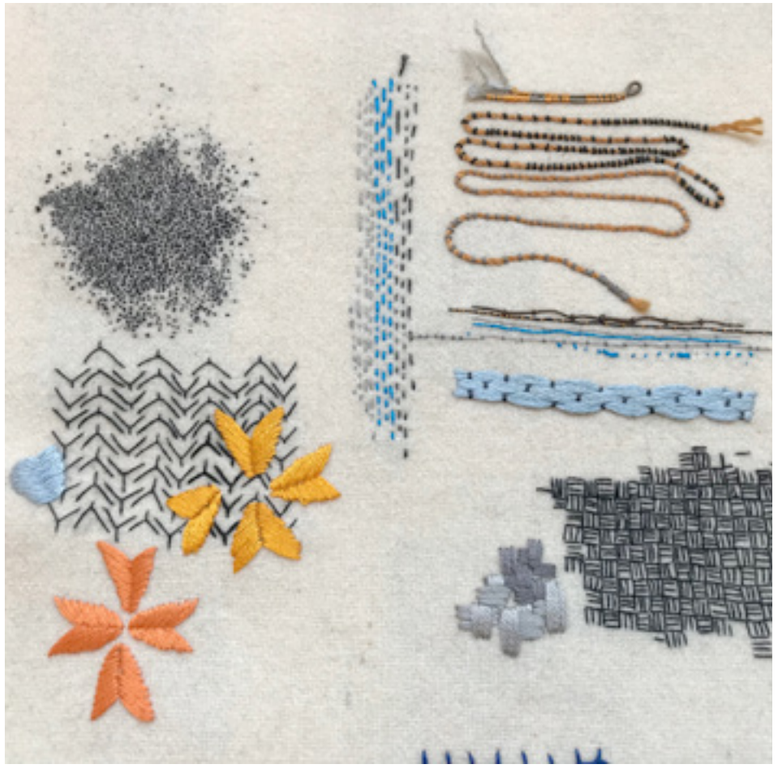
"Some pics from the UCL slime event on Saturday! WOW what an amazing day it was! I met soooo many awesome people as well as my ibf's and some of my fans/followers! I can't tell you how much I appreciate you all omg!! A MASSIVE thank you to the Institute of Making @of_making at UCL for hosting this memorable day, everyone was so approachable, kind and it was so fun! Over 4000 people were there!!"
(Chloe, 14, Miffy Slimes on Instagram and YouTube)

Festival of Stuff
(Masterclasses)

Our five-day Festival of Stuff once again showcased some of our most popular Masterclasses. In its sixth year, the Festival continues its unique tradition of giving the public free access to specialist tuition by expert makers. Its fifteen covetable workshops sold out entirely, most within minutes.

Each day the Festival celebrated not only the skill of accomplished makers but also curated parallels between specialist practices. The Festival's first day explored the world of aggregates with a series of jesmonite and concrete workshops – from the traditional glass, stone and sand, to more contemporary approaches, such as plastic and metal waste offcuts. Day two explored the stuff of smell, with scent-making and essential oil mixing during the day. In the evening, the Institute of Making welcomed back world famous 'nose' and perfumer Roja Dove, whose talk took in the chronological development of key perfume molecules and iconic formulations in the world of fragrance. The third day laid links between the textural qualities of 3D print finishing and embroidery, examining how techniques could produce smooth, rough, speckled, pocked and lined surfaces on a standard base fabric. Silica was the reigning ingredient on day four, where sand mould making for bronze casting ran side-by-side with a Glass Masterclass where glass was engraved, acid-etched and fused using microwave kilns.

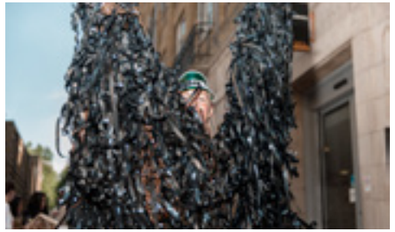




Festival of Stuff
(Open Day)

"Algae drinks, algae pearls in ice cream oysters, ferrofluid from VHS tapes, and 3D printed roads! Festival of Stuff today was truly spectacular! It's fascinating how the Institute of Making always succeeds in finding the most interesting ways to engage the public in science and research! I love that!" (Raghad, visitor)

The seminal event of the Festival of Stuff, our Saturday Extravaganza of making and materials, gave over a thousand people the chance to celebrate a plethora of processes and materials from chimney furnaces to monster slimes, and an algae beauty bar to the Great Glue Off. The Festival heated up with a travelling chimney furnace which melted and poured liquid bronze into sand moulds. Visitors were able to make their own ferrofluid (magnetic liquid) with Dr Anna Ploszajski, and cast pewter into intricate cuttlefish shell moulds to the summery sound of a steel drum band. The day brought back all-time favourites, with 'monster slimes', a plant-powered experiential algae beauty bar, ice cream oysters with agar pearls and coffee siphoning. 'Finishing' techniques took centre-stage at this year's extravaganza, with a whole swathe of making stations teaching visitors to sand, polish, glue, shine and generally buff up materials like wood, metal, plaster and more. Institute of Making research fellow Dr Sarah Wilkes donated expertise built up through her fellowship (see p.56) to give visitors' finished surfaces a once over with her microscope and knowledge of nano-surfaces.



Slime
(Open Day)

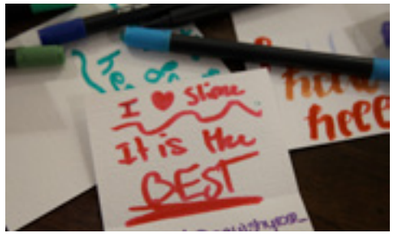
To honour the staggering craze of slime making and its millions of non-Newtonian followers around the world, on the 24th of March, for one day only, the Institute of Making transformed into the Slime Olympics with a state-of-the-art slime making lab. The day proved overwhelmingly popular as we welcomed over four thousand visitors, many of them young people from across the country who visited the UCL campus for the first time. The event paid tribute to a wealth of slime expertise from multitudinous disciplines as well as a brave new generation of Slime Entrepreneurs who sell slimes online with outstanding professionalism and panache, including long-time Institute of Making event visitors Amy and Ben Slotover who suggested the event theme to us.

The Institute of Making team went on to produce a further five thousand slimes six months later. Our Slime event formula was commissioned by New Scientist Live to create a central stand at their exhibition in the Excel Centre, London Docklands, where many more members of the public made slime with the Institute of Making and tested its material properties on the Slime Olympics concourse.

"Live report from @of_making slime fest which has generated so much enthusiasm that it has RUN OUT of SLIME. @zoelaughlin & co, your job of 'firing imagination' is done!" (Amanda Perry Kessaris, visitor)

"Came today with my two children. Absolutely fantastic event and unbelievable there was no charge for this. Would have happily donated to this. Can't wait for the next event."(Vic Banerjee, visitor)

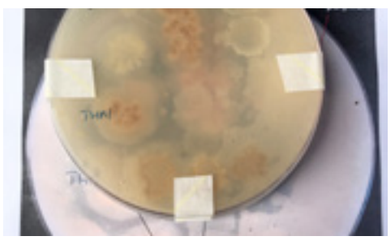
Read our Slime blog for recipes and ingredients at *www.instituteofmaking.org.uk/blog/2018/04*



Plastics (Open Day)

Our autumn event offered a terrific extravaganza on the theme of plastics, aiming to bring deeper exploration and more diverse knowledge to a conversation about a material that is currently very much in the public domain. Over a thousand people joined the Institute of Making to get to grips with plastics – discovering its miraculous material properties; testing it physically with hands-on processes; unpicking the thorny issues of plastics use, lifecycles and recycling; and taking a look at plastic's remarkable cultural history.

A rich and multidisciplinary line up of experts – from chemists, designers, policy advisors, biologists, film makers, economists, architects, behaviour change researchers, artists, musicians, social historians, craft makers and material scientists – provided the event with demonstrations and making activities. Different types of plastics were explored including celluloid and cinema, 3D printed PLA violins, home-made agar bioplastics, and furniture joinery with PET water bottles, while director Mark Miodownik presented a special plastics-themed display in the Materials Library.



The event did not pretend to offer answers to the difficult and worrisome plastics problem, but did provide a more nuanced and complex understanding of plastics and their usage. We hoped to show that the only way to start seeking solutions is by joining forces across sectors, disciplines and schools of thought – and for that reason also sought to be a pre-launch sounding board and public engagement opportunity for academics involved in the Designing-Out Plastic Waste project (see p.44).

"Had an amazing time at the Institute of Making Open Day about Plastics. We need to think carefully about how we value, use and dispose of plastic. It's not always the villain!" (Katherine Curran, visitor)

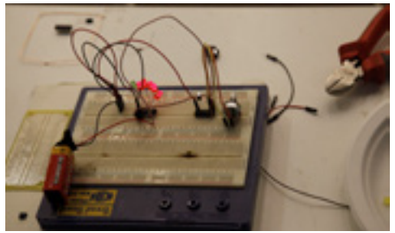
"A chilly but really enjoyable event from @of_making at @ucl on plastic, recycling, waste management, materials, processes and sustainability. Love this place." (Carra Santos, visitor)

I made this whisk from polymorph at the Institute @of_making and got onto the leaderboard whisking egg white to soft peaks in 45 seconds! A fascinating day at their plastics open day. (Judith Needham, visitor)

Circuitry with Jakub Zalesak (Member Masterclass and Big Make)

As part of our programme's initiative to widen access to specialist making tuition, this year we piloted Big Make sessions, which are open to all of our members and teach skills from our specialist masterclasses in a more casual drop-in setting during Makespace opening hours. One of our Big Makes was led by Jakub Zalesak, teaching common circuit-building techniques, soldering and an understanding of electricity and sound.

Jakub is an Institute member and studied physics at UCL. He comes from a family of makers and currently runs workshops for the UCL division of Engineers Without Borders. For most of us, circuitry is something hidden from sight, tucked away in our walls or concealed in plastic casing, but Jakub wanted to showcase the fabric of circuitry itself as he walked people through the steps of designing a Printed Circuit Board (PCB) to make their own synths. In the afternoon members sculpted 'air circuits', utilising the circuit's physical form as well as its function to connect electronic components. With the materials provided there participants were able to build a range of things: from blinking Eiffel towers to glowing pendants.



Recycling Roman Ruins with Beth Munro, Necole Schmitz and Shelley James (Public Masterclass)

We welcomed back specialist glass maker Shelley James to join our Research Manager, Beth, and Makespace Manager, Necole, in teaching an exceptional masterclass that sought to recreate ancient recycling techniques in conjunction with the Being Human Festival. Beth is an archaeologist who specialises in the recycling of ancient materials and Roman villa architecture. Her expert knowledge of how ancient craftspeople transformed Roman materials helped to envision two types of material flow: that of metal pipes (lead in Roman times, the event substituted pewter) melted down and turned into votives, and of glass mosaic tiles, crushed and fired into beads. The event, listed as a highlight of the Being Human Festival by the Institute for Classical Studies, went so far as to build an ancient kiln, using technician Darren Ellis' expertise and real Roman bricks donated by the Archaeology Department of the University of Reading.

As participants hand-crushed glass for cob moulds of clay, sand and sawdust, the kiln was lit outside and despite cold winds, managed to reach the required vitrification temperature of 800°C. In the workshop, under Necole's extensive knowledge of metalwork, participants created moulds and cast these with melted down pewter pipes. The event proved to be a perfect marriage between Beth's original research, Necole, Darren and Shelley's technical expertise and creative hands-on making by our participants, allowing us to investigate the properties of ancient materials in an entirely new manner.

"Great fun today making a little glass kiln out of recycled Roman materials! Getting ready for the Recycling Roman Ruins masterclass" (Laura Ware Adlington, participant)

Leigh Cameron
Concrete Maker (Maker in Residence)

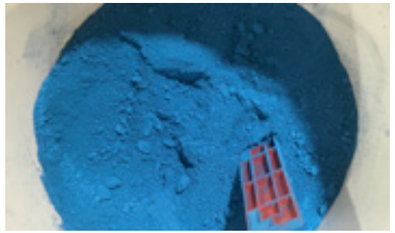
The arrival of concrete artist Leigh Cameron as Maker in Residence this year was much anticipated by members and staff alike. Leigh is known for his innovative and technically advanced uses of concrete, stretching the material to its limits to reveal its most delicate and beautiful properties. We were excited about the possibilities that his presence in the Makespace over the course of a whole week might bring.

Leigh came with a van full of making treasures: a rainbow array of pigments and oxides; aggregates from the silkiest sand to the roughest mirror shards; silicone moulds of all shapes and sizes; and huge bags of his own specially formulated concrete that picks up exquisite detail and sets within hours. Members were able to drop in at any time during the week to explore his materials, while others came specially to pick his brain about thorny technical issues and leaned on his expertise to brainstorm solutions for their own creative projects.

Leigh taught members how to calculate concrete mixes and how to design purposefully for the properties of different mixes, alongside new techniques for mould-making and casting. His welcoming and generous demeanour created a wonderful atmosphere of creative discovery and playful experimentation. In a memorable masterclass, Leigh also taught members how to make terrific concrete stools, using buckets as moulds for the seats and welded metal frames.

"Thank you @leighcam24 for imparting some of your vast knowledge of concrete to me today at the Institute of Making UCL. I'm especially pleased with how my pink garlic turned out!" (Ronan Haughton, member)

"Had an amazing time @of_making during the most recent maker in residence event with @leighcam24. Who would have thought that concrete can be such an inspiring material." (Anne Zakrzewski, member)



The Molecule That Made Perfume by Roja Dove (Public Event)

Roja Dove is one of the world's most respected perfumers, described by The New York Times as 'a master tailor of scent'. His philosophy, focused on creativity and craftsmanship, combined with his extraordinary experience, define him as one of the most complete and provocative authorities on fragrance. The Institute of Making was lucky enough to host Roja for the Festival of Stuff and enjoy his unparalleled knowledge of perfume in a whirlwind olfactory tour of scent formulation.

Roja's talk looked at developments in perfumery through the inventions of new synthetic molecules, and how this paved the way for new styles, families and effects in perfume through every decade from 1882 onwards. As the audience sipped aromatic fluorescing G&Ts on a hot summer evening, Roja provided a magical journey through the history of fragrance; providing not only scent samples of every iconic perfume and its corresponding molecule, but also vividly bringing to life how phases of perfumery connected to key developments in culture, science and the arts.

Super evening of smelling the molecules that made classic fragrances famous! @of_making with #rojadove Some real gems!!"
(Tanya Moulding, visitor)

My Research Makespace: Building for Virtual Reality (Research Event)

Our research-driven events at the Institute of Making often take us on a journey to different planes of thought and areas of study. This is particularly the case in our informal research event series My Research Makespace, where each time a UCL researcher of a different discipline speaks to UCL staff and students about how they have navigated the Makespace and used hands-on making to develop their academic work. During her showcase, artist and neuropsychologist Janneke van Leeuwen took participants into the realms of virtual reality as she presented the Thresholds/Virtual Colour Rooms Installation which she made at the Institute of Making with recycled teak wood from the Bloomsbury Theatre.

The installation is a public adaptation of one of Janneke's PhD research projects at the UCL Institute of Neurology and the Wellcome Collection, in which she investigates the relationship between visual art, the social brain and dementia. The piece takes in Janneke's scientific research, including lab-based eye tracking experiments, which aim to study the impact different forms of dementia might have on how colours in varying spatial contexts make us feel.

During the evening, Janneke discussed the various ways in which the creative arts are driving her scientific research and how the Institute of Making helped to facilitate her interdisciplinary approach, until the time came for the audience to experience Janneke's artwork for themselves. Participants tuned their smart phones, put on the VR head sets and began an intricate dance inside the teak octagonal structure, at first hesitantly but evermore confidently opening and reopening doors.

The Institute of Making event visitors

During the Festival of Stuff Saturday Extravaganza, the Institute of Making team held conversations with a sample of the day's visitors to learn more about them. To make it a creative and self-determining exchange we asked people to tell us what communities characterised their identity. The answers included:

music lovers
social people
the elderly
the business sector
singers
academics
physicists
organic life
humankind
retired people
culture vultures
curious people
travel lovers
educators
artists
feminists
creatives
science enthusiasts
UCL
crafters
"lazy slugs (also retired)"
Londoners
art lovers
the community of the curious
family life fans
home educators
technologists
teenagers
material scientists
home-made lovers
prop-makers
disco fans
San Franciscans

Materials Library

The Materials Library is at the heart of the Institute of Making. It's home to some of the most wondrous materials on earth, as well as those mundane but marvellous materials that surround us every day but often get overlooked. The Materials Library contains over 2,000 samples, ranging from materials engineered in high-tech manufacturing facilities (like the super-smooth surfaces of hard disk drives), to materials grown from waste (like insulating, mushroom-based mycelium foam), and those engineered by nature (like our coprolites: the gem-like fossilized faeces of turtles).

This handling collection acts as source of inspiration for Institute of Making members and the broader UCL community. It's constantly growing, thanks to donations from members, researchers and visitors, and it provides the material-minded and curious with a snapshot of the marvellous world at our fingertips.

The Materials Library is open to all Institute of Making members on a daily basis, and is used by our technicians to support teaching about materials and processes in the workshop. Our events programme and research projects draw on and add to the collection, and the Library is also open to the public on open days.

All of this would not be possible without the fantastic team of Materials Library volunteers who help to manage the collection, curate the Library, and bring to life the many stories behind the materials within the collection. This year we saw the departure of our wonderful volunteer Valerie Ngow and PhD student Liz Corbin.

Cubes: This Is Your Life!

These 4cm cubes, made in a multitude of different materials, are one of the stalwarts of the Materials Library, with a long and rich history. They started their life back in the mid-2000s as one of the first sets of specially made objects as part of Director Zoe Laughlin's PhD, which she used to explore people's experiences of materials as varied as tungsten, jelly and balsa wood.

We still use these original cubes today as an often-memorable part of our introduction to the Makespace for new members: passing round the aluminium and tungsten cubes and seeing the joy and surprise when people experience their drastically different densities. These cubes are used to encourage our members to think critically about how the materials they choose for their work might impact on people's sensory and aesthetic experiences of everyday objects.

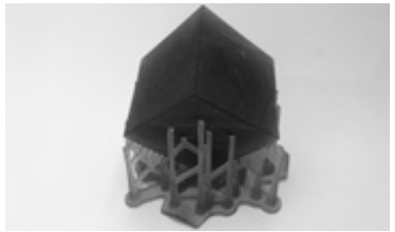
More recently, the cubes have been used for research with amputees and people with limb differences as a way of exploring the materials and sensory properties they would like to see in different parts of their prosthetic limbs (see p.68). The cubes have also recently gone international! They have travelled to the University of Nanterre in Paris as part of a collaboration with psychologists, which explores how material properties like roughness and elasticity can be used to communicate emotions in psychological therapies.

Our collection of materials is constantly growing, with new acquisitions coming from our programme of events as well as from our staff, members and researchers. Some recent additions to our cube family include:

- A cube of the sulphurous and sludgy waste from the clay trap in our sink, which catches all of this waste before it clogs the drains – high-fired by technician Darren to create a beautiful, marbled stratigraphic account of different clay and glaze materials.

- A hand-embroidered felt cube made by artist Richard McVetis, who uses traditional stitching techniques to explore concepts of space and techniques of measuring time.

- A cube of mind-boggling geometry donated by our member supervisor and Medical Physics PhD student Thore Bucking. He 3D printed and hand-finished this model of a Lidinoid, a shape with a 'minimal surface' that was discovered by scientist Sven Lidin. Minimal surfaces are often explained using the example of a wire frame dipped in soapy water: of all the possible shapes that could span the wire frame, the soap film takes the one with minimal energy.



Materials Library Research Visit: Ben Skinner

Wherever we can we like to support practitioners or researchers from outside UCL who are interested in using the collection. Ben Skinner is a transdisciplinary artist and PhD student from the School of Performance and Cultural Industries at the University of Leeds. He visited the Materials Library in December and spent 2 days exploring our collection:
"I was just amazed that there's this place where you can open drawers and pick up and put down and sit in proximity with materials – and where you can handle them – well, at least, not the noxious ones! It was great to see all these materials together on the shelves, and to compare their densities and see the ways they can trick you and be playful. I left with a very strong appreciation for the dynamic qualities of materials, and what happens to materials chemically when they are mixed – which is perhaps something I will explore post-PhD."

Ben comes from a background of both anthropology and dance, and his practice-based research focuses on touch and environmental perception through somatic practice, with a particular interest in the 'thinking-hand'. His work encourages people to engage haptically with the materials in their environment, and he has been working one-to-one with members of the public who are not from arts backgrounds, 'attending together' to materials like clay and charcoal. He sees his work as a form of protest, and as way of changing the way people think about materials and our collective environmental impact on the planet.

Ben's time in the Materials Library fed into his practice, and he is in the process of facilitating touch-focused experimental case studies on a local conservation site, encouraging participants to explore the haptic sensations of massive lumps of coal, limestone, Jurassic monkey puzzle trees and natural fibres. Ben is interested in locating these materials-focused studies in urban centres and working with larger groups of participants.

Polemical Plastics

In the face of the furore surrounding the worrying environmental impacts of single-use plastics, we've been taking a second look at some of our polymerous materials library favourites. The development of this huge and versatile family of materials is shown nicely through our collection: Nigerian cattle horns represent the natural polymers – the predecessors of and inspiration for modern thermoplastics. Our famously flammable celluloid-coated billiard ball represents one of the earliest synthetic plastics – made from cotton to be a substitute for ivory, and our Bakelite telephone represents the first plastic to be made from fossil fuels.

Looking at the history of plastics through the Materials Library helps us to think about the feats and failings of this extraordinary group of materials. This extended family's drawbacks can obviously be seen in the very dispersed and visible problem of plastic waste in the oceans and landfill sites, and the reliance of many plastics on non-renewable petrochemicals.

Its benefits can be seen in the super-absorbency of polymers like sodium polyacrylate (invisible balls – a firm favourite at our open days!) that absorb up to 300 times their weight in water, making them particularly useful in hygiene products and incontinence technologies. We would also struggle without the resin-based composites (carbon fibre) and elastomers (silicone rubber) that are so important in assistive technologies like wheelchairs and prosthetic limbs.

New developments in nano-engineered plastic surfaces that mimic the mechanically biocidal and anti-fouling effects of shark skin and cicadas wings are also leading the

way for a new generation of materials that could help to combat bacteria like MRSA that are becoming resistant to many of the antibacterial chemicals we currently use.

As our directors have shown through their investigations of landfill sites (BBC4's *The Secret Life of Landfill*), explorations of our relationship with plastics (BBC Radio 4's *Plastic Fantastic)* and research projects tackling single-use plastic packaging (Designing-Out Plastic Waste – see p.44), all materials have environmental impacts, but the real problem lies in the vast quantities of plastic we are using and the culture of disposability surrounding them. To use a polymerous expression, not all plastics should be tarred with the same brush: when choosing materials for a specific application we need to think carefully about whether the societal benefits outweigh the costs, and to examine the systems we have in place to govern what happens to them at the end of their lives.

Mycelium Foam

This fungus-based foam is being used instead of expanded polystyrene as an alternative packaging material and as a flame-retardant architectural insulation and cladding material. It's made by growing fungus on a feedstock of locally-sourced agricultural waste like hemp, straw and rice husks. As the root structure of the fungus – the mycelium – grows, it produces a natural polymer (chitin) that binds together the waste materials into this fibrous composite.

This material's claim of insulating against extremes of temperature was tested live on TV by our own Zoe Laughlin as part of BBC4's *The Secret Story of Stuff: Materials of the Modern Age*. In order to put it to the test, Zoe fired a blowtorch at the base of a chunk of the mycelium foam and placed a frozen choc ice on top. As the torch reached over 1000°C, the mycelium began to burn and the steel of the oven rack began to glow, but when the flame was removed the foam self-extinguished. After a few minutes of heating, the bottom of the mycelium was charred but the choc ice remained completely unmelted, much to Zoe's delectation!

A clip of Zoe and her blow-torch in action can be found here:
https://www.bbc.co.uk/programmes/p06q5pn1

Particularities: State: solid Category: vegetable
Relationships: composite, fungus, grown, foam, insulation, flame-retardant, waste-based

Badger Hair Toothbrush

We have been fashioning tools for keeping our mouths clean for a very long time, with the earliest ones dating back to 3500BC. These first artefacts for oral hygiene were not toothbrushes as we currently know them, but chewing twigs, toothpicks or rags soaked in salt or soot. The first recognisable bristle brushes were developed in China between 1000 and 1400CE and were made from hog and horse hair embedded in bone. In Europe, we lagged behind in the oral hygiene department, with the first toothbrushes appearing from the 18th century, along with a rise in consumption of refined sugar and a Victorian obsession with personal hygiene. Pig bristles were used for cheaper brushes and badger hair for the high-end. However, animal hair isn't the ideal material for the job: being porous, it absorbs water and retains bacteria. Following the invention of nylon in the 1930s, animal hair was replaced with more hygienic synthetic bristles, and celluloid handles replaced bone.

Toothbrushes with natural bristles have become popular again in the face of concern about plastics in the ocean: toothbrushes are now made from at least 4 types of co-moulded plastics that cannot easily be separated for recycling. Fully biodegradable toothbrushes exist, but does this composite of plastics and animal products actually represent the worst of both worlds? It's obviously not vegan-friendly, and some dentists claim animal bristles are too abrasive for our teeth. Would you put this in your mouth?

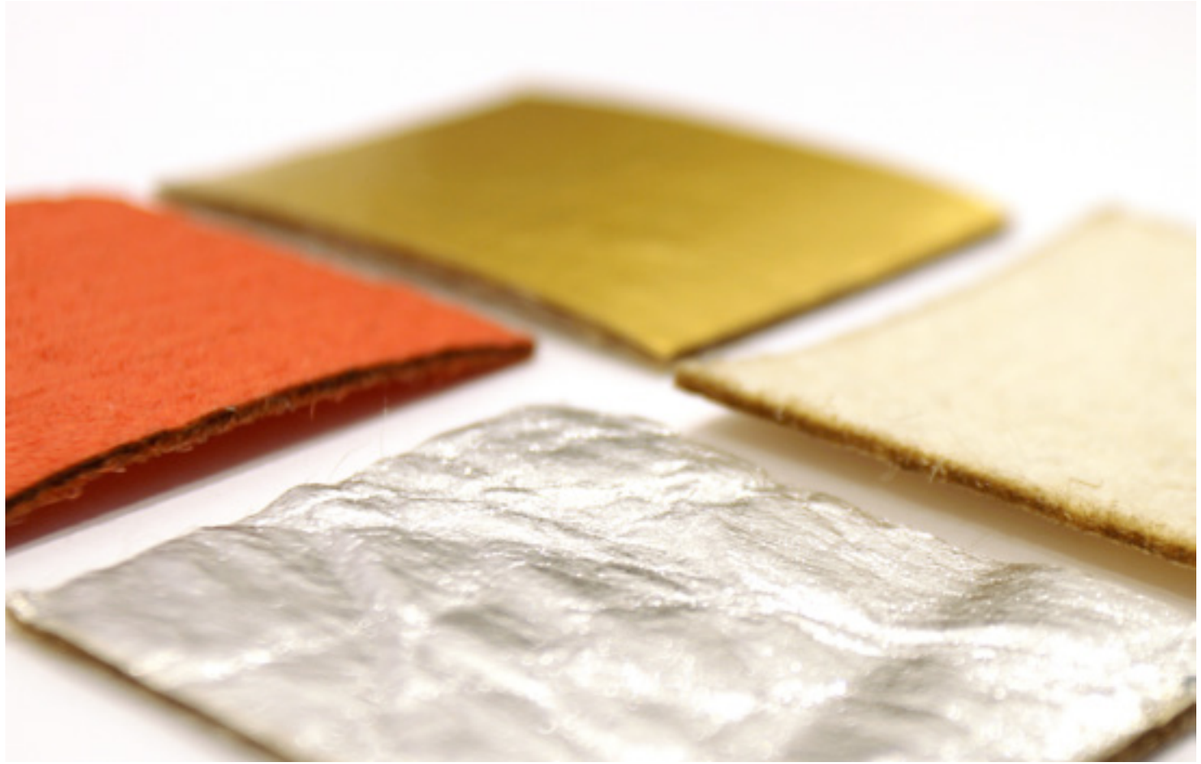
Particularities: State: solid Category: composite
Relationships: composite, hair, animal, polymer, medicinal; delight; disgust

Piñatex

This lightweight leather lookalike is made from pineapple leaf fibres, the waste product of the 700,000 tonnes of pineapples produced by farming communities in the Philippines every year. This non-woven fabric was developed by Carmen Hijosa, a former leather expert who set out to develop a more sustainable alternative to leather and vinyl, inspired by traditional Filipino plant fibre clothing such as the *barong tagalog*.

This material is made by combining waste pineapple fibres with polylactic acid (PLA) fibres and a petrol-based resin coating to make a water-resistant, soft, flexible and convincingly leather-like textile. Its current uses are as varied as high-end, vegan biker jackets (as seen on BBC4's *The Secret Story of Stuff*), trainers and car upholstery. This material is not currently biodegradable, but that's a future goal for the company.

Particularities: State: solid Category: vegetable, composite
Relationships: composite, pineapple, polymer, leather, non-woven, flexible, waste-based



Coprolite

This beautiful iron-like mineral is in fact a fossilized turtle faeces, collected as part of our March Delight & Disgust open day. This gloriously knobbly stool was hand burnished by technician Darren and Tim Laughlin, disproving the old adage that you 'can't polish a turd'.

Coprolites are a firm favourite with archaeologists and palaeontologists, as these mineralized or dessicated poos give us some of the best evidence for reconstructing ancient diets and health. These well-preserved excretions typically contain seeds, fibres and bones that can tell us what was being eaten, as well as parasites, bacteria and viruses that can tell us about the health of the defecator. The first studies of fossilized fecal matter were performed in the 1820s on dinosaur excrement, but the first specialist in human coprolites emerged in the 1960s: Canadian botanist Dr Eric Callen was the butt of colleagues' jokes when he first started restoring fossilized poos to their former glory in order to study their contents, but the importance of his faecal research has since been recognised.

This waste-based mineral is occasionally used by lapidarists instead of their usual precious gems, and made into pendants or cufflinks. As an example of one of many disgusting materials that are made delightful by artisans (such as the use of urine in the indigo dyeing processes) it shows that disgust is a slippery category that changes over time, and is a response to materials that break boundaries, question conventions and evoke emotions.

Particularities: State: solid Category: animal, mineral
Relationships: polished, hard, mineral, fossil, delight, disgust

The Makespace

In 2018, more than ever before, the Makespace has been filled by our members' interesting projects and creative energy. Against the inspiring backdrop of the Materials Library, new and old making techniques bring ideas into materiality. From sewing custom hats or positioning electrodes to building delicate end tables out of concrete and recycled teak, our members are busy making things. Drawing on their own professional expertise, our technicians are always on hand to teach members new skills so they can realise experimental projects. Members collaborate and share making methodologies with each other and simply find other like-minded folks who enjoy making.

Our members come from all parts of UCL. Their motivations for coming to the Institute of Making are as diverse as their backgrounds. Study-related, research and personal projects are embraced in the workshop with equal billing given to explorations of engineering, science, art, design or just learning to do something for the sake of it. Chair legs are mended, glass fused together, ceramics fired, plastics lasered into gears. Beginners learn new skills and experienced makers stretch their creative ambitions with access to our workshop, tools and expertise.

After five years of the Makespace being in constant, full capacity use, we decided that it was a good time to revisit some of the ways that we organise our tools and policies. This was to ensure that members had the best possible experience and also so that we were promoting safety in the Makespace. Frequent users of the Makespace would have noticed the workshop layout and machinery being repositioned in different iterations as we sought to both increase accessibility and provide safer spacing.

We purchased a new table saw and scrapped old equipment; we also drafted more detailed guidelines to help ensure that the health of our members and our technical staff was put first. Members were encouraged to make more informed materials choices as they planned their projects, and unhealthy and environmentally unfriendly materials were prohibited from the workshop. All of the induction materials for both new members and for the tool trainings that teach members how to use specific tools or machinery have been updated and improved.

As we have more and more users in the space, we have secured additional technician time to complete essential and safety-critical maintenance each week. We hope that this will have a great impact on the smooth running of the workshop and our ability to accommodate our members' ambitious and wide-ranging projects. We also created an app to track and record the maintenance of our workshop machinery and tools. Additionally, we are undertaking a review of our website and how we record and track members' training. This should ensure members receive the best possible training and are offered refresher courses when needed.

2018 has been a year of big changes in the Makespace as we have sought to make it an example of best workshop practices whilst maintaining our famous friendly, open atmosphere. As always, the technicians have been instrumental in bringing about these changes with their energy, good humour and creative problem solving.

Makespace Team

Necole Schmitz – Makespace Manager
Necole is an artist with a diverse making background in a variety of materials. Her training is in mould making, lost wax metal casting and other foundry work as well as metalwork and fabrication. She has a keen interest in historical and ancient metalworking and smelting techniques and co-runs an artist-led foundry in Dorset.

Darren Ellis – Technician
Darren is an enthusiastic and creative potter who enjoys sharing skills, from kiln building and layout to the molecular structure within clay and glaze material. This has had a profound influence on his approach to throwing - he specialises in the potter's wheel - and this knowledge of traditional methods feeds his problem-solving skills.

Romain Meunier – Technician
Romain is an artist, designer and creative technologist. He likes mixing a variety of digital and analogue technologies; his work tries to reconcile the virtual and the physical world, bringing together data flows and human senses. Romain grew up surrounded by craft including dressmaking, mechanics and carpentry.

George Walker – Technician
George is a creative technologist and sound engineer. He has worked on a broad range of digital projects from physical music controller hardware to generative software art. He is part of the teams behind the Eyeduino workshops, the robot Ohbot and band Fatlion Hi-Fi. He has responsibility for the Makespace digital tools.

Member Supervisors

Member Supervisors are essential to the smooth running of the Makespace. They are truly an inspiration not just for the positive and effective role they serve in our member community, but also for the diverse skills they bring to their peers. Member Supervisors are students and researchers as well as professional and academic staff. Our current Member Supervisors - Anne Zakrzewski, Arkadiy Serezhkin, Ben Oldfrey, Elliot Magee, Evangelos Himonides, India Davies, Kareem Khazem, Kevin Green, Naomi De Barr, Noor Khazem, Piotr Wasylczyk, Thore Bucking and Tom Crossland - go above and beyond their normal role to share their skills with other members. They teach laser cutting, 3D printing, sewing, pottery, screen printing and other skills to fellow members through our weekly tool training. They help with events, inductions and organising the workshop. They are an essential part of the public programme and members' experience.

This year, we have also sadly had to say goodbye to some of our longest serving Member Supervisors, as they graduated or otherwise moved on to greener pastures. They were essential in establishing the Member Supervisor programme and training new members over the years. Leaving us are Alexandros Kanellopoulos, Eamon Hassan, Prash Ganeswaran, Rebecca (Becky) Lee and Valerie Ngow. We will miss you!

Image credit: Adam Lawrence for Portico Magazine

Raft Race

This year we once again took part in the Community Raft Race, now in its third year and organised by the Open Workshop Network. This year, in an effort to improve the craftmanship of our raft building, we enlisted the help of master coracle makers Kevin and Ellen Grimley. They travelled down from Leicestershire to teach a dedicated group of members and Makespace staff the ancient art of making these unusual boats. After a week of hard graft, lots of bent nails and bitumen-stained surfaces, our seafaring members had created a glorious fleet of coracles ready to set sail on Regent's Canal.

Our 'Coracular Spectacular' team definitely created a stir at the Raft Race as they tried to master the tricky art of commanding these rudderless ships. After some capsized boats and some impressively speedy wins, the waterlogged Institute of Making team came away with the Pirate Award bestowed on them by the Ceremonial Mayor of London who had a go at captaining a coracle in full mayoral regalia.

"Building a coracle boat since yesterday and racing it this Saturday on Regent's Canal. Amazing Masterclass at @of_Making" (Jessica Andrich, member)

"Me and my boat on our way home from raft race day. Thanks for this amazing event @IslingtonBoatCl and @of_Making" (Anouk Harde, member)

"Had a lovely time racing (and falling out) yesterday at the @IslingtonBoatCl! Then paddled home through the canals with my coracle #coracularspectacular #dreamteam @of_Making (Jessica Andrich, member)

Concluding Remarks

For many it feels completely normal to buy a cup of coffee, drink it, and throw the cup away. But it was not always normal, in fact for most of history it would have been regarded as a sign of madness. Materials were expensive, cups were valuable, and to throw something away after only one use was the road to poverty and ruin. So how did disposable products ever become a thing? The answer is that we had to be taught to like throwing things away, to accept it as normal. The story of how this happened is the story of twentieth century capitalism; yes, of our liberation and wealth, but also of a growing environmental catastrophe.

The villain in the story is of course plastic. This is sad not just because plastic is an extremely useful and valuable material, but because at the beginning of the twentieth century, plastic brought us modernity. The telephone, the radio, and the TV all came into our lives as marvellous plastic stuff. More plastics followed, changing the way we lived in almost every way, from footwear to furniture, from stockings to tennis racquets. Indeed, in the 1940s 'cellophane' was rated the third most beautiful word in the English language.

But there was a problem, which was that the engine of this new 'consumerism' relied on people continuing to buy new things. This meant that products needed to break or be constantly replaced to fuel demand for more stuff. But plastic was too durable: its chemical structure makes it not just lightweight but also strong. Think about a plastic toy like a lego set, how often does it break? Hardly ever. Or the steering wheel on your car: strong, comfortable, grippy and durable, right? The steering wheel will outlast the car. But for an economy based on consumerism this is no good.

A new profession rose up to address this problem, called marketing and its answer was surprisingly simple – persuade people to voluntarily throw things away. Thus, in

the 50s and 60s new plastic products came on the market designed to be single use, such as single-use cups, single-use cutlery, single-use straws. Restaurants no longer needed to offer you a ceramic plate to eat from, nor a glass to drink from, nor a metal spoon to stir your coffee. These new single-use plastics created a new life style driven by the growth of the fast food chains. There was even a McDonald's advert which featured a bin that had to be fed; "they are hungry too", chimed Ronald.

From a business perspective it seemed odd at first, since the costs of giving away plastic utensils and packaging added to the cost of a meal. But an increasing number of factors tilted economics in the favour of disposability. Firstly, oil, the feedstock of plastics, was super cheap. Secondly, plastic objects are made through automated mass production – the big cost is the factory itself – once paid for it's approximately the same cost to make a million plastic spoons as it is to make ten. Thirdly, it was hygienic – a point the advertising departments and lobbyists to government emphasised. The disposable spoons had never been used before that meal and would never be used again. This was the new future – soon they envisaged everyone would only have disposable plastic cups and plates in their homes – it was the cleaner way to live and there would be no more washing up! Indeed, this is the origin of the TV dinner.

As a result, consumerism boomed, the economy grew, and life became more convenient – who doesn't like to eat a takeaway every now and again, especially after a long day at work? But the reputation of plastics suffered, no longer idolised they became a by-word for a throw-away culture. No product symbolised this more than the single-use plastic bag, which was marketed to the public in the 1970s without any thought for what it would do to the environment once thrown away. Of course, there is no 'away', because of their very stable chemical structure, plastics do not

biodegrade or dissolve in water. These, of course, are the very remarkable properties that make them so special. But once they have been used they can't just be discarded, because they stay in the environment for a hundred years or more, and since the sea is pretty much downhill from everywhere, they tend to end up there.

The answer isn't to ban plastics, they are massively useful, not least in our homes, hospitals and transport systems. The way forward is for us to engage more with plastics, to build trust and love of plastics again. It is only by understanding that they are indispensable that we will summon the political will to end the era of disposability. At the Institute of Making we have long championed materials libraries in helping people understand and appreciate the role materials play in our lives. Never have materials libraries been more important than now as we seek to redefine our relationship with plastics and end the era of disposability.

Mark Miodownik (MM), Martin Conreen (MC) and Zoe Laughlin (ZL).
Directors, Institute of Making 2019.

Appendix

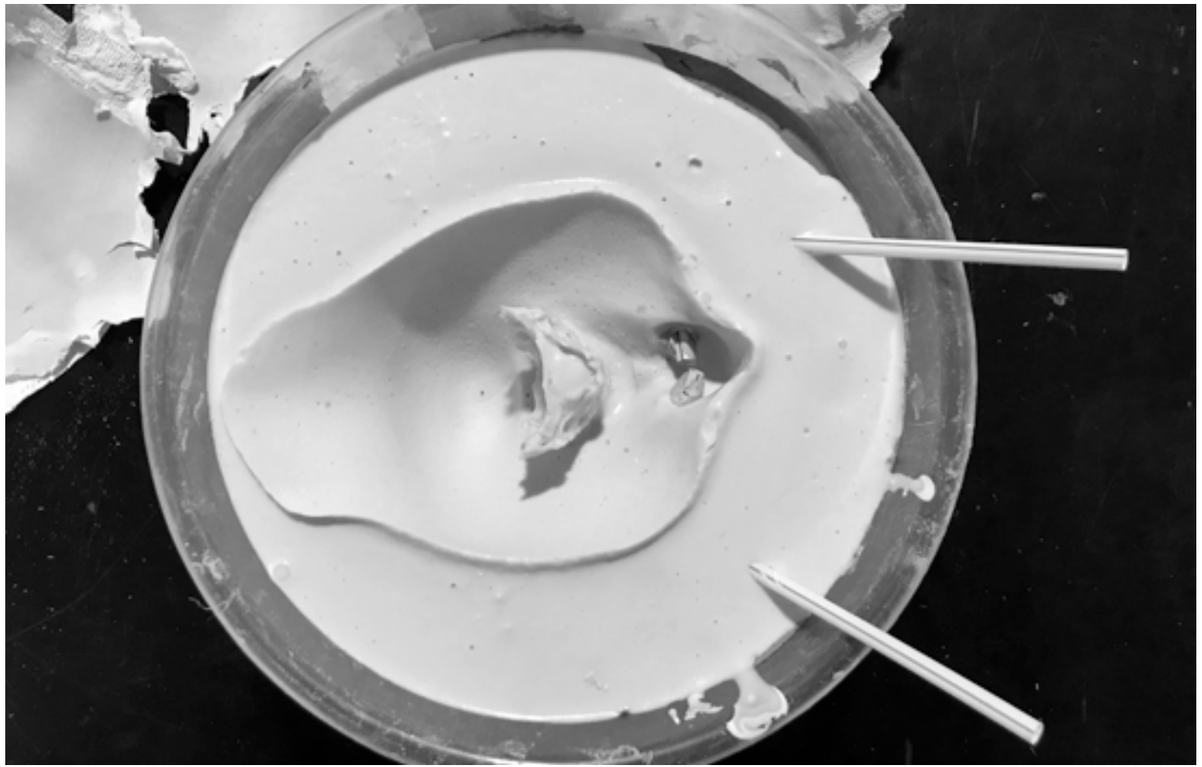
Full Statistics of Membership

Total number of registered members: 12,434
Active inducted members: 2,824

Gender
Female 42%
Male 53%
No gender declaration 6%

Member type
Staff 29%
- Academic staff 19%
- Professional services staff 10%

Students 71%
- Undergraduates 38%
- Postgraduates 33%



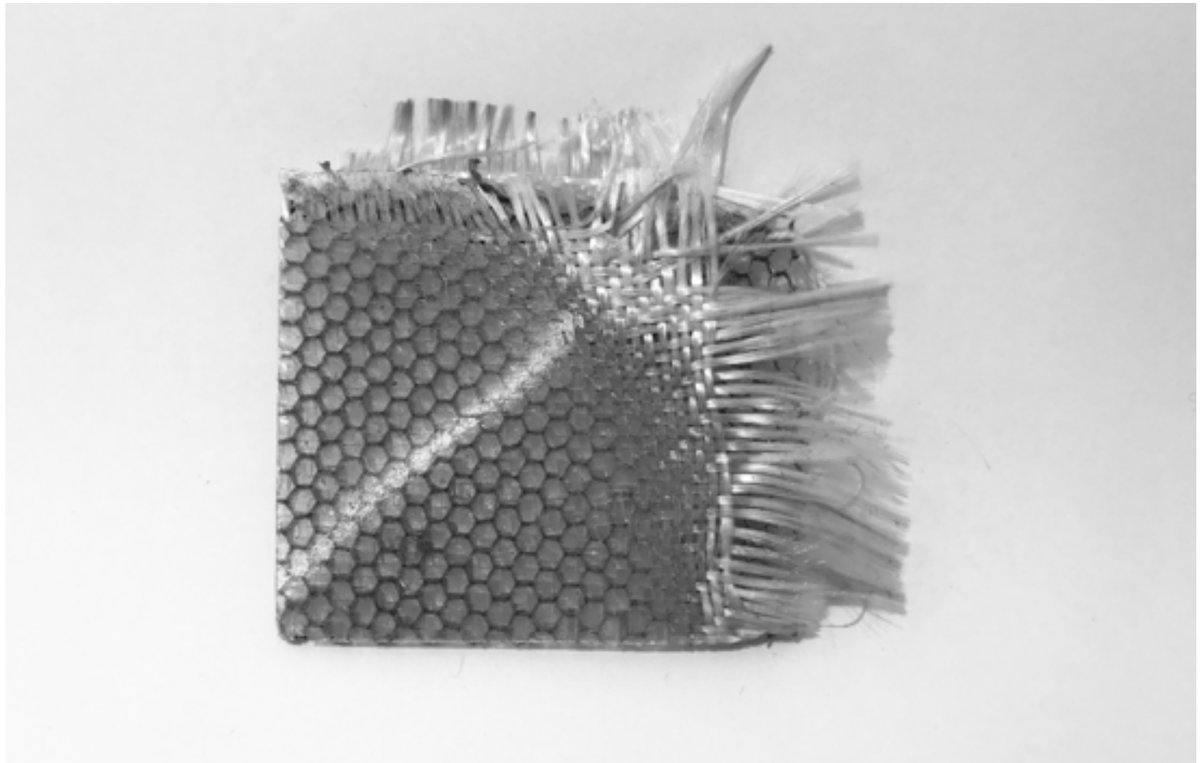
Full List of Events

Total number of events: 52 (21 member events and 31 public events)
Breakdown: 30 masterclasses, 10 research events, 1 Materials Library evening, 2 outreach events, 2 workshops, 4 week-long events and 3 large public open days.

13th March 2018. *My Research Makespace: Building for Virtual Reality.* (Research event).
16th March 2018. *Institute of Making Member Party.* (Outreach).
24th March 2018. *Slime.* (Open day).
11th April 2018. *Morning - 3D Print Finishing with Hannah Cameron* (Masterclass) Member event.
11th April 2018. *Afternoon - 3D Print Finishing with Hannah Cameron* (Masterclass) Member event.
30th April 2018. *Materials Research Kitchen - How Do You Like Your Eggs?* (Research event).
3rd May 2017. *Jesmonite with Stephanie Tudor* (Masterclass) Public event.
14th May 2018. *Morning – Introduction to Glass.* (Masterclass) Member event.
14th May 2018. *Midday – Introduction to Glass.* (Masterclass) Member event.
14th May 2018. *Early afternoon – Introduction to Glass.* (Masterclass) Member event.
14th May 2018. *Late afternoon – Introduction to Glass.* (Masterclass) Member event.
21st May 2018. *UCL Food Metabolism and Society Research Domain Summer Lecture: Live Cheesemaking.* (Research event).
4th June 2018. *Morning - Silver Ring with Rahel Pfrommer* (Masterclass) Member event.
4th June 2018. *Afternoon - Silver Ring with Rahel Pfrommer* (Masterclass) Member event.
3rd July 2018. *Morning - Jesmonite Masterclass* (Festival of Stuff).
3rd July 2018. *Afternoon - Jesmonite Masterclass* (Festival of Stuff).

3rd July 2018. *Morning - Concrete with Recycled Plastic Masterclass* (Festival of Stuff).
3rd July 2018. *Afternoon - Concrete with Recycled Plastic Masterclass* (Festival of Stuff).
4th July 2018. *Morning - Scent Making Masterclass* (Festival of Stuff).
4th July 2018. *Afternoon - Scent Making Masterclass* (Festival of Stuff).
4th July 2018. *Evening Talk - The Molecule that Made the Perfume* (Festival of Stuff).
5th July 2018. *Morning - Textural Embroidery Masterclass* (Festival of Stuff).
5th July 2018. *Afternoon - Textural Embroidery Masterclass* (Festival of Stuff).
5th July 2018. *Morning - 3D Print Finishing Masterclass* (Festival of Stuff).
5th July 2018. *Afternoon - 3D Print Finishing Masterclass* (Festival of Stuff).
6th July 2018. *Morning - Introduction to Glass Working Masterclass* (Festival of Stuff).
6th July 2018. *Midday - Introduction to Glass Working Masterclass* (Festival of Stuff).
6th July 2018. *Afternoon - Introduction to Glass Working Masterclass* (Festival of Stuff).
6th July 2018. *Sand Mould Making Masterclass* (Festival of Stuff).
7th July 2018. *Festival of Stuff Saturday Extravaganza* (Open day).
25th-28th July 2018. *Coracle Masterclass.* (Masterclass) Members event.
28th July 2018. *London Makespace Raft Race. (*Public and members event).
30th July 2018. *Materials Research Kitchen - Cupboard Love, Reimagining the Pantry.* (Research event).
3rd September 2018. *Super 8 Film with Ben Slotover.* (Masterclass) Member event.
20th-23rd September 2018. *Slime Olympics at New Scientist Live.* (Public event).
19th October 2018. *UCL Lunchtime Looks.* (Open to all UCL).
20th October 2018. *Focus Group for Prosthetics Wearers.* (Research event).
27th October 2018. *Plastics* (Open day).
19th November 2018. *Morning – Recycling Roman Ruins.*(Masterclass) Public event.
19th November 2018. *Afternoon – Recycling Roman Ruins* (Masterclass) Member event.
27th-30th November 2018. *Leigh Cameron – Concrete Artist.* (Maker in Residence).
28th November 2018. *Concrete Table with Leigh Cameron.* (Masterclass) Member event.

29th November 2018. *Sensory Preference in Prosthetics Study: Glasgow.* (Research event).
17th December 2018. *Big Make Merry* (Workshop) Member event.
26th January 2019. *Sensory Preference in Prosthetics Study: London.* (Research event).
26th January 2019. *Sugar: Creation.* (Research event).
26th January 2019. *Sugar: Transformation.* (Research event).
4th February 2019. *Morning - Microwave Steam-Bending with Stefano Santilli.* (Masterclass) Member event.
5th February 2019. *Afternoon - Microwave Steam-Bending with Stefano Santilli.* (Masterclass) Member event.
20th February 2019. *Circuitry & Synth-Making with Jakub Zalesak.* (Masterclass) Member event.
20th February 2019. *Big Make: Circuitry with Jakub Zalesak.* (Workshop) Member event.
22nd February 2019. *Sensory Preference in Prosthetics Study: Liverpool* (Research event).



Publications

Holloway, C., Austin, V., Barbareschi, G., Ramos Barajas, F., Pannell, L., Morgado Ramirez, D. Z., Frost, R., McKinnon, I., Holmes, C., Frazer, R., Kett, M. Groce, N., Carew, M., Abu Alghaib, O., Khasnabis, C., Tebbutt, E., Kobayashi, E., Seghers, F. (2018). *Scoping Research Report on Assistive Technology. On the road for universal assistive technology coverage.* Prepared by the GDI Hub & partners for the UK Department for International Development.

Jackson, R., Wojcik, A. and Miodownik, M. (2018). 3D printing of asphalt and its effect on mechanical properties. *Materials & Design*, 160, 468-474.

Kenney, L., Ssekitoleko, R., Mwaka, E., Donovan-Hall, M., Morgado Ramirez, D. Z., Chadwell, A., Kyberd, P., Sobuh, M., Ackers, L., Howard, D., Head, J., Holloway, C., Miodownik, M. (2018). Upper-limb prostheses for low and middle-income countries. *IPEM SCOPE Magazine*., 27(4), 38-40.

Miodownik, M. (2018). *LIQUID: The Delightful and Dangerous Substances That Flow Through Our Lives*. Viking Books. ISBN: 9780241977293.

Oldfrey, B., Jackson, R., Smitham, P. and Miodownik, M. (2019). A Deep Learning Approach to Non-linearity in Wearable Stretch Sensors. *Front. Robot. AI*, 8th May.

Ploszajski, A. R., Jackson, R., Ransley, M. and Miodownik M. (2019). 4D Printing of Magnetically Functionalized Chainmail for Exoskeletal Biomedical Applications. *MRS Advances*, 4, 1361-1366.

Media Coverage

Today Programme. (2018). BBC Radio 4, 2nd March.
Fireworks for a Tudor Queen. (2018). BBC 4, 7th March.
Kitchen Cabinet, Portmeirion. (2018). BBC Radio 4, 14th April.
Plastic Fantastic. (2018). BBC Radio 4, 21st May.
Britain's crumbling roads could be fixed by DRONES! (2018). Daily Mail, 11th June.
Pothole robots could work through the night to repair damaged roads, UCL says. (2018). The Telegraph, 11th June.
Which super plasters are worth the money? (2018). Daily Mail, 18th June.
PM Programme. (2018). BBC Radio 4, 27th June.
The Big Life Fix: *Series 2*. (2018). BBC2, 16th August.
Lime with Beth Munro. (2018). 'rial Talk podcast (www.rialtalk.com), 21st August.
The Secret Life of Landfill. (2018). BBC4, 23rd August.
Liquids not to be trusted. (2018). The Guardian, 9th September.
Slime with Sara Brouwer. (2018). 'rial Talk podcast (www.rialtalk.com), 18th September.
Liquid with Mark Miodownik. (2018). 'rial Talk podcast (www.rialtalk.com), 2nd October.
Ice with Zoe Laughlin. (2018). 'rial Talk podcast (www.rialtalk.com), 16th October.
Kitchen Cabinet, Sheffield. (2018). BBC Radio 4, 16th October.
Potholes 'could be prevented' by road-repairing drone. (2018). BBC News, 17th October.
Why liquid matters. (2018). Financial Times, 19th October.
The Secret Story of Stuff. (2018). BBC4, 31st October.
Kitchen Cabinet, Oxford. (2018). BBC Radio 4, 3rd November.
Start The Week. (2018). BBC Radio 4, 24th December.
Kitchen Cabinet, Melton Mowbray. (2018). BBC Radio 4, 29th December.
Kitchen Cabinet, Kendal. (2019). BBC Radio 4, 2nd February.

Social Media Feeds

www.facebook.com/InstituteOfMaking

www.instagram.com/of_making

www.twitter.com/of_making

www.instituteofmaking.tumblr.com

Institute of Making Member Supervisors

Anne Zakrzewski
Arkadiy Serezhkin
Ben Oldfrey
Elliot Magee
Evangelos Himonides
India Davies
Kareem Khazem
Kevin Green
Naomi De Barr
Noor Khazem
Piotr Wasylczyk
Thore Bucking
Tom Crossland

Birthday Award Winners

Outstanding Contribution: Kareem Khazem

Public Engagement Award: Naomi De Barr

Most Helpful UCL Staff Member: Simon Wheeler

Springboard Award: Ben Oldfrey

Research Through Making: Rafat Chowdhury

Makespace Ethos: Thomas Crossland

Community Award: Noor Khazem

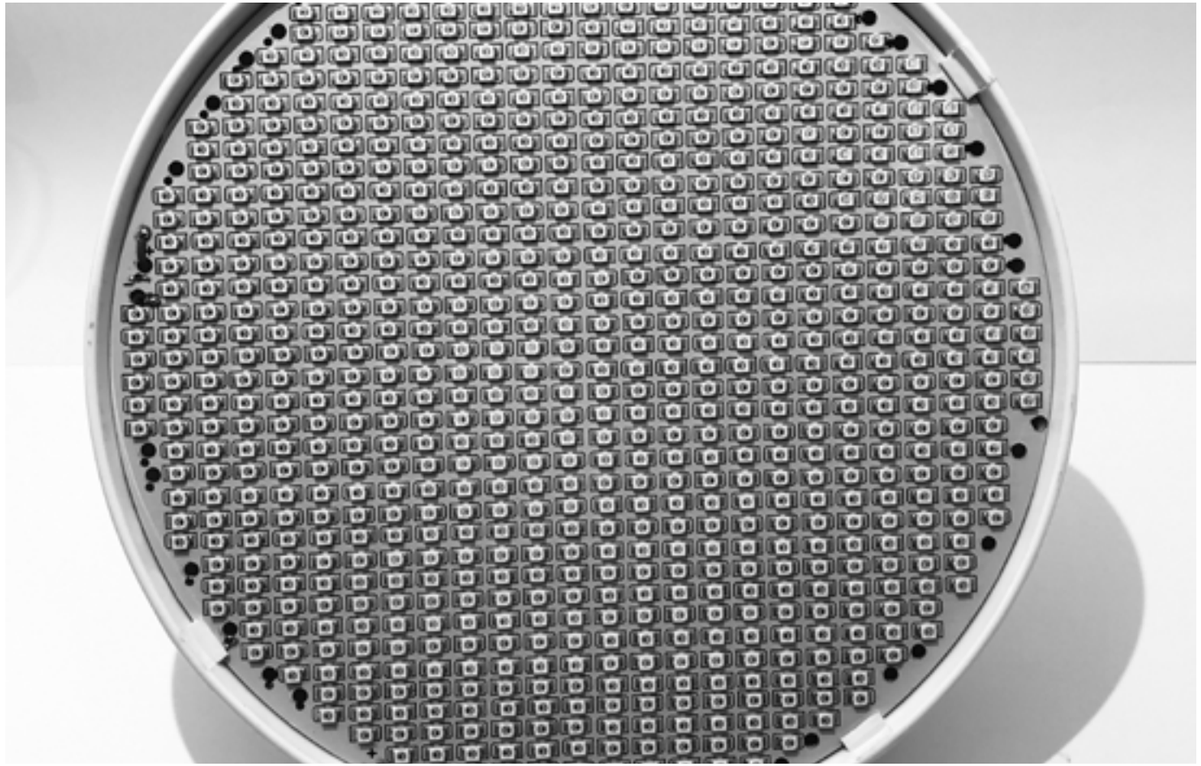
Development Award: Ellie Doney

Superstar Supervisor: Thore Bucking

Attention to Detail: Nicholas Salthouse

Persistence Award: Susan Nicholas

Ambition Award: Andreea Ionascu



The Institute of Making Current Team

Anna Ploszajski – Research Fellow

Beth Munro – Research Manager

Darren Ellis – Makespace Technician

Ellie Doney – PhD Student

George Walker – Makespace Assistant Technician

Mark Miodownik – Director

Martin Conreen – Director

Necole Schmitz – Makespace Manager

Romain Meunier – Makespace Technician

Sara Brouwer – Events Coordinator

Sarah Wilkes – Research Fellow

Zoe Laughlin – Director

Steering Committee

Andrea Sella – Professor of Inorganic Chemistry, UCL

Bob Sheil – Professor of Architecture and Design through Production, and Head of the Bartlett School of Architecture, UCL

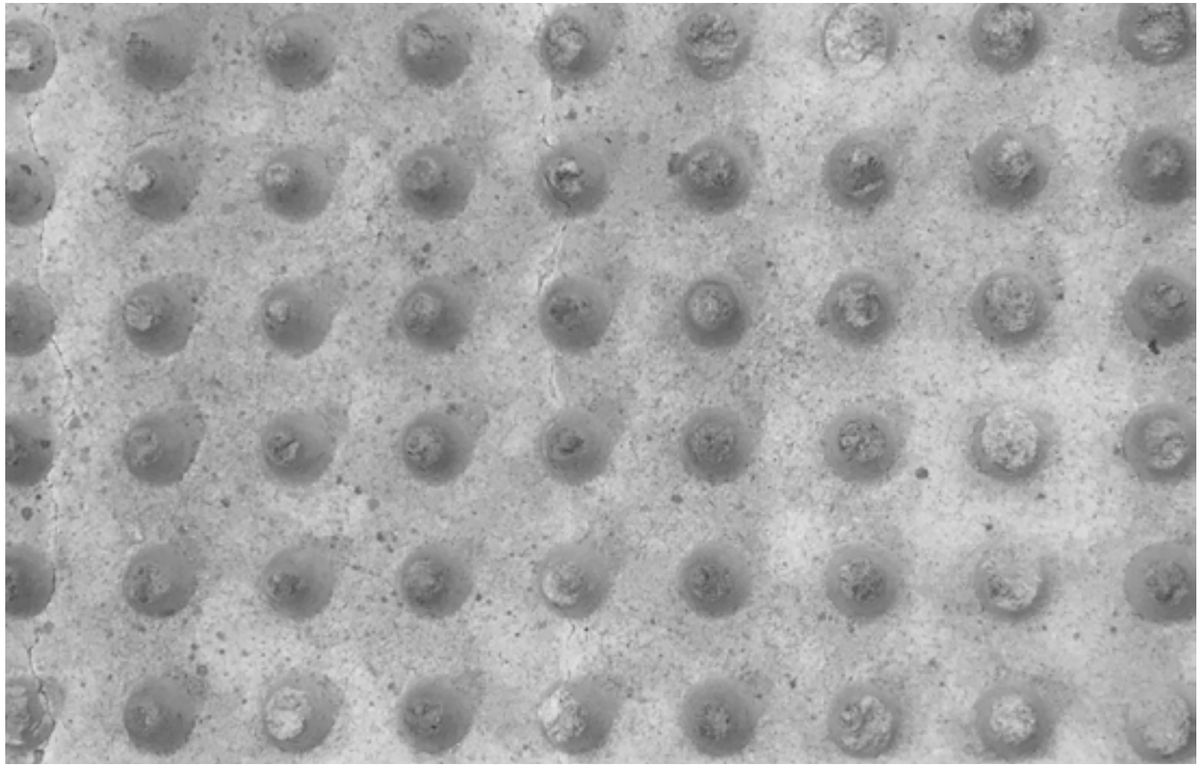
Chris Wise – Expedition Engineering

Mark Handley – Professor of Networked Systems, Computer Science, UCL

Nigel Titchener-Hooker – Dean of Faculty of Engineering Sciences, UCL (Chair)

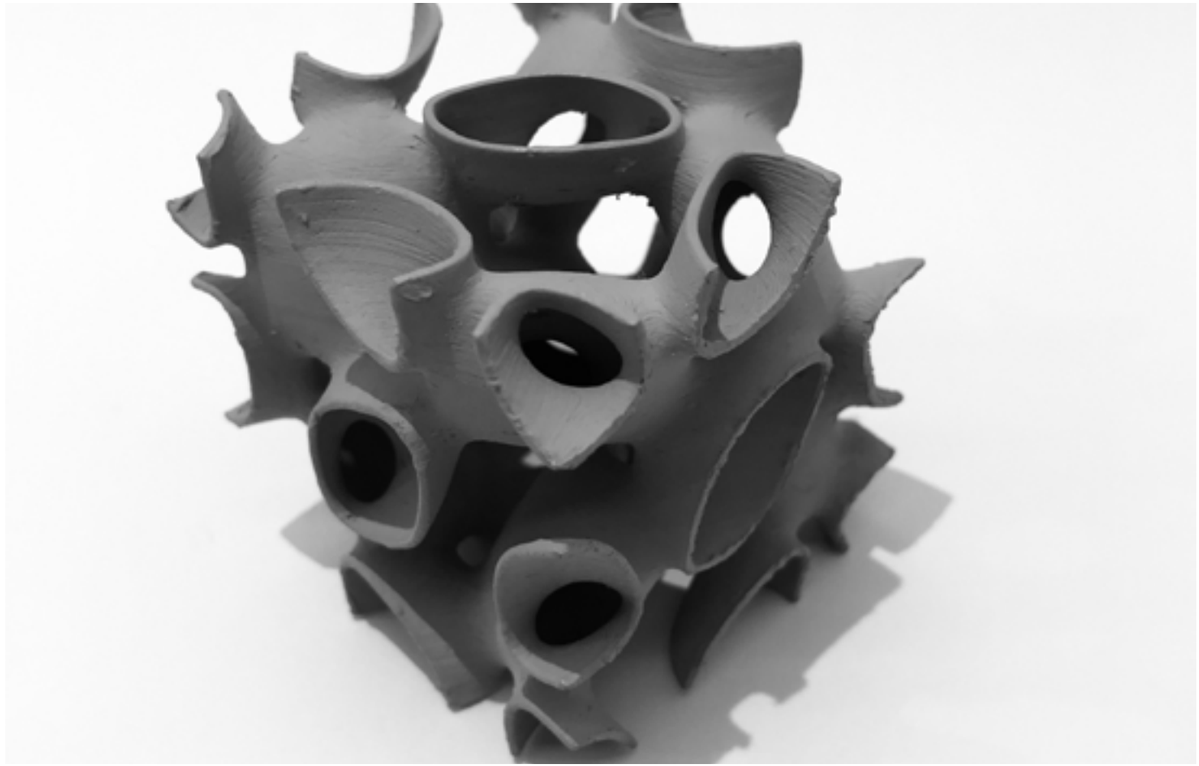
Susan Collins – Director, Slade School of Fine Art, UCL

Susanne Kuechler – Head of Anthropology, Professor of Material Culture, UCL



Funding, Donations & Commercial Support

Alan Brener
AHRC
Atkins
BBSRC
Cancer Research UK
Chris Nolan
DfID
Emma Thomas
EPSRC
European Union
Jeremy Anderson
Leverhulme Trust
Robert Nichols
UCL Engineering
UCL Grand Challenges
UCL PACE
UKRI
Wellcome Trust



Thanks

Alan Brener
Alan Philcox
Andrea Sella
Andres Tretiakov
Andy Fugard
Andy Minnis
Angela Clemo
Angharad Milenkovic
Anna Clark
Anthony Finkelstein
Bob Sheil
Brenda Parker
Brendan Bryne
Caitlin O'Grady
Caralyn Banham
Chris Wise
Christine Simms
Christopher Nolan
Diane Davis
Elaine Briggs
Eleanor Morgan
Elpida Makrygianni
Emma Thomas
Emma Richardson
Gaurav Sharma
Giles Corby
Graeme McPhillips
Gwen Mott
Hassan Osman
Hayley Midwinter & team
Hilary Powell
James Keith
James Lawrence
Janic Nielsen
Jeremy Anderson
Jess Wade
Jill Saunders
Jim McKenzie
John Stewart
Katherine Fletcher
Laura Dempsey
Lee Wilkinson
Liz Walker
Lori Manders
Marina Stephanides
Mark Handley
Mark West
Michael Arthur
Mike Dawe
Miranda Laughlin
Nick Booth
Nigel Titchener-Hooker
Peter Kelly and team
Phil Howes
Prashanthan Ganeswaran
Praveetha Patalay
Rob Nichols
Rosie Meredith
Ruth Siddall
Saffron Hutt
Sam Green
Sara Collins
Sarah Mackay
Sarah Richey
Sarah Wishart
Simon Werrett
Simon Wheeler
Subhadra Das
Susan Collins
Susanne Kuechler
Thea Sherer
Tim Laughlin
Tom Hamer
Tom Kile Hartshorn
Tony Lawler


UCL
UCL ENGINEERING
Change the world