IN FORMATION

Pei-Ying Lin

Solveig Lill

Helen Pynor

Anna Dumitriu

In Formation presents four artist-in-residence projects that delve into the science of constantly forming cells that constitute the complex processes of life, specifically cell fates, cell memories and DNA replication. The artists Anna Dumitriu, Solveig Lill, Pei-Ying Lin and Helen Pynor explore through a rich diversity of artistic media and practices in collaboration with scientists laboratory and experiment practices as well as the imagination and representation of cells.

Curator & editor **Claudia Schnugg**
Lead scientist **Maria-Elena Torres-Padilla**

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In Formation
Exhibition catalogue

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European doctoral network on DNA replication

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Lead scientist
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Curated by
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Preface, *Maria-Elena Torres-Padilla*, **and comment by** *Emilio Lecona* 08

Curatorial Introduction, *Claudia Schnugg* 10

In Formation, introduction to the exhibition, *Claudia Schnugg* 12

Artwork section Pei-Ying Lin

A Textile Study of the Craftsmanship in Bioloabs, *Pei-Ying Lin* 14

The Artist's Fold of the knitted USP1-UAF1 bound to Lys63-linked diubiquitin, *Pei-Ying Lin* 16

Scientists' reflections on The Artist's Fold of the knitted USP1-UAF1 bound to Lys63-linked diubiquitin, *Kaustav Majumder* **and** *Titia Sixma* 22

Embroidered white thread(s) colonies dyed with retired crystal violet previously used in clonogenic assays, *Pei-Ying Lin* 24

Scientists' reflections on Embroidered white thread(s) colonies dyed with retired crystal violet previously used in clonogenic assays, *Hồ Mỹ Phúc Võ* **and** *Sylvie Noordermeer* 30

Human body conditioned to Xenopus laevis, performed on a sewing machine, *Pei-Ying Lin* 32

Scientist's reflection on Human body conditioned to Xenopus laevis, performed on a sewing machine, *Julien Duxin* 35

Weave bindings and wefts interactions sampled in 1536 wells, *Pei-Ying Lin* 36

Scientist's reflection on Weave bindings and wefts interactions sampled in 1536 wells, *Utkarsha Pande* 39

Artistic reflection on the process, *Pei-Ying Lin* 40

Curatorial reflection, *Claudia Schnugg* 44

Biographies 46

Artwork section Solveig Lill

Cell Lines, *Solveig Lill* 48

Cell Lines, installation at Muffatwerk, *Claudia Schnugg* 51

On the process, *Solveig Lill* 52

Meditations, *Solveig Lill* 56

Exploration of artistic media, *Solveig Lill* 58

Scientists' reflections on the collaboration with *Solveig Lill*, *Silpa-Mary Johnson*, *Virginia Pasti* **and** *Julius Thomas* 62

Curatorial reflection, *Claudia Schnugg* 64

Biographies 66

TABLE OF CONTENT

Artwork section Helen Pynor

A RepliFate residency, *Helen Pynor* 68

Blot series / Early-Middle-Late / Cloud, *Helen Pynor* 72

Scientists' reflections on Blot series, Early-Middle-Late and Cloud, *Scott Churcher* **and** *Emilio Lecona* 80

2 Metres, *Helen Pynor* 82

Scientists' reflections on 2 Metres, *Ran Tong*, *María Gómez* **and** *Juan Méndez* 84

Extra / Spread / Metaphase, *Helen Pynor* 86

Scientists' reflections on Extra, Spread and Metaphase, *Alex Haider* **and** *Zoi Lygerou* 94

Scatter, *Helen Pynor* 98

Scientists' reflections on Scatter, *Yicong Chen* **and** *Maria-Elena Torres-Padilla* 100

Curatorial Reflection, *Claudia Schnugg* 102

Biographies 104

Artwork section Anna Dumitriu

The Mutability of Memories and Fates residency, *Anna Dumitriu* 106

Scientist's reflection on the experience of working with artists-in-residence, *Adam Burton* 112

The Mutability of Memories and Fates, *Anna Dumitriu* 114

Scientists' reflections on The Mutability of Memories and Fates, *Maria-Elena Torres-Padilla* **and** *Federico Pecori* 118

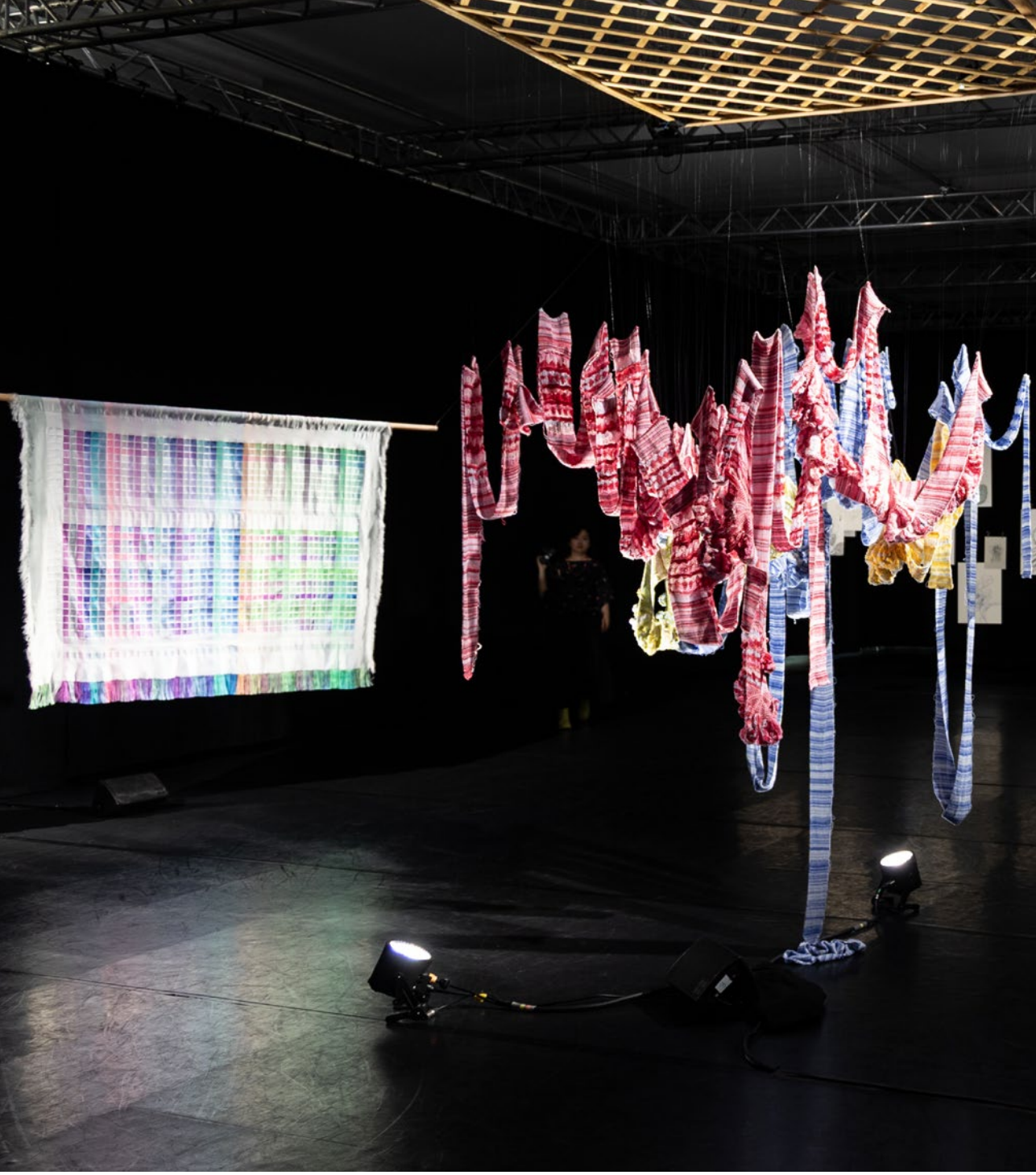
Totipotence, *Anna Dumitriu* 120

Identity in Flux, *Anna Dumitriu* 123

Cellular Reprogramming Necklace, *Anna Dumitriu* 124

Curatorial reflection, *Claudia Schnugg* 126

Biographies 128





Exhibition space showing works by Pei-Ying Lin and Solveig Lill, Muffatwerk
photo credit Stefanie Winkler

Preface

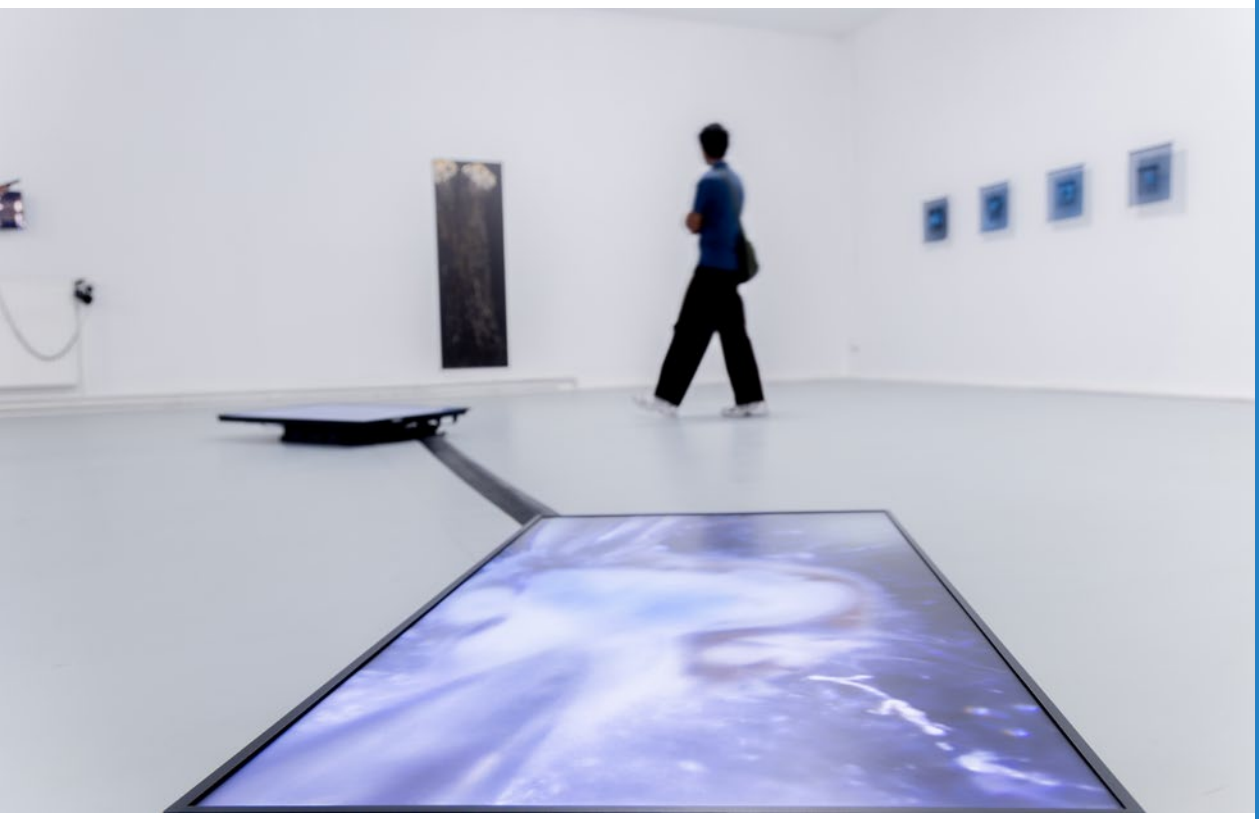
Maria-Elena Torres-Padilla

Scientific discovery has been my driver over many years. As I embarked in a scientific career, I have come to enjoy the scientific method and the rewards that it brings, which range from seeing things that 'nobody saw before', pursuing the truth to working with outstanding people from all over the world. During this time, I have learnt that the universe of science expands well beyond the borders I thought it had. I have had the pleasure and privilege of working with Claudia Schnugg, the curator and mastermind behind the exhibition that is the subject of this catalogue, *In Formation*.

In Formation **brings together work by four different artists, with different views and different inspirations. Their work stems from their residencies in scientific laboratories working on fundamental questions about life. These range from understanding how our bodies come to the making, after the very first instant of life during fertilization, all the way to how cells transform into malignant cells in diseases such as cancer. The molecular processes behind these transformations are the basis of** *In Formation*, **which is the fruit of an artistic process on those biological events and the quests they raise in us, as humans.**

I very much hope that the reader will be able to absorb all those emotions, thoughts and reflections, which embody both scientific curiosity and rigour as well as artistic creativity and structure. As you go through this catalogue, I encourage you to imagine not only the art pieces that you will see in these pages, but also the discussions between the artists and the scientists behind them. We have included some of these reflections, directly from the scientists 'working at the bench' and their dialogues with the artists, to help you navigating and discovering those thoughts. At the same time, I hope this catalogue will inspire others and will continue building bridges across disciplines, bringing a broader impact to the work done by scientists and artists in our human society, bringing back values of creativity, knowledge and truth to our everyday life.

I will finish with a quote from Emilio Lecona, the coordinator of *RepliFate*, **the Doctoral Training network funded by the European Union, which is one of the drivers of the residencies that led to In Formation: "I walked into In Formation a bit uncertain of what the results of the program would be, as I did not know much about the work the artists had been carrying in the last months. Walking through the exhibition and talking to Helen, Pei and Solveig made me realize the deep connection established between them and the network. I felt the three artists managed to see us and our work as scientists, and not only as scientists. I was impressed by how brilliantly their work conveyed the ideas that moved** *RepliFate* **and I felt thankful for having the chance to contribute to the Artist in Residence program."**



Exhibition space showing works by Anna Dumitriu and Helen Pynor
photo credit Stefanie Winkler

Prof Dr Maria-Elena Torres-Padilla, Director of the Stem Cell Center; Director of the Institute of Epigenetics and Stem Cells (IES); Director of Biomedicine at the Helmholtz Pioneer Campus; Professor for Stem Cell Biology, Faculty of Biology of the Ludwig-Maximilians-University Munich (LMU)

Prof Dr Emilio Lecona Sagrado, independent group leader at the Genome Dynamics and Function Program in the Centro de Biología Molecular Severo Ochoa at the Spanish National Research Council (CBMSO - CSIC)



Curatorial Introduction

Claudia Schnugg

The exhibition In Formation and this catalogue in front of you are both the result of a multi-year endeavour at the intersection of art and science, including the Art the IES residency from spring 2020 to autumn 2024 and the three RepliFate residencies from early 2024 until summer 2026, as well as the documentation of four very different artist-in-residence projects, each of them resulting in a comprehensive body of work, entailing intense artscience processes, philosophical reflections, hands-on experiments, and processes of reflection. The three RepliFate artists-in-residence were Solveig Lill, Pei-Ying Lin, and Helen Pynor. Their residencies were designed as networked residencies, with each artist working with four PhD students and their labs throughout the duration of their RepliFate doctoral fellowship, while Anna Dumitriu was the first artist-in-residence at the Institute of Epigenetics and Stem Cells (IES) at Helmholtz Munich, working with different scientists and all groups at the IES.

While the composition of groups for each of the three artist-in-residence projects was designed to provide some prompts to the artists, the Art the IES residency focused on artistic research within the scientific work realised at the IES. The call for the artists was about collaborations between artists and scientists, with full freedom to develop an artwork based on their artistic research by engaging with the scientists' projects, processes, core questions, or experimental techniques. In both residency programmes, the guiding principle was that this collaborative approach and the dialogue between artistic and scientific research could contribute new perspectives, self-reflective processes, or enhance the skills of scientists and artists alike, opening scientific research up to the public, for example through events or an exhibition, which was the cherry on top. While, as curator, I had the pleasure of working with and supporting the process of all four artists, the RepliFate artists also had moments where they could exchange ideas about their artistic projects and insights with each other.

In Formation is an exhibition that responds to this process as well as being a poetic reflection on central research questions and the subject matter the scientists are dealing with. All four artists responded to this in their own language and artistic medium.

This diversity is also reflected in the chapters on each of the artists' works and their reflections on their process in this catalogue. This is followed by reflections on collaborations and artworks by the scientists, and reflections on each residency and artwork by the curator. Thus, with this catalogue we do celebrate more than the exhibition and the artistic outcomes: we celebrate the diversity of collaborations, insights and processes at the meeting of art and science.

Dr. Claudia Schnugg is an Austrian curator and artscience scholar working at the intersection of art, science, and technology. Her practice explores how collaborations across disciplines can generate new knowledge and societal impact through exhibitions, residencies, and research initiatives. She is the founding curator of the Universe Pavilion in Venice (2025), recognized by Table Media's Space Table as "Top of the Table 2025." Over the past decade, she has realized more than 35 international projects, resulting in over 80 artistic productions, in collaboration with partners including the European Space Agency ESTEC, Helmholtz Munich, TU Berlin, acib Vienna, and the European Commission's Joint Research Centre, Ars Electronica and the Science Gallery Network. Her recent exhibitions span Europe and Asia, including Brussels, Venice, Munich, Berlin, Timisoara, Beijing, Shenzhen, and Shanghai. She is the author of *Creating ArtScience Collaborations* (Springer, 2019) and has held research and teaching roles at institutions including JKU Linz, Copenhagen Business School, UCLA Art|Sci Center, and the European Southern Observatory.

Interaction during opening event, artwork by Pei-Ying Lin
photo credit Stefanie Winkler

In Formation

Claudia Schnugg

In Formation traces the unseen layers shaping life and knowledge, where biological processes and scientific inquiry unfold in parallel states of continuous transformation.
Between precision and uncertainty, it highlights the variability and instability inherent in living systems, opening a space where knowledge, images, and meanings remain perpetually in formation.

The artworks in this exhibition emerge from what the four artists Anna Dumitriu, Solveig Lill, Pei-Ying Lin, and Helen Pynor experienced, observed, and discussed during their residencies in biology laboratories. Each artist reveals aspects of knowledge, ideas, processes, and biological matter that are constantly shifting and becoming.

In the exhibition space, the artworks are divided between two rooms, a black box and a white box, where different artistic media enter into dialogue with one another. In the black box, two room-filling installations suspended from the ceiling create a tension between the intense colours and sound of Pei-Ying Lin's textiles and the delicate drawings on paper by Solveig Lill. This tension extends into the scientific dialogue between the two works: craftsmanship and hands-on skills in precise and complex techniques in Lin's artwork meet human imagination and the subtle growth and aliveness of knowledge and biological matter in Lill's artwork. The soundscape in Lin's work provokes the audience to listen carefully about what scientific questions and processes led to the science behind each textile in the installation, while the meditations that can be read while exploring the details of Lill's installation give a small glimpse into the convergence of human imagination, scientific knowledge, and aesthetic experience.

In the white box, two bodies of work draw on scientific knowledge, laboratory materials, and microscopy imagery in distinctly different ways. Helen Pynor's works reflect on a multitude of laboratory experiments and their highly visual outcomes, depicting moments in the life of cells, moments of transition, and glimpses into the composition of living matter. Through visual material, colour compositions, and a language moving between blur, shimmering, and precision, the works reflect on certainty and uncertainty, tangibility and intangibility, and the ever-becoming nature of living systems, while also revealing the sheer beauty of scientific techniques.

In dialogue with this, Anna Dumitriu works with laboratory materials and microscopy imagery. Her sculptural installations translate scientific models into three-dimensional forms, while microscopy imagery becomes a poetic interpretation of cellular life and an entry point into the intense experiences of processes in the laboratory. Throughout her work, Dumitriu brings cultural history and contemporary science into a productive tension, connecting them through a fluid and ongoing process of development. Her works return us to fundamental questions that humans have long asked themselves: What is life? What creates life? What prolongs life?

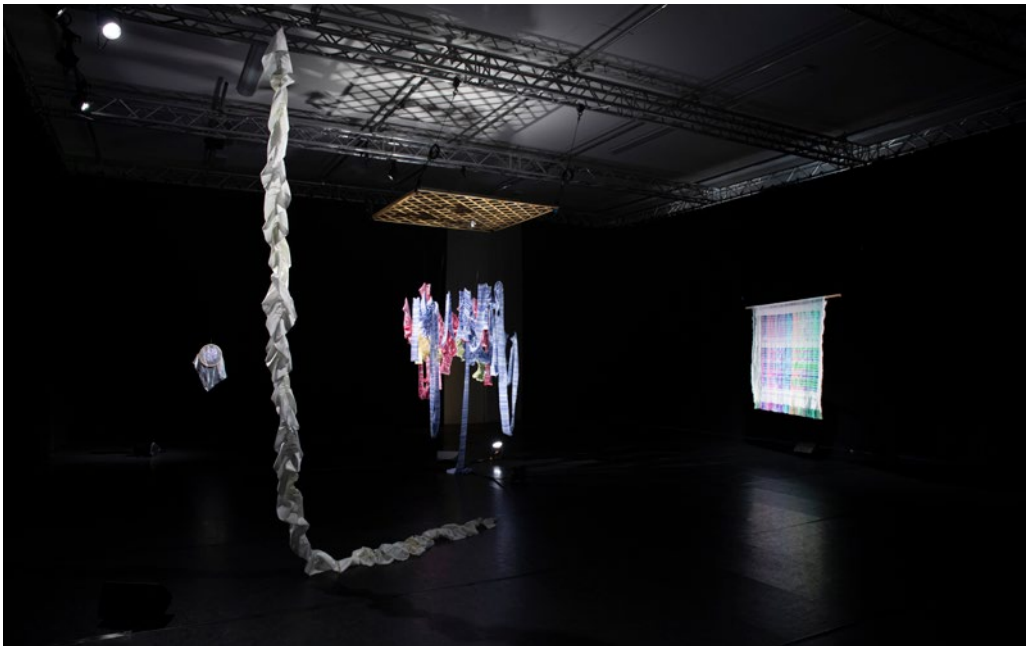
Each artistic body of work stands on its own while entering into dialogue with the others. Together, they reveal the multiple layers of In Formation: the ever-changing living cell, the perpetual formation of new life and new knowledge, imagination, the process of aesthetic production, and the scientific and artistic research that approaches these questions through craft, processes, media, and constant exchange.

Pei-Ying Lin

IN FORMATION

A Textile Study of the Craftsmanship in Biolabs

A RepliFate residency



A Textile Study of the Craftsmanship in Biolabs, installation view
photo credit Pei-Ying Lin

Biological Wet Lab requires highly skilled craftsmanship. In order to discover the underlying mechanisms of living organisms, many of which are invisible to the human eye, scientists still have to use their human bodies and hands to interact with the complexity and use different techniques to contrast and reveal what is hidden. The hands-on skills of handling samples, planning strategies that would allow us to understand the materiality and vitality, and awareness of the procedural steps, speak much to the similarities with textile making. In this project, each textile installation speaks the craft wisdom from the biological wet lab where the artist had a residency, accompanied by the recordings collected for the conversation between the artist and the scientists about how they deal with the physicalities correlated with the wet lab practices. It is an investigation through making for the shared attention and attitude towards the physical otherness between the biological lab and the crafts.

Collaboration partners
University of Copenhagen - Marta Olivia Santiago and Julien Duxin with support of Ellen Sofia Kakulidis, Mads Meier, Xueyuan Leng; Netherlands Cancer Institute - Kaustav Majumder and Titia Sixma; Lead Discovery Center - Utkarsha Pande, Bert Klebl, and Kathrin Klebl; Leiden University Medical Center - Hồ Mỹ Phúc Võ and Sylvie Noordermeer

Production collaborators
Eindhoven University of Technology Wearable Senses Lab, Femke Vorselen, Milou Voorwinden, Kristina Andersen, EE Labels, Karolina Tomaszewska

Installation with four textiles and 4-channel sound

The artwork is composed of four elements that elaborate on key elements along which the collaboration between the artist and the scientists unfolded in four different laboratories.
Each of them unfolds through the translation into textile practices and processes.
The four elements are:

The Artist's Fold of the knitted USP1-UAF1 bound to Lys63-linked diubiquitin

Embroidered white thread(s) colonies dyed with retired crystal violet previously used in clonogenic assays

Human body conditioned to Xenopus laevis, performed on a sewing machine

Weave bindings and wefts interactions sampled in 1536 wells


The Artist's Fold
of the knitted USP1-UAF1
bound to Lys63-linked
diubiquitin

My residency with NKI began with a knitted protein - the PCNA protein. My earlier project, Studies of Interbeing - Trance 1:1, brought me into the world of textiles, where I first attempted to understand how scientists study and document the SARS-CoV-2 Spike protein structures and translate the structure into knitting - both for hand knitting and machine knitting. I translated the Spike protein into a long, thin piece of knit with spirals, representing part of the protein's secondary structure. It made me start to look at the materiality of long, stringy things, and how structure is constructed. During my first visit to Titia and Kaustav, I asked about what would be a good protein to begin with, and Kaustav provided me with a PDB file of PCNA. I knitted one subunit of the protein using the same logic as I worked on the Spike protein, with Python code generating a pattern that I could load into the semi-automatic knitting machine Kniterate in TU/e Wearable Senses Lab. I went through a few days of failure on the machine and finally knitted one subunit of the PCNA protein that took 8 hours - still with falling stitches - and brought it to Titia and Kaustav. I still remember Titia looked at this long piece of turquoise-pink scarf-like knit with appreciation, and made the remark that there is also a lot of craftsmanship needed in the lab. This remark later became the backbone of my RepliFate residency.

As I dove deeper into laboratory practices by following Kaustav around, I noticed many unwritten details that are extremely relevant but rarely appear in publications. If looking at the laboratory work as a craft practice, it engages largely with planning, preparation, building up of the embodied experiences, and a lot of imagination. It requires a lot of 'material understanding' – although the idea of material here is not only non-living matters, but also living matters and semi-living matters – and they possess different levels of agencies. This is very different from the general public's understanding of science nowadays that's heavily influenced by the digital-based system: though unspoken, we often assume that science is precise, fact-based, rational, pragmatic, and rarely romantic. That we also assume the materials scientists work with in the lab are like digital computation, complex but precise. Where in fact, much more often the time spent in the lab was to deal with things that did not work out in the ways expected despite strictly following a detailed documented protocol. We also forgot that science is also very much about hypothesis – an action that engage largely with fact-based but wild imaginations. And working in the lab requires scientists to look at what is known, knowing that 'facts' can potentially be wrong, imagine the possible underlaying scenarios, coming up with an hypothesis, deal with matters with their own agencies, and orchestrate all these together to allow an observable situation to happen in order to understand a little bit more about our world.

And that was I have noticed when following Kaustav around: he looked at the consistency of bubbles when an ultra-sonic machine broke the cell, he touched to check if the eppendorf were properly cooled in the ice, he observe the speed of fluid going through a filtration with eyes to know if it is working well.

The Artist's Fold of the knitted USP1-UAF1 bound to Lys63-linked diubiquitin, close-up
photo credit Pei-Ying Lin

He has tricks of treating the proteins for extraction gently by pippetting to the wall of an eppendorf instead of dropping to the bottom of an eppendorf. What I have heard most frequently in their lab was 'to keep the protein happy'. One might ask about the definition of proteins being happy. However, such term is not a quantitative definition, but rather a working prompt the guides the attention and care towards handling the physically-existing but visually invisible molecules. If to put on the analytical lens of Kaustav as a human body mediating between all the matters in the lab, I see it is more about fuzzy and complex evaluation and not precise numbers, not reading of sensors, but the awareness of how the invisible matters are giving traces of their status, along with a well-conditioned human body that is extremely sensitive to the physical details. Also, the gaze of the scientist in the lab changes; they see the human-ness within the materiality where scientific data is being reported. For instance, they are able to



read the temperament of the person from a western blot gel where the main visual markings were bars. They are able to read how the specimens were loaded to the gel, and how the electrode bath was set up. The scientists in the lab are no just human flesh bodies performing tasks from bench to bench; they are like improv dancers who use their body to respond to the surroundings.

My artistic response to the lab was to also engage in making proteins myself, but with a semi-automatic knitting machine – because it is impossible to hand-knit – and wool yarns – because they felt good. I was pondering how the craft aspect of Titia and Kaustav's lab – where I find a lot of similarities in textile-making – would echo back in the actual making process. I began with the USP1-UAF1 bound to the Lys63-linked diubiquitin structure that has been published by Titia and Kaustav together with Niels Keijzer, Jan Sakoltchik, Nina van Lil, and Farid El Oualid as a start. My goal was to create a 2-meter-by-2-meter space with the proteins floating in the space, just like how it looks in the Chimera software - which is a snapshot of the moment when USP1-UAF1 cuts the link between two ubiquitins. This requires the building of a few mechanisms: I need the knit to naturally form helices at the precise location, tubes for beta-sheet attachments, and some kind of colour or structural coding that will allow me to 'read' the knitted protein for the structural folding later. On top of these structural considerations, there are also aesthetic considerations: the look of a helix, the colour palette, and the material.



The whole process soon became challenging. I used the technique that's called 'short-rowing' in knitting to create the spiral. And to create the aesthetic effect of electron density of each residue, I incorporated many drop stitches that will create an airy effect. These techniques mean that I will need to have yarns accumulated on the needle bed of the knitting machine and drop them when needed. In a way, I need to test the boundary condition that will allow the machine to knit without failure. Another challenge is that the proteins are too complex

Knitting samples in the prepartion of the artwork
photo credit: Pei-Ying Lin

to be manually drawn in the knitting programming interface. For that, each line of the knitting programming code (colour-codes) will correspond to one line of knit. To create a structure, multiple lines of programming code are needed. To create helix-shaped short-rowing, at least 10 lines of code are needed for a 30-degree turn. And creating the airy structure of a basic residue also requires at least 8 lines of code to begin with. The tunnels for beta sheet attachments also require at least 10 lines or more. And on top of this, I need to incorporate colour coding for each residue so that I will be able to read the knit. I'm using a 3-colour system to code the 21 amino acids. Meaning that each basic structure will need at least 3 times the number of basic structure. The USP1 protein contains 813 residues, the UAF1 protein contains 712 residues, and the two ubiquitins are 76 residues each, but have slightly different secondary structures. This means that even the smallest ubiquitin will require 76 x 10 x 3 = 2280 lines of code, with 50 stitches in each line, meaning that I will have to hand-draw 114000 stitches. This is beyond possible. Therefore, I began by trying to communicate with the machine directly. In the Wearable Senses Lab in Eindhoven University of Technology, I have access to a Kniterate semi-auto knitting machine. It reads a human-readable code named KCode. This allowed me to work out the basic structure of helices, basic residues, and beta-sheets, then assign them according to the protein structure stored in the CIF file to the corresponding position, and piece together a KCode file that can be loaded directly into Kniterate. However, it is not easy to make the Kniterate knit without having fatal errors. In knitting, if a line fails, then the whole knitting procedure will have to be stopped and is not repairable. But the machine has its own criteria, for instance, where it references the origin of the yarn carrier, where it parks its yarn carriers, and if they interfere with each other. These all require machine codes additionally. I had to build up a lot of tests to understand what the additional machine manoeuvres are, to know how to piece together the knits line by line, and to figure out how to stabilise the structures between different basic components (helices, sheets, and basic residues). In the end, a 76-residue-long ubiquitin requires 58779 lines of KCode, and the longest being UAF1, which contains 482202 lines of KCode.

The production speed was also another issue. Due to practicalities, the Knitrate can only be accessed for a maximum of 8 to 9 hours a day. After running test samples, it calculates that the maximum speed without creating a fatal error is roughly 450 lines per minute. At one point, the design would require more than 50 hours to knit the UAF1, creating practical production issues because it would stay on the machine for too many overnights and be more likely to fail fatally when starting each morning. Partly because the needles will slowly accumulate defects, and the environment also changes from day to day. After redesigning the structure and optimising the machine actions, it comes to 482202 lines, which will take around 17.5 hours to knit, which could be just manageable in two days.

Surprisingly, cellular biological mechanisms also became useful at some point. Before the machine stops every day, I have to identify which line of code the machine has reached. However, it turns out that the display screen was not displaying the correct line. But because the knit is colour-coded, I can visually see which colour of yarn carrier the machine was using. I sat there,

observed the machine's action, recorded the sequence of yarn carriers, and then found the corresponding sequence in the machine code with the help of AI. Almost similar to sequence-specific DNA recognition.

Kaustav and I talked about how he builds up protocols for new experiments. A protocol will need to guarantee that things will perform with consistency. It requires a lot of experimenting, finding out the space between workable procedures and unworkable conditions. We find similarities between his challenge of building protein extraction protocols and my knitting process: we both start with the smallest basic components, understand the complex codependencies, and figure out the most stable working space. Then these small basic components can be combined together and become more complex. The goal is to have a stable production of protein/ knitted protein, but also, in the process, it reveals many details of entanglements and underlying mechanisms that surround our protein - whether knitted or purified. The process of producing it becomes the process of understanding the system, revealing the system within.

As Kaustav can now explain what happens during the moment of ubiquitin being removed from PCNA, I can explain very well how the design is translated into Kniterate machinery in collaboration with the yarns. This knowledge was discovered through the process of making.

The knitted installation was put together the first time during the setup of In Formation at Mufftawerk, and obtained its name "The Artist's Fold of the knitted USP1-UAF1 bound to Lys63-linked diubiquitin" because only when I was trying to bring all four proteins together, then I realised that I am living in a physical space where gravity is everywhere, while in Chimera where the proteins are visualised, there's no gravity. It literally makes folding the proteins the same as how they are in the digital space much harder than expected.

Although the temporary journey with *RepliFate* and NKI ends as *In Formation* exhibition is being taken down, I'm still constantly finding more and more similarities in how we gain knowledge in science and in art. Through mingling in and with complexity, with care, that fundamentally changes the way we see the world.

Credit
Pei-Ying Lin in collaboration with Kaustav Majumder and Titia Sixma from NKI. With support from TU/e Wearable Senses Lab, Femke Vorselen, and Kristina Andersen. Special credit to the friends who supported the starting point of knitted proteins: Hsiang-Lin Kuo and Shi-Shing Huang.

Materials
Installation with 4 knitted textiles, hanging from ceiling

Year
2026



Length of one of the knitted elements in the artwork
photo credit Pei-Ying Lin

Scientists' reflections on The Artist's Fold of the knitted USP1-UAF1 bound to Lys63-linked diubiquitin

Kaustav Majumder

It was intriguing to follow the entire process, from the initial plans for representing protein structures in a textile to a finished piece knitted in thread with minute details. I felt curious at the start, wondering how something as abstract as protein folding could become thread, and increasingly excited as each piece took shape. What I value most is the care in Pei's work, and her enthusiasm during the organized lab visits, where she became fully immersed in protein purification research. That experience clearly unfolded into the artwork, where every knit feels deliberate.

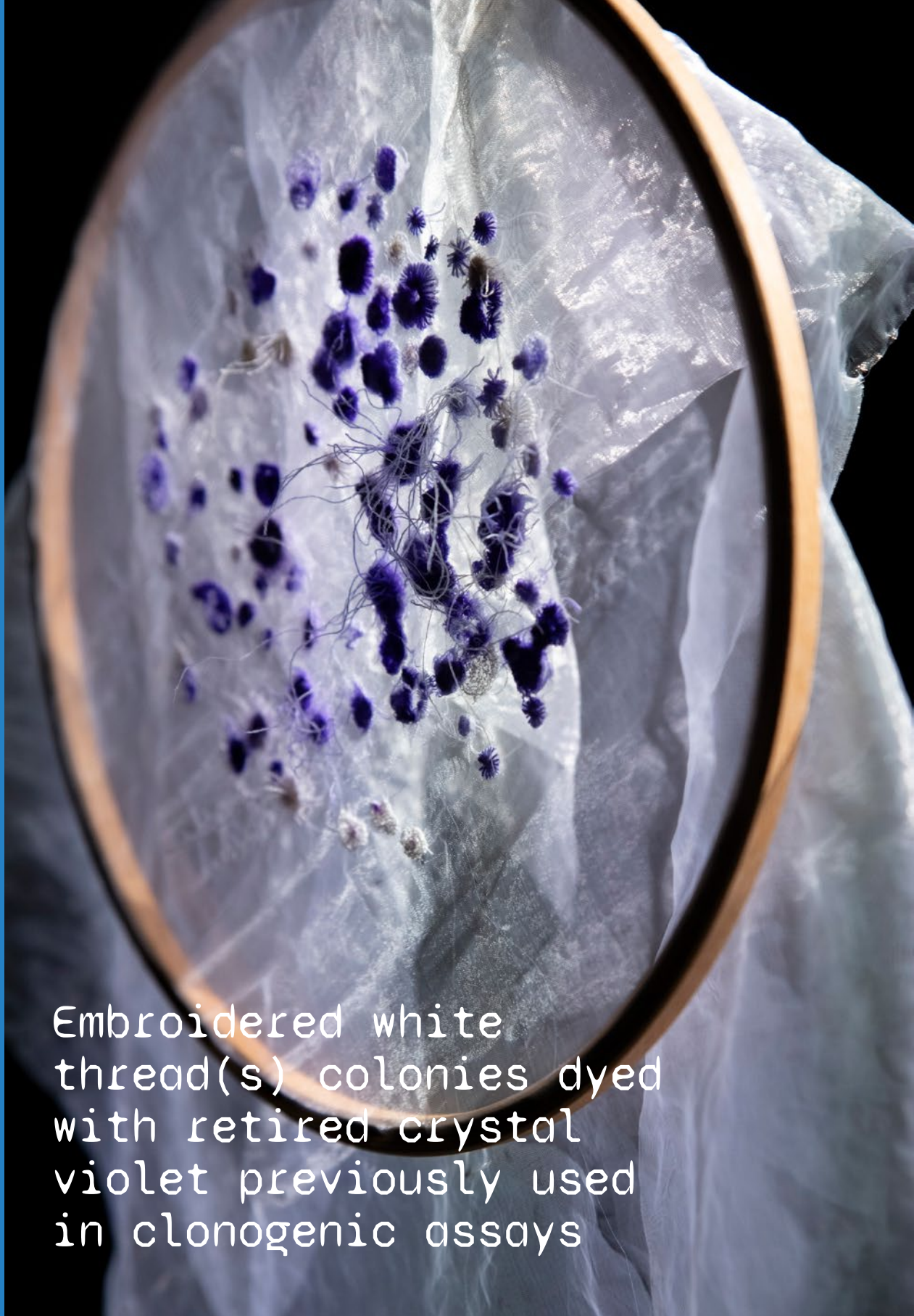
I can only imagine how challenging it was to stay true to the science while working with a material that has a mind of its own, but that tension is what gives the pieces their life and keeps the underlying biology intact. In a research context, Pei's work shows that art is a way of thinking about science, not just explaining it. It has also started conversations between disciplines that might never have happened otherwise.

Titia Sixma

This whole project has been great fun, seeing how Pei thinks about our work and how she reacts to the science. I was impressed with the different approaches for all four labs, with completely different results. In line with Pei's focus on craftsmanship, there were many aspects of the textile work that were completely new to us, but I must say that the art was special and enjoyable beyond all the science background. However, it also gave me new respect for the difficulty of protein folding itself, which was a surprise!

The Artist's Fold of the knitted USP1-UAF1 bound to Lys63-linked diubiquitin, close-up
photo credit Pei-Ying Lin



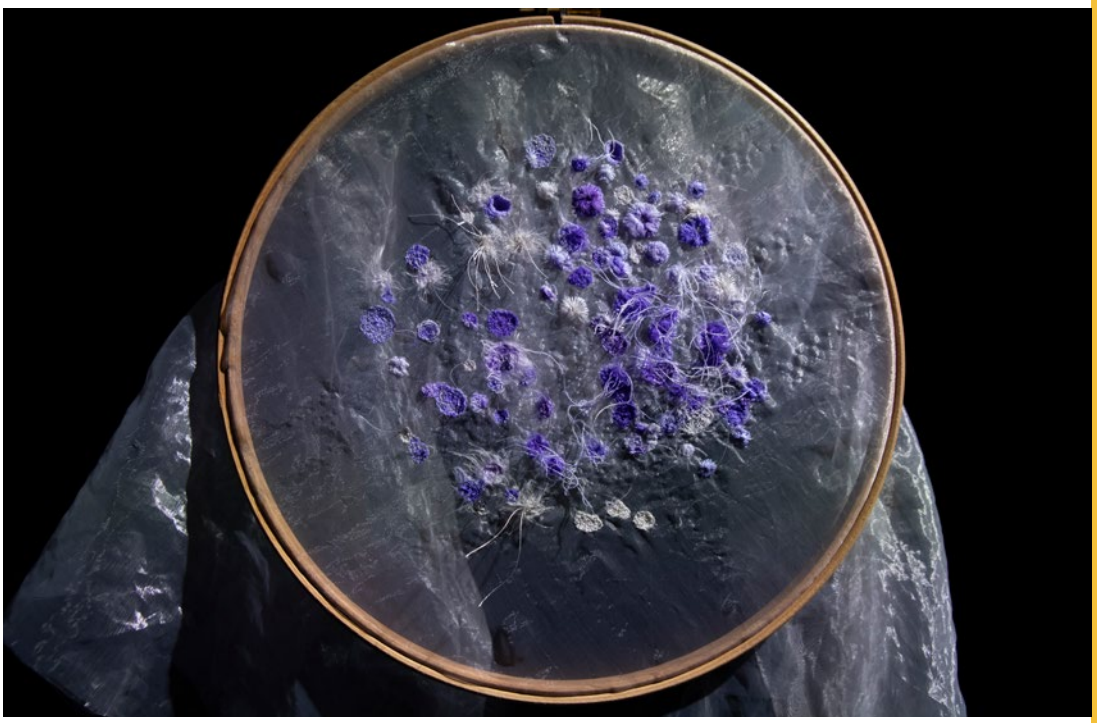


Embroidered white thread(s) colonies dyed with retired crystal violet previously used in clonogenic assays

This work was heavily inspired by the clonogenic assay that Phuc used extensively in the lab. In Sylvie Noordermeer's lab, their main collaborator is the cells, where the cells become the location where they 'incubate' the variations they created, which helps to reveal a bit of a clue within the complex molecular cascade of DNA repair.

If Titia Sixma's lab is more about stability and precision, perhaps my understanding of Sylvie Noordermeer's lab is more about variation and possibilities. They work in a layering manner – through creating arrays with variation that gradually identify the route that has influence on the target question they have. How I see Phuc's work is to reveal the variations through various ways of colouring – crystal violet, fluorescent dyes – the expression of genes is visualised through living matter, and knowledge emerges through the images obtained from colouring that are visible to human eyes.

The second core of my *RepliFate* residency was to ask: 'how do humans enable ourselves to see information and turn it into knowledge?' And I was utterly surprised by the simplicity and delicacy of the techniques used in Phuc and Sylvie's lab. On the day when Phuc introduced me to the clonogenic assay technique (probably also because it's one of the most newbie-friendly techniques), I felt I was in an indigo dyehouse. The cells were already grown attached to the bottom of special coated transparent Petri dishes. Crystal violet was applied to the dish and then poured, followed by water washes. The shape of the cells gradually appeared in the colour of crystal violet, like a plotted chart of stars. In the lab, stacks of these dishes sat, some faded to a more reddish colour. Phuc told me that they keep the dishes as data – which, in my eyes, are beautiful artworks with volume, nothing like how we think about data, but more like a sample archive.



Embroidered white thread(s) colonies dyed with retired crystal violet previously used in clonogenic assays, installation view (left), front (below) photo credit Pei-Ying Lin

Perhaps it was the shape, the colour, and the process; when I was thinking about what to make for the In Formation exhibition, embroidery immediately came to mind. The patterns of cell colonies emerge because crystal violet attaches to the protein and DNA of the cells and not to the plastic of the Petri dish. This difference in dye attachment creates the effect of purple colonies on a transparent surface. This material-specific characteristic made it an interesting element to play with. What if I create an embroidery whose pattern only appears after dye?

The work *Embroidered white thread(s) colonies dyed with retired crystal violet previously used in clonogenic assays* **is made with 6 different yarns (originally planned to be 9), ranging from cotton, silk, seaweed, Tencel, lyocell, and polyester, embroidered on a polyester organza fabric. Again, my artistic body works in a textile lab reproducing/producing-with the process of uncovering in the biolab.**

Digital Embroidery works through a protocol in which designs are made in a digital interface, often with vector drawing software, then translated with embroidery software to assign the embroidery machine properties and loaded onto the embroidery machine. The digital instructions are colour-coded, corresponding to each set of threads and needles. The threads are manually threaded, meaning that the colour-coding does not represent the colour of the thread, but rather the 'name' of the thread. The embroidery software is capable of applying stitch-specific routes along the existing vector curves. For instance, assigning zigzag stitch to a curve will generate a zig-zag route along the chosen vector curve, and assigning satin stitch to the same curve will generate a much tighter zig-zag movement that is so dense that it creates a column-like embroidery along the chosen vector curve. In this process, the digital design to the finished embroidered textile, vector curves were translated into machine movements, and then into the 3D space where threads are stitched to the fabric with tension. The materiality comes into play at this stage: the tension and elasticity of the threads and fabric work together, pulling the whole design into a more stable form, which sometimes can become voluminous, bringing nice material surprises.

My challenge in making the work mainly surrounds several aspects. First is the material characteristics between the dye and the textile, where I am hoping to create a situation where the dye can directly reveal a visible difference between different materials. A process similar to how the cell colonies were revealed in contrast to the plastic petri dish. Second, I'm looking for a way to create a material aesthetic that would echo the beautiful clonogenic assay. In this process, I have to go through a period of not-knowing: the moment when all the threads still look the same, and implement a hidden indexing that would allow me to identify them afterwards. In designing the indexing, I made the design with shapes that are directional, meaning that no matter which direction I turn them, I will be able to identify which side is left and right. The design also has several different types of density. The digital colour coding fits with the coloured polyester threads I used, which helps to validate the workability of actual embroidery before I move on to the actual threads. Partly because some of the threads I have chosen are not made for embroidery, the threads might

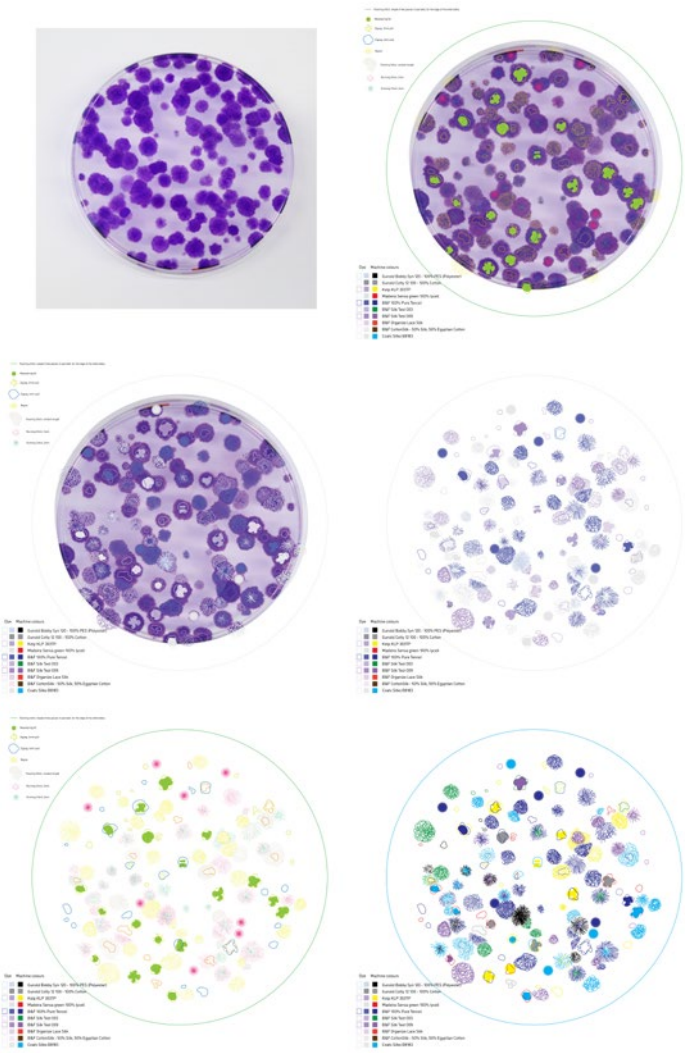
be too fragile for the tension between the needle and the fabric and break easily. The polyester thread embroidered sample also later became the reference to work out which white thread I had used after dyeing. The test sample is then taken to Phuc's lab, where we experiment with the crystal violet in the lab. The clonogenic assay dye protocol was used on the textile, where we also experimented a bit on optimising the protocol specifically for the textile, and ended up with a gradient that is able to show different colours for the threads.

The actual design of the work took several layers of translation. From a photograph of the clonogenic assay, I created basic shapes and grouped them by colour for different types stitches that previously tested to have interesting 3D formation. And then re-group them colour-wise according to the threads.

The project then departed from just replicating the clonogenic assay in textiles. During my residency with all four labs, I noticed there was a lot of 'following the agency of the subject studied', that the experiments and protocols are designed 'because the cells or proteins work in a certain way'. That every procedure was designed to allow the cells and proteins to show their agency. Instead of 'designing' something to have certain functionality, within the RepliFate network the research focuses more on 'allowing the subject of study to perform so that we can see more clearly.' And such an approach is never easy, and possibly even much harder than making something work in the way we want. Craft practices often take the approach that's somewhere between 'design' and 'following the material agency'. I decided to push it towards allowing more material agency to perform.

The materials I used for embroidering the work are very tricky to work with. Organza is very thin and can be very difficult to fit to the embroidery frame that holds the fabric in place on the embroidery machine. It creates unrepairable holes if the needle punctures through the fabric too many times. The Tencel thread lacks elasticity and tends to break and deform in the process. One of the silk threads is extremely thin

The artist's process illustrated, from a photograph of a dish in the lab to the final embroidery image credit Pei-Ying Lin



and breaks easily whenever there's too much tension. The twist of the thread also tends to travel and grab the needle, creating a lock on the needle and breaking it. The embroidery machine uses a mechanism that pulls the loose end of thread to the back side of the fabric when it cuts the thread, so that it won't appear on the front. All these difficulties were turned into the features of the embroidery. The tension was used to create very deep curvatures, and the tail of the cut thread pulls from the surface to make it grass-like.

Although the whole process might sound automatic, the reality was that I had to stay close to the embroidery machine at all times, pushing the loose ends of threads away from the current working needle so that they wouldn't be embroidered back into the fabric, making sure all the thread tensions were adjusted on the go, stopping the machine when it pulled too hard on the fabric, and re-threading the machine every now and then (almost once every 10 minutes). The embroidery took about 16 hours of work with full attention. The finished embroidery is fully white. After dyeing, the different tints of violet appear, creating gradients of purple colonies that grow out from the fabric.

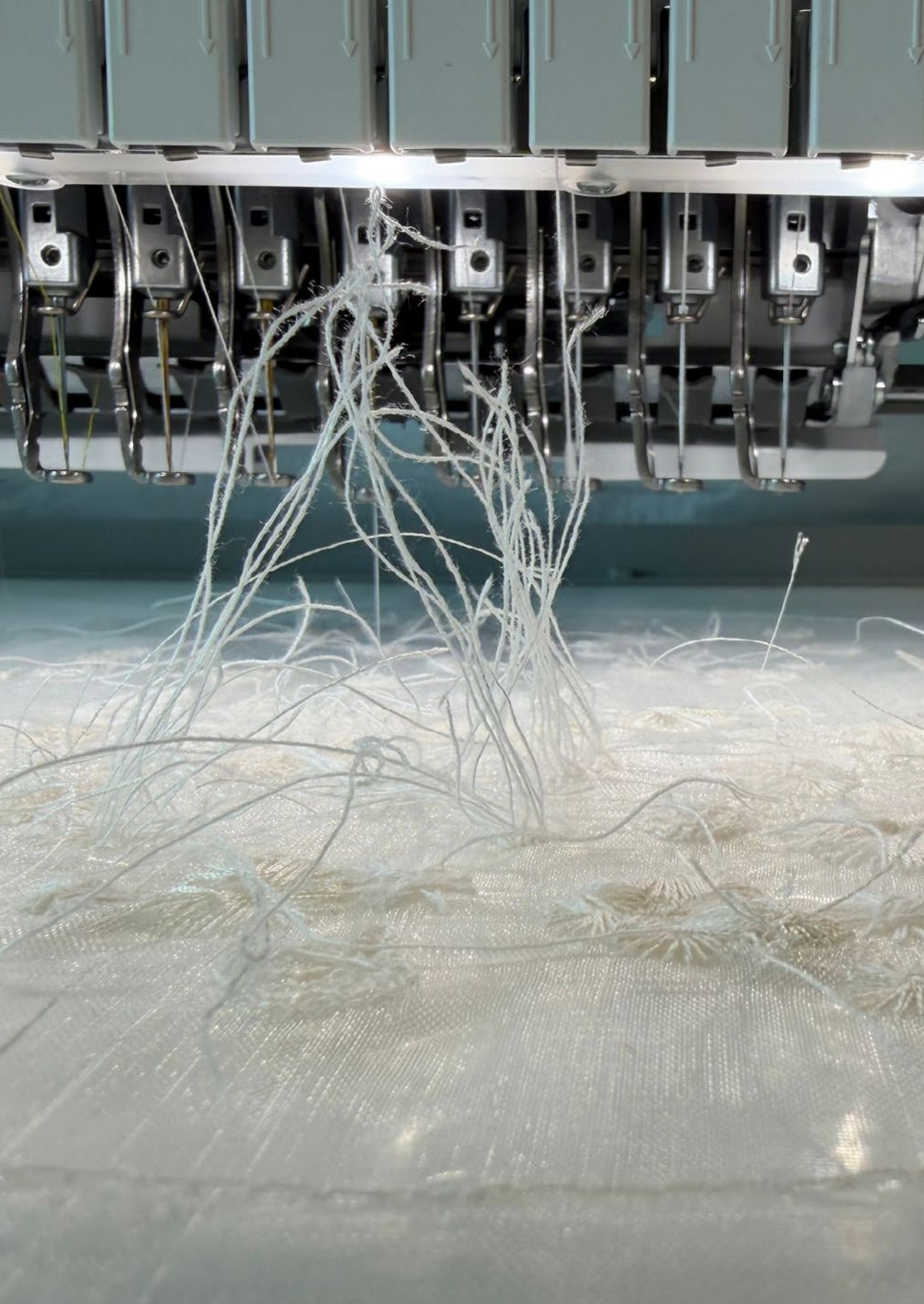
In this work, I planned and integrated the variation of material just like how Phuc integrate the variation of genotypes into the cells, and uses crystal violet to reveal their differences. It became a process of carefully encoding and translating a series of information from digital design to the physical textile, embracing the material and machine agencies, and using crystal violet to 'see'. The process is almost like learning how to work elegantly within the physical boundaries, passing obstacles introduced by physical limitations, and gaining the intricate diversity of colours.

Credit
Pei-Ying Lin in collaboration with scientists Sylvie Noordermeer, Hồ Mỹ Phúc Võ (Leiden University Medical Center). With support from TU/e Wearable Senses Lab, Femke Vorselen, and Kristina Andersen.

Materials
Installation with embroidered textile, hanging from the ceiling

Year
2026

Embroidery process, close-up
photo credit Pei-Ying Lin



Scientists' reflections on Embroidered white thread(s) colonies dyed with retired crystal violet previously used in clonogenic assays

Hồ Mỹ Phúc Võ

Pei-Ying Lin works through questions. That was the first thing I noticed about her, and it is still what I admire most. They are good questions, the kind that sound simple but make you stop and think before you answer. Some are about the science: what we are trying to find out, how an experiment works, what a result actually tells us. Just as many are about us. What does a normal day in the lab look like? What keeps us going, what frustrates us, what gets us excited? And how does all of this, over the years, become part of who we are?

Pei-Ying watched the lab closely, much as a researcher observes a living system. She picked up on routines, materials, and small habits that we had stopped noticing a long time ago. Crystal violet is one of them. In our lab, we use it at the end of clonogenic assays to stain the colonies that single cells have grown into over several weeks. Each colony starts with one cell that copies its DNA and divides. Its daughter cells do the same, again and again, until there are enough of them to see by eye. Once the stain had served its experimental purpose and was about to be 'retired ', Pei-Ying gave it a second life through embroidery. An embroidery grows in a similar way, one small stitch after another, until the repeated actions add up to a visible form. I like that the repetition of the needle mirrors the replication of the cells, and our own work as well: the plating, staining, counting, and repeating of experiments through which results slowly take shape. Seeing a stain and a technique we had used so often show up in her work felt familiar and new at the same time. Working with Pei-Ying through *RepliFate*'s Artist in residence programme was a real invitation for us to look again at our work, and at what is, in its own way, in formation.

Sylvie Noordermeer

Although I have always had an interest in art and it is one of my driving forces as a scientist to inform the general public about the purpose of fundamental research, I have never had the change to be involved in a science-meets-art initiative. Hence, I was excited to be involved in the *RepliFate* artist-in-residence action.

Already before meeting Pei-Ying Lind for the first time, I was impressed by her art that visualizes the very small scales that we study (cells, virus particles, etc). When meeting her the first time, her eagerness to visualize the invisible became more an more clear. In addition to visualizing the very small scales, she also aims to visualize the lengthy processes and tedious work that are inevitably connected to fundamental science. Hence, the programme's title 'In formation' couldn't have given a clearer understanding of the work that Pei-Ying, and also we do on a daily basis.

In our conversations with Pei-Ying I always felt a close connection to the way we as scientists and she as an artists thinks: detail-minded, the end-goal being only part of the journey, mixing creativity and perseverance. However, it was also sometimes an eye-opener to appreciate what details became an important entity for her, which we would regard it as a triviality.

Altogether, my interactions with Pei-Ying provided me an exciting opportunity to think of, and eventually see, our daily research efforts in a new light of creation and eternal motion towards knowledge.



Human body conditioned to Xenopus laevis, performed on a sewing machine

The four labs of my *RepliFate* residency each have a different temporality, each conditioned by the type of experiment and the living beings they work with. Duxin's lab undoubtedly works in a Xenopus laevis' timezone.

During my first visit to Duxin's lab, Ellen Sofia Kakulidis and Mads Meier showed me the core procedure of their experiment: the NPE protocol (nucleoplasmic extract protocol) of Xenopus laevis. The NPE (nucleoplasmic extract) are extracted from the unfertilised Xenopus laevis eggs, which can provide a non-membrane nucleus system in a test tube, allowing better observation of DNA replication. The NPE protocol takes weeks because it begins with injecting the frogs with hormones so that they will lay eggs. The eggs are then collected, and the extraction needs to be done within the day. Everything has to be well-timed, and even when everything is perfectly timed, there are many conditions that might cause the whole extraction to go astray. On the day of extraction, the researcher will have to move between facilities that are 20 mins walks apart, carrying all the equipment, carefully massaging the frogs to obtain the eggs, picking out the problematic eggs, and then begin the extraction. During the extraction, the researcher has to work with a timer, carefully timing each step, conditioning their own body to the timer up to minutes and seconds. They go to the toilet with a timer, eat with a timer, grab equipment with a timer, walk between fridges and hoods with a timer, pipette with a timer, stir with a timer. As an observer, I see the researcher's body work between two qualities of milieux: as a coordinated athlete in a physical landscape filled with facilities and equipment, and as a fluid body that softly, gently interacts with the life and matters they handle. Efficient, precise, but also tender and receptive. They work with highly complex and unstable subjects (the frog eggs) to pull out a semi-stable yield. They often joke to 'pray to the frog god' for a good yield of extraction.

My main collaborator, Marta, works with precision and efficiency with invisible things. She works often with a Geiger counter, Eppendorf tubes, pipettes, and tiny transparent liquids that appear all the same in my untrained eyes. She would print out the protocols, position the Eppendorfs in a specific order, set the timer, and then move through a well-coordinated choreography between the tubes with the timer as her metronome. Again, the body is an athlete working within the physical landscape of tubes and pipettes, although she sits on a chair in front of a lab bench instead of running around the buildings. But she is also like a Taichi master that works with the invisible flow, where she manoeuvres just adequately.

Duxin's lab often reminds me of a well-organised beehive, where all the members work in coordination. They each work on their own experiments, but always jump in to help the others when someone requires something without the person asking. The lab, as a field site, has a quality of an intricately intertwined network between the human members, the animal members, the living matter, chemicals, and equipment. Vibrant, and always running against the clock.



Human body conditioned to Xenopus laevis, performed on a sewing machine, detail (left), installation view (right)
photo credit Pei-Ying Lin

This inspired the work *Human body conditioned to Xenopus laevis, performed on a sewing machine*. **I received the NPE protocols in writing from Xueyuan Leng, one of the members in the lab. The protocol was written in a Word document consisting of 5 pages of A4 bullet-pointed text with 12pt font size. The whole protocol takes around 2 weeks to perform. However, if read in detail, the time stretches disproportionately. The beginning of the protocol takes days with not much action, and the final part of the protocol is fast and complicated. A lot of preparation was planned between the longer time gaps, also precisely timed. I decided to unpack the protocol on a non-stretched timeline, visualising the action points on time to make a better sense of how it feels, trying to reconstruct my physical experience of shadowing the NPE protocol in person. Therefore, I printed the protocol on the fabric with the spin-like pattern of Xenopus laevis as the tick marks. Each fabric is a day, and the fabrics are welded together to make a long, full timeline of the protocol. The long fabric is then run through a sewing machine to make manual folds whenever a protocol action is taken.**

As all four works for the *RepliFate* **are some kind of re-staging of my observation on the bodies working in the lab, through and with textile materials and machines, the choices of this work were highly related to 'running with timed turning wheels'. The heat press rotary machine rolls and takes the print and the fabric in to transfer the ink onto the fabric. This means that I have to be standing there, feeding the machine fabric and prints, following the speed of its rollers. The fabrics were welded together using an ultrasonic welder, which also has a roller cutter that takes in the fabric. The sewing machine has a rolling belt that takes in the fabric so that the needle can stitch through the fabric with stable gaps. The making process for me became pushing my body to move with the same speed as the fabric being taken in by the machine, making sure the right movements were being done at the right time so I could obtain the desired textile outcome. Feeding the fabric, pushing the pedal, making the fold. Each action is well conditioned, and any errors will reflect on the textile outcome.**

The end piece is a 5-meter-long pleated textile that hangs from the ceiling, where the textile became the archive of my physical movements and interactions with the machines. The textile is also a documentation of the NPE protocol unfolded on a timeline.

Credit
Pei-Ying Lin in collaboration with scientists Marta Olivia Santiago and Julien Duxin with support of Ellen Sofia Kakulidis, Mads Meier, Xueyuan Leng (University of Copenhagen). With support from TU/e Wearable Senses Lab, Femke Vorselen, and Kristina Andersen.

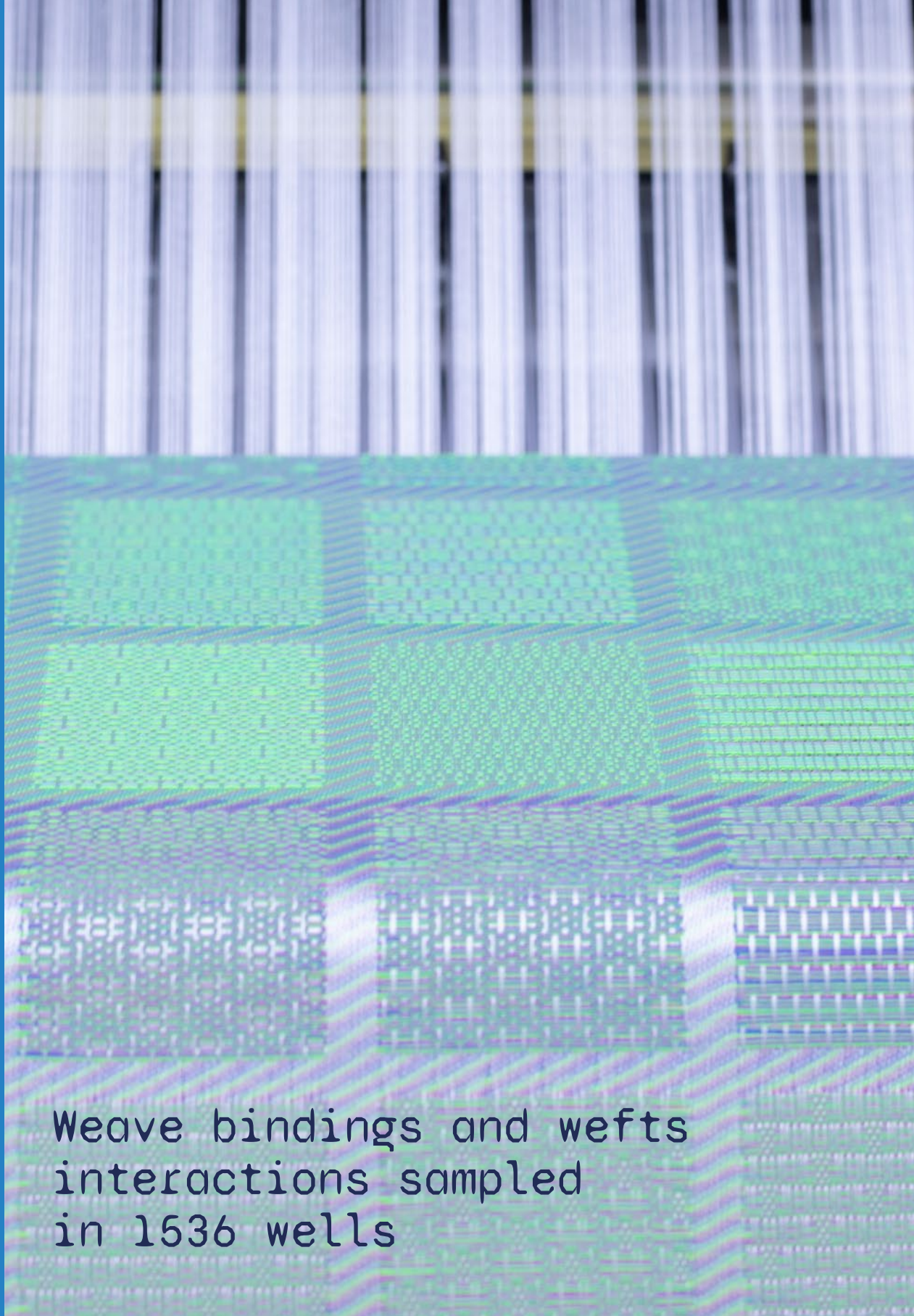
Materials
fabric with heat-press prints and sewn folds, hanging from ceiling. Voice recording.

Year
2026

Scientist's reflection on Human body conditioned to Xenopus laevis, performed on a sewing machine

Julien Duxin

Watching Pei and the other residents express our science through art has given us a chance to step back from our meticulous daily tasks and appreciate how fortunate we are to do what we do. It's also a way to think outside the box and reflect on the endless possibilities before us! ones we too often narrow our focus away from in the day-to-day.


Weave bindings and wefts
interactions sampled
in 1536 wells

For my experience at Lead Discovery Center Dortmund, it was a lot of grids, rows, columns, and sizes. These grids, rows, and columns often engage with liquids of extremely small volume. To validate existing research findings and scout for their potential for future drug development is the main focus of LDC, which I was told by Kathrin during my first visit. The research at LDC engages with testing a huge variation of molecules and studying their reactions – many of which are automated by machines and robotics, or work in batches. Kathrin and Utkarsha showed me the tools they used the most often: electronic pipettes that have 4 pipette tips, where one can pipette into 4 wells each time, perfectly matching the sizes and gaps of the multi-well plates they use in the lab. That was where the story of the piece *Weave bindings and wefts interactions sampled in 1536 wells* **began.**

Working with multi-well plates creates more efficiency, but also changes the planning and choreography in the lab. Utkarsha showed me how different sizes of the tubes will fit with different sets of multi-tip pipettes, and how she plans the experiment accordingly. Because these plates are only the size of a palm, each well also contains a very small amount of fluid. This means that they are very vulnerable to environmental influences, and it is important to always have them in check. Additionally, to work with a 4-tip pipette means to work with the set of 4 at all times. In a plate with 24x16 wells where Utkarsha often used to hand-pipette using the 4-tip pipette, it can be very difficult to visually know which well is to be pipetted into next. They are eye-dazzling. Therefore, certain wells have to be marked as a divider, but also as an indicator for reading the environmental influences. Utkarsha's strategy is to section the plates into sets of 6, where two columns are marked with a red sample that serves as a visual divider but also as an indicator, then followed by four columns where the samples for testing are loaded. There are other plates with different sizes, and this size-tool-planning relationship also exists for them. A plate that has a 48x32-well design contains 1536 wells, which is almost impossible to count visually, and contains an even smaller volume of liquid in each well, making it even more vulnerable to environmental conditions. Utkarsha designed the plate in a way that will allow her to see the threshold easily and identify machine (pipette) errors easily. The grids work in a way that they are colour-coded according to the digital reading of reaction intensity, where the patterns emerge through contrasts between colours.

Underlying the experiment design of the 1536 plates, I see it as a landscape that can quickly reveal the interactions between rows and columns, between different mixtures of molecules. The grid can quickly show a landscape of possibilities between the horizontal and the vertical. And when I tried to find a textile technique that echoes the concept of 'complexity emerging through horizontal and vertical interactions', weaving immediately came to mind.

Weave bindings and wefts interactions sampled in 1536 wells **is a woven tapestry that contains 48x32 small squares. Each horizontal line is one binding (the interwoven structure between the weft and the warp), and each vertical line contains the same**



Weave bindings and wefts interactions sampled in 1536 wells, weaving process (left), close-up back (right)
photo credit Pei-Ying Lin

set of colour wefts. In the tapestry, the interaction between bindings and wefts became clear and comparable. In some vertical rows, some squares show very different colours, despite being made from the same wefts. And the horizontal line shows how the same binding can bring out different textures when the wefts are different.

Making the tapestry requires detailed control of the weaving process. It was woven by EE Labels (Van Egelen & Evers B.V.), which is a Dutch label company. The machines at EE Labels are designed in a way that can control the weft density per centimetre, making it easier to create size-specific shapes. The looms can load files that specify warp and weft movements that were drawn in red and white pixels: like a binary matrix, the red is 1 and white is 0. To make a 200 cm x 150 cm tapestry with 16 picks (16 weft yarns) per cm requires controlling 11520x25600 pixels, which is 294,912,000 digits of binary code.m These codes control the 1536 different binding-weft combinations, as well as the setting of the background and the fringe. The complexity of it makes it impossible to be drawn manually. Not to mention, the weft density is unknown before weaving the design on the loom. Therefore, to make the tapestry work in the one-day weaving window at EE label requires a flexible way to create the design that allows adjustments on the spot.

In confronting the complexity of retaining the same woven specification (200 cm x 150 cm tapestry with 48 x 32 wells), a Python program was created for this purpose. The program allows loading the binding design for each well accordingly, setting the weft picks individually and automatically, and adjusting the weft density according to the test weaves. The structure of the Python script works similarly to Utkarsha's lab setting: the bindings are like the molecules for tests, and they are being put into a tube (folder) for automatic loading, where the Python code loads these files into the design and sets the molecule to test for interactions (wefts) with the machine's assistance (Python code in setting the weft picks) to mix the fluid.

In the outcome, the tapestry became a landscape of binding and wefts interactions, where the structural and material qualities unfold at once.

Credit
Pei-Ying Lin in collaboration with scientists Utkarsha Pande, Bert Klebl, and Kathrin Klebl (Lead Discovery Center). Special credits to: Eindhoven University of Technology Wearable Senses Lab, Femke Vorselen, Milou Voorwinden, Kristina Andersen, EE Labels, Karolina Tomaszewska.

Materials
Woven tapestry, 200 cm x 150 cm, hanging from ceiling

Year
2026

Scientist's reflection on Weave bindings and wefts interactions sampled in 1536 wells

Utkarsha Pande

"Pei's artwork centered on the craftmanship similarities between an artist and a scientist. I was initially surprised by the concept of her artwork. I couldn't see how textile studies could be related to scientific lab work, considering that all of the materials involved are completely different. But when she began asking me questions about how I structure my lab work, or how I visualize and perceive the effects of combining 'invisible liquid solutions'; I began to think more deeply about my process of learning how to use the reagents, what to expect, and how to design an experiment so that I could achieve my desired outcomes. Through further conversations and Pei's art process, I was able to understand the similarities and envision scientific work as skilled craftmanship.

Pei's artwork from my PhD research was created using intricate weaving patterns and yarns that interact across various horizontal and vertical weaving patterns to create unique art pieces. Her artwork depicted a 1536-well plate, that we use for simultaneous testing of multiple experiments on a single-plate. She adapted this concept and combined it with testing different weave patterns, textures and colors to build her artwork through interactions between horizontal and vertical variables, much like how in a scientific lab we test various conditions based on hypotheses and anticipate the outcomes to match careful predictions. Interestingly, building such an inspiring art piece also involved use of automation, computation and pre-requisite preparation very similar to how we optimize an assay suitable for handling large volumes and robotic automation to be able to test multiple reactions together without much error. Overall, I found the entire process with Pei very inspiring and reflective of the similar ways in which an artist and scientist think in building their artwork. The artist-in residency program, as well as all the artworks displayed at the *In Formation* exhibition, very impressive and insightful."

Artistic reflection on the process

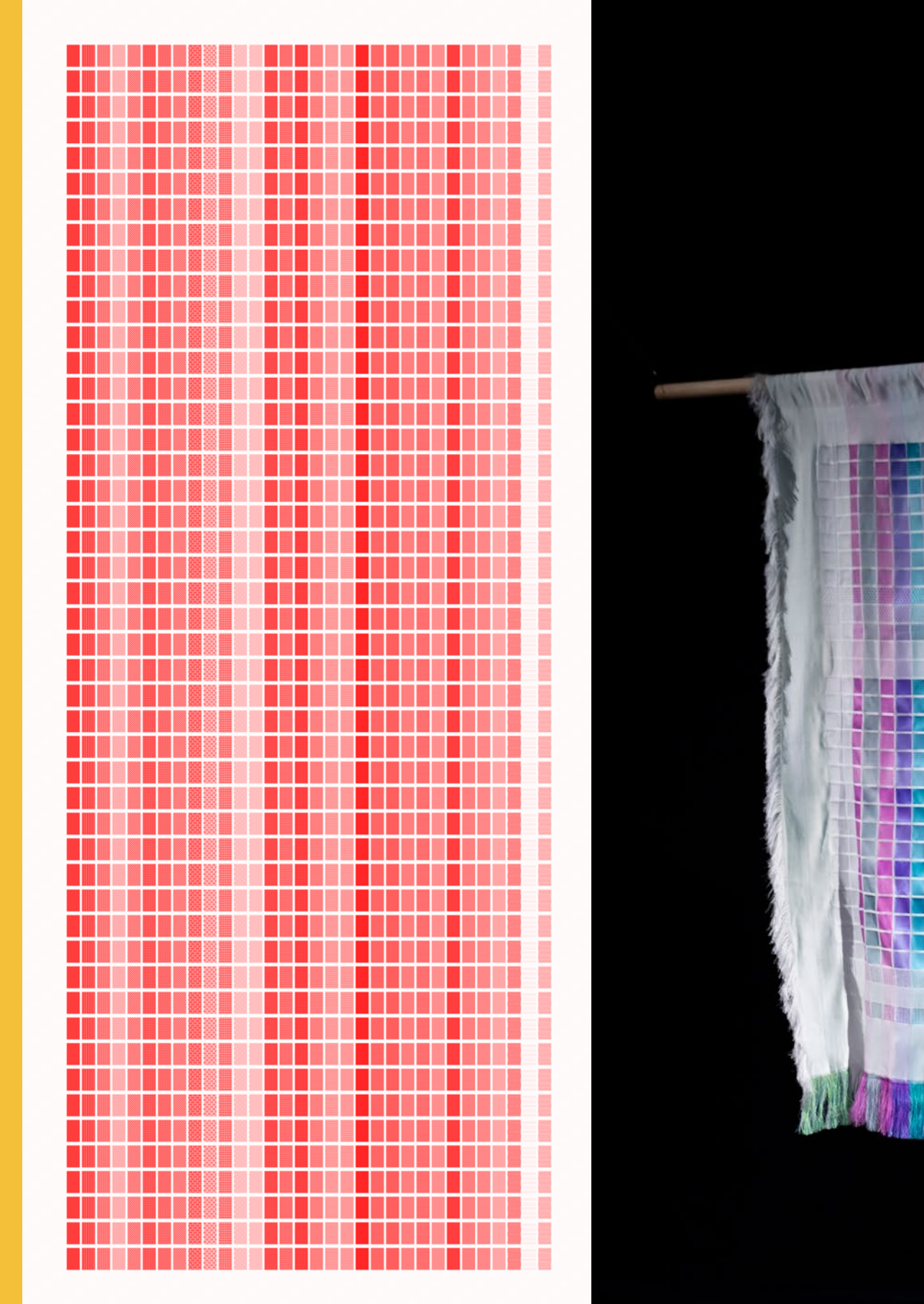
Pei-Ying Lin

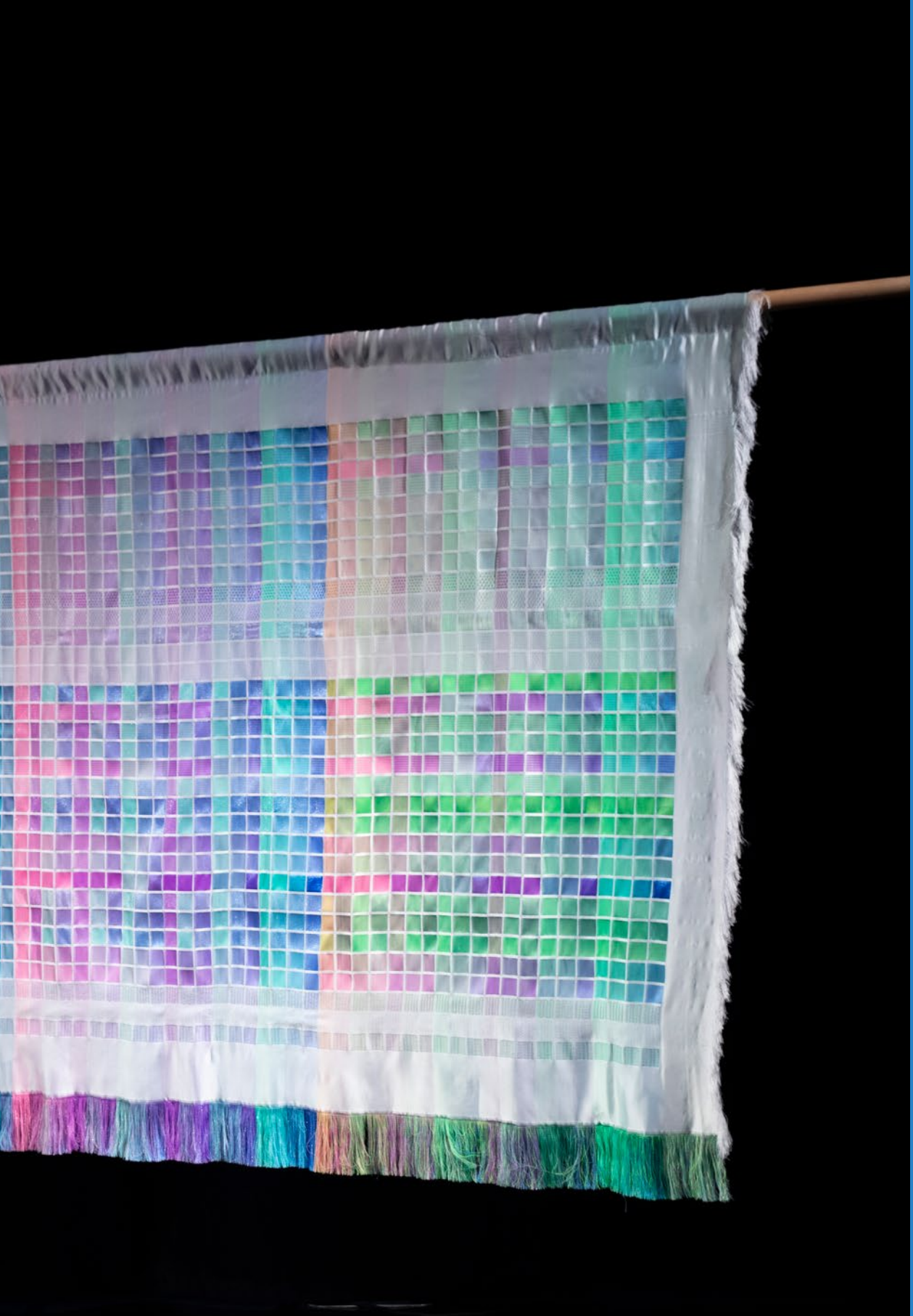
The four textile installations exist as my portrait for each lab, and each of the four textile installations comes with a voice recording. The voice recording is an attempt to capture aspects of dealing with complexity and uncertainty in the lab. It attempts to capture the parts that are not written in scientific papers but are crucial for the thought process that pushes experiments forward from each collaborating scientist's own experience. Things like detailed surprises where the reason is only discovered after years of performing the same procedure: a gel electrophoresis apparatus that performs weirdly sometimes, which produces a quirky Western blot; the Copenhagen tap water that contains too much calcium and induces Xenopus egg apoptosis; a droplet that was pipetted directly into the Eppendorf that 'made the protein unhappy'.

During the whole residency, I was constantly impressed by the working knowledge of the lab, the detail of observation that engages not just the visual but the tacit and embodied. My role as the residency artist was not only to make artistic works, but also to observe as a researcher who looks at the workings in the biolab as actions, movements, and negotiations with the more-than-human matters, where it strongly echoes craft practices. The opportunity to work closely with the scientists as an observer, as an innocent student, and as a parallel creator who adopts the scientist's fuzzy side of working also brings me very new perspectives to my own work. It also brings deeper cultural context and insight into how humans work with otherness.

Weaving process (right)
Weave bindings and wefts interactions design (page 42)
Weave binding and wefts interactions sampled in 1536, front view (pages 42-43)
photo credit Pei-Ying Lin







Curatorial reflection

Claudia Schnugg

The final artwork Pei-Ying Lin developed for the exhibition is a dialogue of four textile works, produced using different textile manufacturing techniques: weaving, knitting, embroidery and dyeing, and a combination of sewing and printing on fabric. Each responds to her lived experience as an artist in residence at one of the laboratories, as well as to her conversations and collaborations with the scientists. Her work revolves closely around the laboratory techniques and experiments that the scientific groups focus on, and the forms of attention embedded in these processes: attention to the science being conducted, to laboratory conditions, materials and techniques, and to the people whose lives may ultimately be affected by the medical treatments being developed. The sound accompanying each textile extends the works beyond their visual and material surfaces, carrying fragments of conversations and the voices of those involved in the research. The peculiarities of life in each laboratory, the experiments that dominate the research, specific research conditions, and intangible elements such as protein structures, techniques used when engaging with a dish, or experiment timelines are transformed into corresponding textiles. As a new media artist with roots in biology, AI in creative practices, and digital textile fabrication, Lin's practice is reflected in the dialogue between these different media.

But let us step back and look at the process between the beginning of 2024 and 2026 that led to this outcome. Starting from her artistic trajectory as a media artist who had begun to make textile works increasingly central to her practice, and from her doctoral research into creative approaches to digital textile fabrication, Lin initially approached the shared theme of the four laboratories: questions of stability and damage repair. Clear parallels soon appeared between stability and damage repair in cell replication and textile manufacturing, such as knitting processes that are able to overcome faulty stitches.

The longer Lin spent in the laboratories and with the scientists, however, the more this direct correspondence gave way to an interest in the practices through which scientific knowledge is produced. Her roots in biology allowed her to build on previous knowledge of laboratory protocols and wet-lab routines, while her attention increasingly focused on the embodied knowledge involved in scientific work: reading gels in Western blot experiments, interpreting visual data, handling frogs to obtain their eggs, or adjusting experiments according to room temperature, humidity and material conditions. These forms of knowledge exist in tension with rigorous protocols, scientific documentation and the abstraction of experimental results.

The protocol provides a framework for an experiment, but it does not contain the entirety of the practice. Around the documented experiment exists a much larger body of situated knowledge: ways of looking, handling, adjusting, recognising and responding that are learned through repeated encounters with materials and situations. A Western blot gel, for example, may be understood as valuable evidence by one research group and unusable by another, depending on what they are looking for and how they evaluate the result. Similarly, working with frogs requires more than following a prescribed procedure: it involves recognising variations, handling another living body and responding to conditions that cannot be fully reduced to written instructions. Scientific objects and procedures therefore become meaningful through situated practices of attention and interpretation.

At the same time, Lin encountered another dimension of scientific practice: care. Rather than something added from the outside, it is

embedded in the ways experiments are conducted, materials and organisms are handled, conditions are maintained and outcomes are interpreted. In the context of medical research, medical centres and hospitals, science also becomes connected to particular bodies, needs and possible futures.

While developing the four textile techniques that would ultimately produce the installation, Lin began to recognise parallels between this embodied scientific knowledge and the knowledge embedded in craft and digital textile fabrication. The same attention to materials, repetition, precision, timing and subtle differences that characterises laboratory practice can also be found in textile making. The same hands that operate instruments or manipulate biological matter are hands capable of weaving, knitting, sewing and making. Craftsmanship therefore does not appear as an opposite to advanced technology, but as another form of accumulated and embodied knowledge through which bodies, materials, tools and technologies are brought into relation. The initial question of how a knitting machine can continue to produce a textile when a stitch has failed, and how this might correspond to a cell replication process responding to an error, remains visible in the knitted textile. Yet rather than building the overall work around this first connection, Lin allowed it to become one layer within a deeper investigation.

This movement between forms of knowledge is central to Lin's practice. A still image, an animation, a scientific graph, a laboratory gesture, a sound recording and a textile each make certain aspects of a process perceptible while leaving others outside their frame. A scientific paper can document a method and its results, but cannot fully convey the gestures, adjustments and observations through which an experiment was carried out. A textile cannot reproduce a laboratory process, but it can make other aspects tangible: repetition, duration, structure, material resistance, rhythm or transformation. This becomes visible in her practice: the integration of these insights and processes into her artistic practice, her academic work, and a multitude of collaborations.

Lin does not attempt to resolve these differences between media. The sound accompanying each textile retains something of the conversations through which the works developed: voices, fragments of discussion, hesitations and different perspectives. The textiles approach the same encounters differently, transforming structures, processes, rhythms and observations into another material language. Neither medium simply explains the other. Together, they allow the viewer to approach the research through different forms of perception and understanding. The work therefore moves away from a direct translation of scientific concepts into artistic form. What develops through the residency is an attention to the conditions under which knowledge is produced: the protocols and deviations from them, visible results and the tacit knowledge required to read them, technologies and the human hands operating them, scientific objects and the practices through which they become meaningful.

In this sense, Lin's textiles do not attempt to make laboratory knowledge transparent. Instead, they draw attention to knowledge that normally remains in the background of scientific production. They give material form to practices that are repetitive, situated and embodied, while the soundscapes retain voices and encounters that cannot be contained by the textile alone. The four works create not a synthesis of art and science, but a space in which different forms of knowing remain distinct while entering into relation with one another.

Pei-Ying Lin

Pei-Ying Lin, born in 1986, is an artist/designer from Taiwan and is currently based in Eindhoven, the Netherlands. Apart from her practice, she is also a PhD Candidate researching human-AI-material collaboration in the Department of Industrial Engineering and Innovation Science and the Department of Industrial Design at the Eindhoven University of Technology. She also holds an MA in Design Interactions from the Royal College of Art, UK. For her bachelor's, she has a BSc in Life Sciences with a double minor in Humanities & Social Sciences and Computer Science from National Tsing Hua University, Taiwan. Her main focus is on the synthesis of science and human society through artistic methods that range from visual arts, performance, fiction, cooking, and crafts, where she also engages with Bio dry lab and wet lab practices. For which, she builds common discussion grounds for different cultural perspectives that construct our individual perception of the world. She plays with the boundary of invisible/visible, living/non-living and finding ways to build tools and methods that facilitate such explorations.

She has won the Honorary Mention of STARTS Prize 2020, Honorary Mention in Hybrid Arts Category of Ars Electronica 2015, Professional Runner Up in Speculative Concepts of Core 77 Awards 2015, and BioArt and Design Award 2016. Her project PSX Consultancy is a permanent collection of the Museum of Architecture and Design, Slovenia. And she is currently a MIT Open Documentary Lab Fellow 2025-2026, and a Artist in Residence with the RepliFate network.

Julien Duxin
Prof Dr Julien Duxin leads a research group at University of Copenhagen. The Duxin research group focuses in understanding basic mechanisms of genome maintenance using Xenopus egg extracts as a model system. Particularly, we study how DNA lesions induced by chemotherapeutic agents are repaired. This has led to the first system that recapitulates DNA-protein crosslink (DPCs) repair in vitro (Duxin et al. Cell, 2014). This initial discovery opened an entire new area of investigation, highly relevant to human health as DPC-inducers are commonly used in the clinic to treat cancer. Our lab is now investigating how DPC-repair is intrinsically linked to DNA replication and interrogating which are the main players orchestrating the repair reaction (Larsen et al. Molecular Cell, 2018). The ultimate goal is to unravel new molecular mechanisms of DNA repair and identify novel chemotherapeutic targets that could be used in the clinic to sensitize patients to commonly used anti-cancer drugs.

Kaustav Majumder
Kaustav Majumder is PhD student at the Netherlands Cancer Institute in the laboratory of Prof Dr Titia Sixma. His doctoral research within the RepliFate doctoral network focuses on the regulation of DNA replication by PTMs during cell fate decisions. To unravel the mechanistic insights to such regulation, he uses quantitative biochemistry and structural biology approaches.

Sylvie Noordermeer
Prof Dr Sylvie Noordermeer is Associate Professor at Leiden University Medical Center. In 2019, Sylvie started an independent research group at the Department of Human Genetics at the Leiden University Medical Center. Sylvie Noordermeer obtained her PhD in 2012 at the Radboud University Medical Center in Nijmegen. Her PhD research focussed on the process of ubiquitylation in acute myeloid leukemia (AML). A key finding during her PhD research was that overexpression of BRE – a protein interacting with BRCA1 –has prognostic value in AML and breast cancer. Funded by fellowships by the Canadian Terry Fox foundation and the Dutch Cancer Foundation (KWF), Sylvie continued her career as a postdoctoral fellow in the laboratory of Daniel Durocher in Toronto, Canada (2012-2016) and in the group of Haico van Attikum at the Leiden University Medical Center (2017-2018). During her postdoc, she worked on the molecular determinants of DNA double strand break repair. Key findings included the USP11-mediated regulation of homologous recombination during the cell cycle and the discovery of the Shieldin complex as an active inhibitor of resection during DNA double strand break repair.

Utkarsha Pande
Utkarsha Pande is PhD student at Lead Discovery Center working with Dr Bert Klebl, Dr Anne-Kathrin Klebl and Dr Jan Eickhoff. Her doctoral research focuses on the discovery of small molecule modulators of human PLK1-Interacting Checkpoint Helicase PICH1 and Ubiquitin-E3_LigaseTRIP12.

Hồ Mỹ Phúc Võ
Hồ Mỹ Phúc Võ is PhD student at Oncode Institute at the Leiden University Medical Center in the group of Prof Dr Sylvie Noordermeer. In her doctoral research within the RepliFate doctoral network she is exploring the genetic space of replication proteins.

Marta Oliva Santiago
Marta Oliva Santiago is PhD fellow at Copenhagen University Biotech Research & Innovation Center in the group of Prof Dr Julien Duxin. Her doctoral research within the RepliFate doctoral network focuses on the identification of novel ubiquitin/SUMO ligases involved in the DNA damage response/replication stress.

Claudia Schnugg
Dr. Claudia Schnugg is an Austrian curator and artscience scholar exploring the intersections of art, science, and technology. Founding curator of the Universe Pavilion in Venice, she develops international exhibitions, residencies, and research initiatives. She is the author of Creating ArtScience Collaborations (Springer, 2019).

Titia Sixma
Prof Dr Titia Sixma leads the Structural biology group at Netherlands Cancer Institute. The group uses a combination of structural biology, biophysics and biochemistry to quantitatively analyze molecular mechanisms in cells. Our lab is interested in DNA regulation by ubiquitin and DNA mismatch repair. Crystal structures from the lab provided the first structural insight in ligand binding for pentameric ion channels such as the nicotinic receptors, and insight in the initiation of DNA mismatch repair. Titia Sixma received her PhD in Groningen with Wim Hol and did her post-doc with Paul Sigler at Yale. She is group leader at the Netherlands Cancer Institute and 'bijzonder hoogleraar' at ErasmusMC (affiliated Professor). She is member of EMBO (2004), Academia Europaea (2008) and the Netherlands Academy KNAW. She received the NVBMB prize, an ERC advanced grant, several TOP research grants and is a member of the Oncode Institute.

Additional PIs working with Pei-Ying Lin and the PhD students were Anne-Kathrin Klebl and Bert Klebl.

Solveig Lill

Cell Lines

A RepliFate residency



IN FORMATION

The series of drawings has grown throughout the two and a half years I've spent participating in the *RepliFate* program. The images are derived from observations of different cell cultures and associated microscopic imaging during my visits to laboratories, as well as from numerous conversations with fellows across the *Replifate* network. Some of the works contain direct references to specific visual or verbal sources, but for the most part they form a synthesis of the many influences and materials I encountered during this highly enriching period. In the process of creating, I have allowed myself to let go of strict adherence to factual accuracy in interpreting what I have seen and heard, leaving space for something new to emerge through the act of translation itself.

A close-up view of the everyday work of scientists has made me keenly aware of the many similarities our professions share. Both are engaged in a continuous search for connections yet to be made, reaching towards territories still to be discovered.



Cell Lines





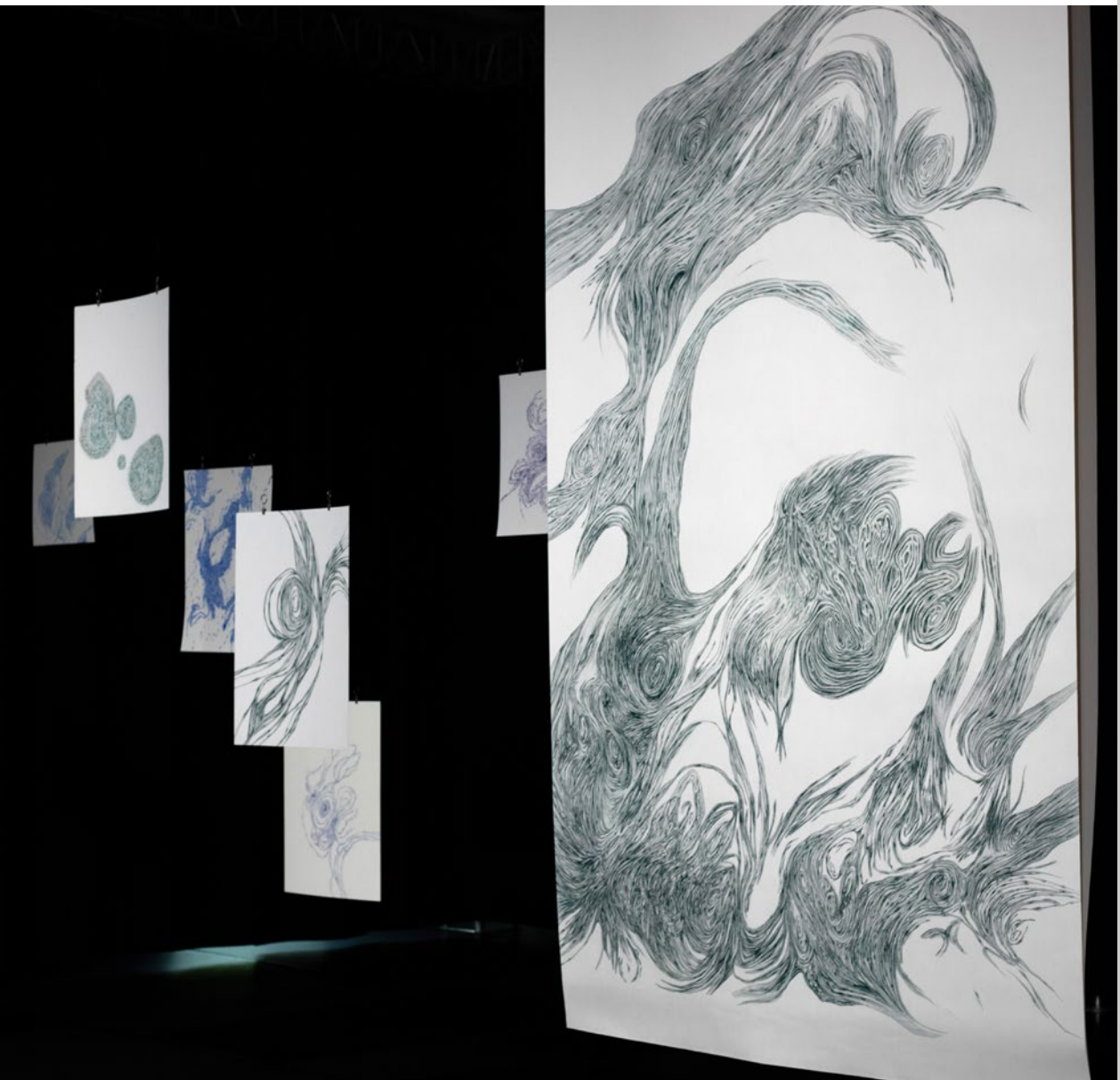
Artist
Solveig Lill
Collaboration with CSIC CABIMER Elena Pietrini and Prof Dr Andres J. Lopez, CNRS and University of Montpellier Silpa Mary Johnson and Prof Dr Philippe Pasero, University of Zurich Virginia Pasti and Prof Dr Matthias Altmeyer, University of Zurich Institute of Molecular Cancer Research Julius Thomas and Prof Dr Lorenza Penengo

Materials
Coloured pencil and graphite on paper

Year
2024-2026

Cell Lines, installation view, Muffatwerk
photo credit Solveig Lill (top), photo credit Pei-Ying Lin (right, and pages 48 - 49)

The installation shows a series of coloured pencil drawings on paper representing the development of the artist's use of this material in the process of engaging with the scientists. A selection of 29 drawings on paper of the sizes between 21x29.5cm, 24x32cm, 30x40cm, 40x39.5cm, 50x65cm, 50x64.8cm and one work with 65x50cm are clustered in two groups left and right of a center piece, of 350x150cm, closed as loop in the bottom. Starting from the fascination in cells and microscope imaging of cells, throughout her residency Lill developed the series of drawings developed from artistic interpretations of narrative descriptions of specific cell processes such processes leading to malignant cells, to the inside and outside view of individual cells based on conversations and meditations with the scientists, to the growth of cell cultures combining artistic imagination, microscope imaging and the use of the artistic medium to create lifelike cell lines.



On the process

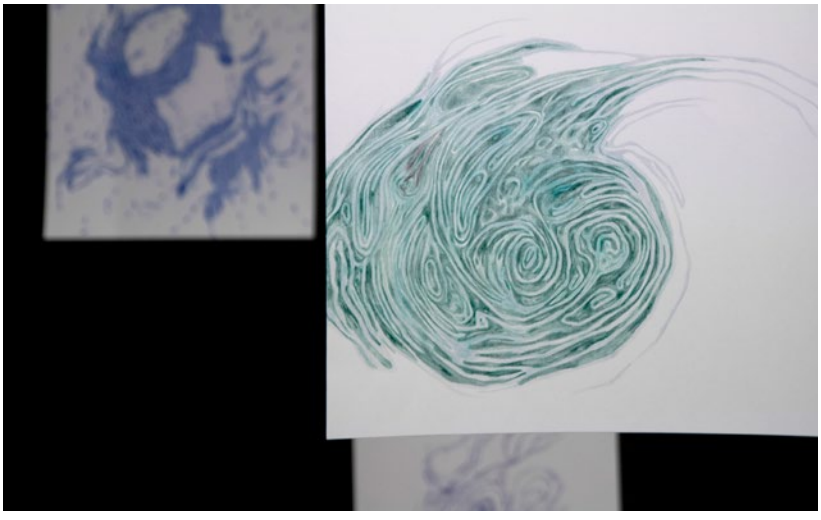
Solveig Lill

As part of the *Replifate* project, I visited a total of four laboratories: the CNRS (National Centre for Scientific Research) in Montpellier; the Department of Molecular Mechanisms of Disease and the Institute of Molecular Cancer Research in Zurich; and the CABIMER Institute in Seville (Andalusian Centre for Molecular Biology and Regenerative Medicine).

During each trip, I spent one working week closely observing the scientists' work and, under their guidance, had the opportunity to try out various technologies and techniques they use in their research. It was extremely eye-opening to gain such close insight into the facilities of advanced scientific laboratories and the way research is organised and conducted there.

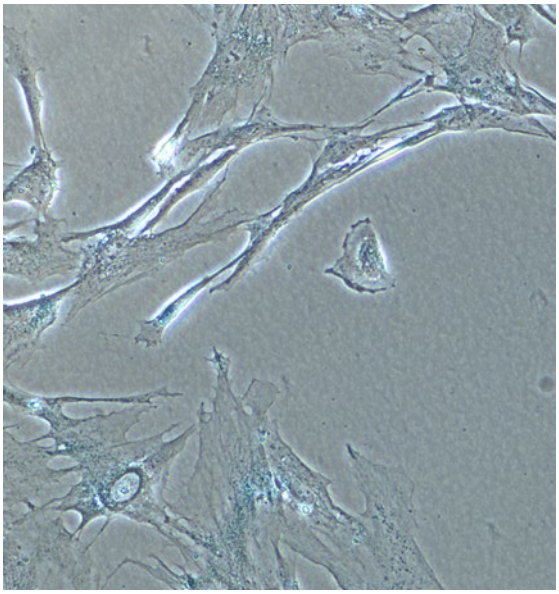
Throughout the residency, we also remained in close contact with the scientists remotely. They regularly updated me on the progress of their research and sent me visual documentation of their experiments. The constantly evolving visual and written materials they shared with me, together with our conversations, served as the basis for my artistic explorations and experiments throughout the project. In turn, I sent them documentation of the different stages of my own work, and during our online meetings we discussed the progress of both my project and theirs.

Besides all the exciting things I learned about their research, it was very interesting to hear their feedback to my artworks, since they approached them from a very different background and perspective. Oftentimes it was quite surreal to hear how they connected certain elements they saw in my drawings to things they had previously encountered in the lab, even though I had not had these specific connections in mind, nor was I aware of them, while creating the work. Such coincidences occurred more than a few times.



Cell Lines, installation close-up
photo credit Pei-Ying Lin





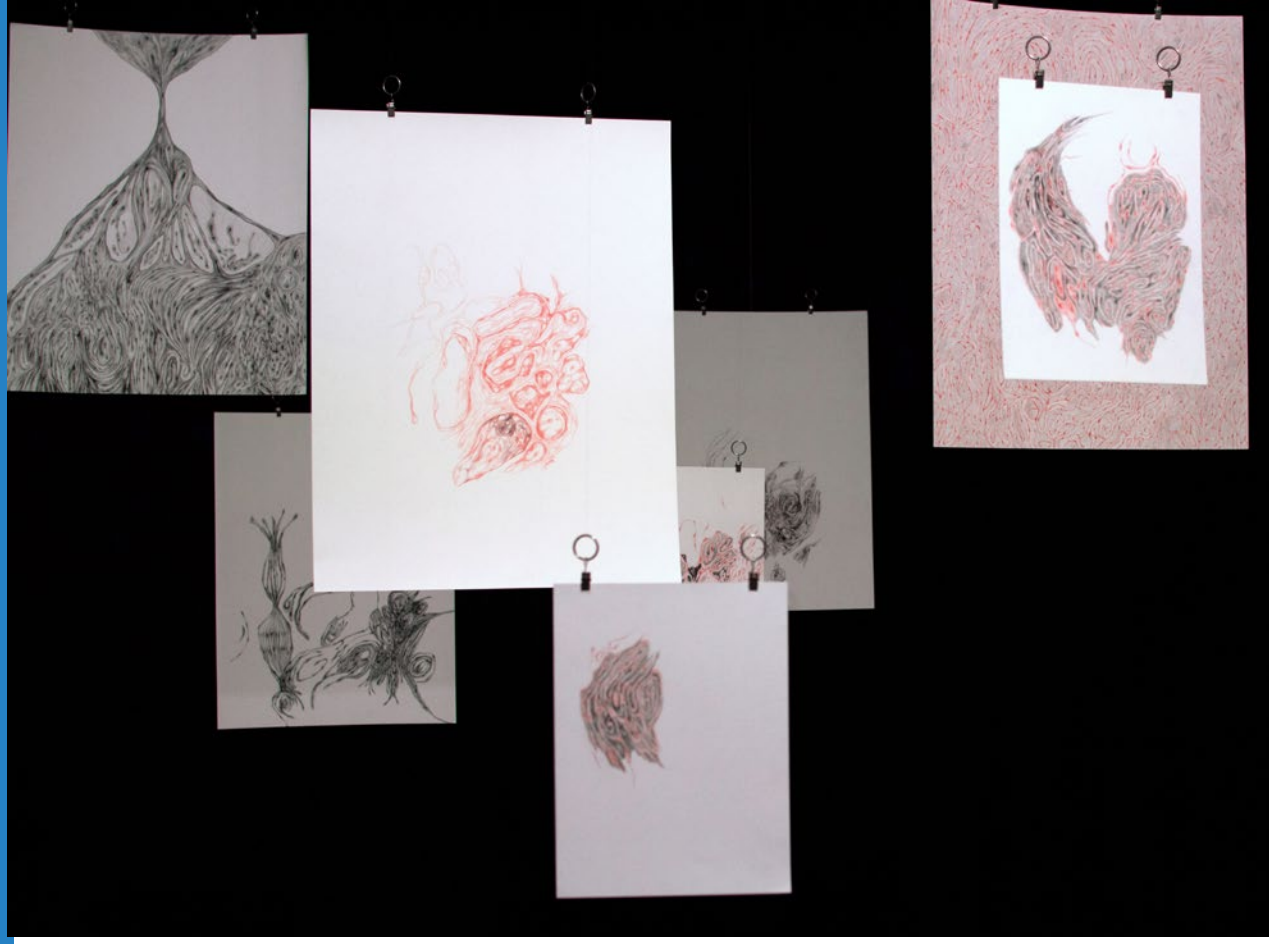
Elena Pietrini working with Solveig Lill in the laboratory in Sevilla (left), cells observed under the microscope in the laboratory in Montpellier
photo credit Solveig Lill

During some of my lab visits, I also conducted a small drawing workshop for the scientists. I asked them to imagine themselves as a cellular form and draw what they imagined they would look like as such. It was an absolute pleasure to see how much focus and devotion they put into the task, and how excited they were about their results.

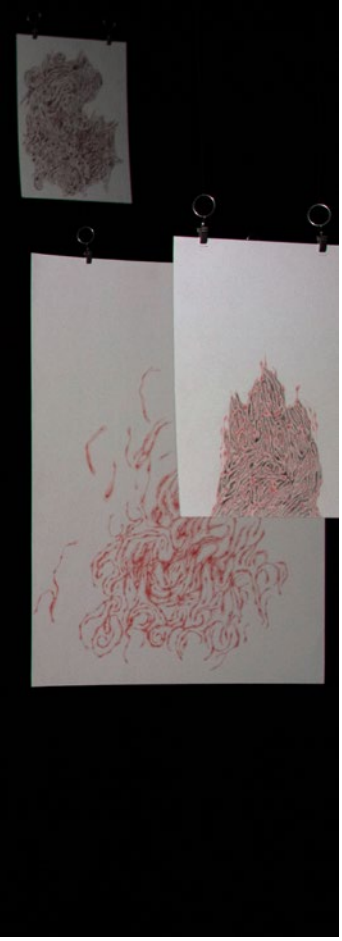
Throughout my visits, one of the things I noticed most often was how many fundamental similarities our professions share. Both as an artist and as a scientist, you are on an ongoing search for new angles from which to look at things, new ways of seeing and thinking about ourselves and the world around us. The hands-on aspect of our work, altering and working with different kinds of materials, can also be seen as a form of shared craftsmanship, even though the ultimate goals are different. The constant sense of curiosity that surrounded me in the science labs was infectious in the best possible way. This is why I believe that collaborations between our fields can be beneficial not only through the direct exchange of knowledge and perspectives, but also because they can offer a fresh way of approaching one's own field of research more broadly.

Throughout the residency, we also had regular meetings with the programme curator Claudia Schnugg. Her constructive feedback, support and encouragement were, and will remain, immensely valuable to me. Her dedication and ability to understand where my work was heading, sometimes even before I could see it myself, as well as all of her thoughtful and helpful comments, were truly an irreplaceable part of bringing the project together.

I am immensely grateful to her and to all the fellows and PIs who so generously shared their time and knowledge with me. Their warmth and curiosity towards my artistic practice was deeply touching to experience. I couldn't be happier to have been part of this programme.











Cell Lines, installation views and close-ups
photo credit Solveig Lill (top left, bottom)
photo credit Pei-Ying Lin (top right)

Meditations

As a large part of my work process relies on imagination, I was very interested to get to know how the scientists themselves imagine the cell to look and feel like from the inside. I was eager to hear about their perception of these environments not only from a scientific perspective but also from the imagery that their own minds generate. As a molecular biologist one spends such an enormous piece of time "inside" this physically inaccessible space, so I figured it's unlikely to not have some sort of imagined visual perception around it. It turned out I was not wrong.

I conducted a small session with each of the fellows individually, where I let them dive inside the cell, describing to me all the visuals surfacing in their heads. The following texts are constructed based on the detailed notes I made during each of the sessions. To guard the personal nature of the scientists opening up in this way, the texts are left anonymous.

1. Inside the cell there is overcrowded chaos all around. The membrane of the nucleus looks green and is like transparent foil, there are little pores in the membrane, like ventils, and a constant flow of particles moving through them. Around me, there are mRNA strings and proteins floating around, also many tiny dots that are sugar, amino acids etc. The proteins are red and blue. Some proteins are large like a truck you'd see standing on the side of the road and some are small like a dog compared to my body. When I press my body through the membrane of the nucleus, it feels fatty, cold and slimy. The blue of the DNA is not there anymore, but there are scaffolds of cytoskeletons. There are proteins floating all around me. I can see the endoplasmic reticulum and it looks like a fungus. There is also the golgi complex that is big and gray and looks like a coral. Inside the cytoplasm it is very dimly lit and the light around me is brownish, evenly distributed. I see several mitochondria around me, they look like maggots that are moving slowly and they are light blue. When I turn around and look back at the nucleus, it is a greenish bubble where you can see streams of blue light coming through, these are generated by the DNA. When I go towards the nucleus membrane, there are lots of surface proteins moving on it and they are also bluish. There are many pores on the surface of the membrane.

2. The inside of the nucleus has a black background, but you don't see a lot of it because there is so much movement in front. It's like a roller coaster, things move around very fast, you see the DNA wrapped around proteins, the proteins opening and closing, it's like a factory. Busy, colourful, fast and wet. If you move towards the membrane of the nucleus, it's bubbly, having many proteins attached to it. It's almost like looking at a forest from the top side. If you look well, you can find the holes inside it. The membrane looks brownish. When I squeeze myself through it, it's very tight. Inside the cytoplasm it doesn't look like a roller coaster because there is no DNA there. It's very big and the proteins are moving like little ants everywhere. Each protein has a different color. The nucleus, when looking from afar, is dark and kind of rounded, it's bubbly. The membrane of the cell is beige, it has a light coming through.

3. The nucleus doesn't have an exact shape in my head, but it has tiny pores where DNA escapes through. The DNA strains are white. They could also be transparent but I imagine them to be white. Everything else around me has a light pink color. The membrane has an uneven, curvy shape. It's something between dark pink and maroon. There is water around me or actually it's something thicker than water. The DNA around me is very small, compared to the proteins that are small too. The DNA is coming from different directions and moving around me. It's moving very slowly. I float outside the nucleus through a pore, sitting on a DNA fiber. Now I'm in the cytosol. I'm not cold, I'm not warm, I don't feel anything specific. It's a neutral feeling. The overall color around me is still pink. The proteins are gathering around the DNA, trying to capture it. They are very colorful, like in the scientific illustrations of proteins. The proteins are coming together, wrapping themselves around the DNA, trying to break it. Now I lost my DNA, I'm sitting on one of the proteins. The nucleus behind my back is standing still, everything else inside and around is moving. The proteins around me signal other proteins to come together. All the proteins around me are very active, like they are waving flags. I don't exactly know what they are doing, it's very vague to me. There is the endoplasmic reticulum everywhere around me, there are so many things happening around. Also I see the RNA changing into proteins in the process of RNA translation. There are many ribosomes, a chain of DNA and ribosomes. I am big compared to the DNA that is floating around. The proteins are bigger than the DNA but still smaller than me.

4. The membrane, when looking from inside the nucleus, is yellowish. I imagine the movie Inside out, where there is a command centre. The nucleus is like that command centre with little people working inside and performing tasks. It is a safe and pleasant place, a warm environment, it feels like you are in a womb. There is diffused light coming through thick curtains. In the membrane there are no holes but there are cracks, like in the desert where there is very dry ground with cracks. But these cracks are softer. When I press myself through a crack, it feels squished around me, it is squishing me from the sides. Outside, in the cytoplasm it is cooler and the color is not yellow anymore, it is white. Like white LEDs shining. And the environment feels sterile. I see the golgi complex, it looks like a huge maze. It stands tall in front of me, a tall green wall. When I touch it with my hand it is rough, but textured. When I look around me again, there are balls in different colours all around me, mostly big yellow balls. I see a protein, it is lilac in colour, but it doesn't have an exact shape, it is like a blob of colour. Like an oil spill, it is moving, changing shape. It looks similar to if it were moving on water. I sense there is liquid around me but I don't see it, I just see how the different objects that float around are responding to the liquid moving. When I look back at the nucleus from inside the cytoplasm, it stands tall above me, above all things like watching and overseeing everything. And when I approach the membrane of the cell, it is far away but it has an orangy tone, darker than the nucleus. I also see a mitochondria floating, it is big and red and looks like a forest but instead of trees there are what look like little fingers in different shapes and sizes. It is very smooth, it looks like the corals in *Finding Nemo*. When I touch it, it feels like dolphin skin.

Exploration of artistic media

Throughout my residency, I explored and experimented with many different techniques and media. I started off with pencil drawings, while simultaneously diving into the technical possibilities of water marbling. Water marbling is a technique that through some non-traditional methods and approaches (that I discovered through trial and error) allows one to produce images with a strong resemblance to the visuals you could find looking through a microscope. From these two techniques I moved on to oil painting for a while, creating a series of five paintings. Although accompanied by the overpowering smell of turpentine, this switch of media was a breeze of fresh air to me. That is something I have come to realize many times before – if you want your creative work to maintain a certain kind of freshness, it is highly effective to regularly switch between media and formats, if possible. As the material limits of every technique require a different approach, the change of techniques comes with an unavoidable change of perspective towards the subject itself. For a brief moment in my residency I also experimented with some linocut printmaking and blind embossing, but returned to my initial practice of pencil drawings and stayed on that path through the greater part of the residency period.

My working process usually doesn't contain any initial sketching or much planning ahead. Throughout the residency I usually began a new work with some rough framework of an idea or a leading impulse, such as a reference image or a specific description by a scientist, but I never fully knew where it would lead me during the process. I like to think about the growth of my artworks to be similar to the growth of organic material, of a cell forming into tissue, for example. I let the work itself guide me the way, every step leading to the next one organically.

Water marbling studies
photo credit Solveig Lill







Oil paintings
photo credit Solveig Lill





Scientists' reflections on the collaboration with Solveig Lill

Silpa-Mary Johnson

Explaining cell biology to a non-scientist usually means trying to translate complex mechanisms into plain language. But watching Solveig turn those ideas into art went way beyond translation. Seeing my work on DNA replication stress reflected through her creative lens showed me that science isn't confined to a lab. It has a real visual energy that anyone can connect with. Working with Solveig during the RepliFate residency was a great reminder of how deeply science and art overlap. As a biologist, I spend my days trying to map out the precise mechanisms inside cells, even though there's an underlying chaos to how they actually work. Watching Solveig interpret that cellular chaos through her own creative lens was fascinating. She didn't need lab equipment to get the rhythm of what's happening at the cellular level; she captured the energy and complexity of it in a way that data on a screen just can't.

Virginia Pasti

I really enjoyed this collaboration, as a scientist I struggle to see the beauty in what I do and I tend to over-rationalize it. Through our conversations I was able to look at science in a different way, and we were able to draw parallels between two worlds that seem so far apart. In the end the beauty of both science and art lies in making visible and trying to explain something that we cannot see. I gained a lot from this experience and it is mostly thanks to you and your ability to make me see things from a different perspective.

Julius Thomas

As scientists we are often trapped in our own bubble, talking about highly specific matters that hardly anybody from outside understands. The exchange with an artist, a profession that is in some ways the very opposite of a scientist, was a very valuable lesson as it presented a new way of thinking to me. Having to explain things in more simple terms, being forced to think outside the box and then seeing the result as beautiful, thoughtful pieces of art is an experience that I can recommend to everyone!

Curatorial reflection

Claudia Schnugg

As a fine artist working primarily with drawing and painting, Solveig Lill has been fascinated by the world of cells for many years. During the residency, she approached the cellular world through a process of listening, describing, imagining, translating, and making. Her first step was to ask the scientists to describe, in their own words, what they observed in their experiments and microscopy, what they noticed in the cells and processes they were researching, and which details had caught their attention. These short, often very precise but personal descriptions became the initial material for her artistic research. The scientists would often add scientific information and explanations to contextualise what they had described, but it was the act of describing itself that remained important to Lill: the attempt to put into words something that is observed at a scale largely inaccessible to direct human perception.

This first process was later extended through meditation sessions with the scientists. Lill invited them to step outside their usual scientific modes of observation and to imagine themselves inside the cell or nucleus they were studying. What would the environment look like? What would it feel like? What would be moving around them? What colours and structures would they encounter? The scientists were asked to temporarily move beyond the established scientific image and to describe the cellular environment through subjective experience and imagination. Their responses, sometimes fragmented and highly personal, became another layer of material for Lill's drawings.

The shift from description to imagination opened another perspective on how scientific knowledge is formed. The scientists' descriptions were informed by their expertise, but also by the images they had encountered throughout their education and research. Textbook illustrations, microscopy images, diagrams, animations, and computational models all contribute to a visual vocabulary through which cells are imagined. During the meditation sessions, several scientists became aware of referring to familiar textbook colours when describing organelles, recognising how deeply these visual conventions had entered their own ways of thinking about the cellular world. This awareness points to a larger question at the heart of Lill's practice. Images do not simply communicate scientific knowledge after it has been produced. They also participate in shaping the questions scientists ask, the structures they expect to find, and the ways they interpret what they see. Scientific knowledge informs imagination, while imagination in turn participates in the production and interpretation of knowledge. Lill's process makes this feedback loop visible by moving between observation, description, scientific representation, subjective imagination, and artistic image.

Her own position within this process is deliberately different. Lill began making some of the works before immersing herself deeply in the laboratory, working from the scientists' descriptions and from her own imagination rather than from direct visual references. This created a space in which she could respond to the cellular world without beginning from the established imagery of biological research. Yet some of her drawings later appeared remarkably close to images produced through microscopy. The encounter raises a subtle question: where does scientific knowledge end and imagination begin, and how much of what we recognise as scientific reality is already shaped by the ways we have learned to picture it?

Lill's artistic process is also deeply material. She experimented with

coloured pencil, dry pastel, pastel powder, ink, water, oil, paper, canvas, and marbling techniques, allowing the material behaviour of each medium to become part of the investigation. Her early drawings (unaware or unconsciously aware) recall the hand drawn images produced by scientists working with microscopes before photography and digital imaging became available, which is an aspect first observed by some heads of laboratories who pointed this historical imagery later out to her. Her experiments with ink droplets unexpectedly resonated with laboratory procedures and cellular structures described by the scientists. Oil painting allowed her to introduce depth and a sense of three dimensionality, creating layers that seem almost to move beneath the visible surface. Movement became another recurring element in the conversations between Lill and the scientists. When describing their work, they repeatedly spoke about cells as vivid, dynamic entities, constantly moving and changing. Lill responded through fluid lines, translucent surfaces, and layers that resist complete stillness. The works suggest cells not as fixed forms, but as environments in which structures emerge, overlap, transform, and remain in relation to one another.

The resulting works move between scientific reference and artistic invention. They are not illustrations of cells, nor attempts to reproduce scientific images. Instead, they inhabit the space between verbal description, memory, scientific representation, and imagination. Their visual language emerges through conversations and encounters rather than through direct observation alone, bringing the subjective and phenomenological dimensions of scientific practice into view.

The title *Cell Lines* captures this layered relationship. On one level, the lines of the coloured pencil drawings reimagine cells through a continuous and often fluid gesture. On another, they refer directly to the cell lines cultivated and studied by the scientists in the laboratory. At the same time, Lill's cell lines enter into a much longer history of artistic and scientific attempts to picture the microscopic world. They recall early microscopy drawings, the colours and forms of textbook models, and the visual conventions through which cells have become familiar to us. The title therefore brings together biological material, artistic gesture, and the history of representing the unseen.

Layering becomes both a formal and conceptual principle in Lill's work. It reflects the experience of looking through a microscope, moving between different scales and levels of focus, but also the layers through which knowledge is formed: observation, description, memory, scientific models, imagination, and artistic interpretation. The installation draws on this movement between scales, inviting the viewer to zoom in and out, to look through and beyond individual works, and to experience the cellular world as something that is never fully contained within a single image.

In Lill's work, imagination is therefore not opposed to scientific knowledge. It is one of the conditions through which knowledge becomes visible. By inviting scientists first to describe what they observe and later to imagine themselves inside the cells they study, and by translating these words and impressions into material forms, Lill makes visible a dimension of scientific practice that usually remains implicit. Her works open a space in which observation and imagination, scientific image and artistic image, knowledge and speculation become porous, allowing the invisible world of the cell to remain as vivid, complex, and constantly moving as the processes it contains.

BIOS

Solveig Lill

Solveig Lill (1994) is an Estonian artist whose practice explores the microscopic scale of life through various visual media. Lill obtained a bachelor's degree in the department of painting from the University of Tartu and a master's degree in contemporary art at the Estonian Academy of Arts (2020). During her studies, she also attended the Berlin University of Arts as an exchange student. In recent years, working primarily with drawing and oil painting, Lill explores the microscale, highlighting the essential role of this strange yet physically closest layer of nature in shaping our existence. Lill has participated in numerous group shows in Estonia and abroad and has presented several solo shows.

Silpa Mary Johnson
Silpa Mary Johnson is a doctoral research student at the Institute of Human Genetics at the CNRS - University of Montpellier. In her doctoral research she is working in the lab of Prof Dr Philippe Pasero as part of the RepliFate doctoral network on characterization of immunogenic cytosolic DNA species induced by DNA replication stress (RS). She holds a Master from the Indian Institute of Science Education and Research, Thiruvananthapuram.

Virginia Pasti
Virginia Pasti is PhD student at University of Zurich in the laboratory of Prof Dr Matthias Altmeyer in the Department of Molecular Mechanisms of Disease. Her doctoral research in molecular biology on PTM regulation of replication stress responses with implications for ALT and PARPi sensitivity is part of the RepliFate doctoral network. She holds a Master in pharmaceutical biotechnology from the University of Bologna, Italy.

Elena Pietrini
Elena Pietrini is PhD student at CSIC CABIMER in the laboratory of Prof Dr Andres J. Lopez. Her doctoral research studies within the RepliFate doctoral network focus on Replication estress and genome instability in human cancer.

Claudia Schnugg
Dr. Claudia Schnugg is an Austrian curator and artscience scholar exploring the intersections of art, science, and technology. Founding curator of the Universe Pavilion in Venice, she develops international exhibitions, residencies, and research initiatives. She is the author of Creating ArtScience Collaborations (Springer, 2019).

Julius Thomas
Julius Thomas is PhD student at the Institute of Molecular Cancer research at the University of Zurich in the laboratory of Prof Dr Lorenza Penengo. He holds a master's degree in biochemistry. His doctoral research within the RepliFate doctoral network investigates the role of ISG15 in the viability of cancer cells.

The four RepliFate PIs working with the PhD students and also welcoming Solveig Lill in their laboratories were Prof Dr Matthias Altmeyer, Prof Dr Andres J. Lopez, Prof Dr Philippe Pasero, and Prof Dr Lorenza Penengo.

Helen Pynor

A RepliFate residency

IN FORMATION



Installation view, RepliFate works by Helen Pynor, Muffatwerk
photo credit Helen Pynor

The molecular processes taking place during DNA replication unfold at flickering speed, with a dynamism and complexity beyond human perception and almost beyond human imagination. The movement of hundreds of complex molecular species is an intricate, mysterious, beautiful choreography, played out slightly differently each time a stand of DNA replicates, in which dancers in perpetual motion touch, interlock and glide around each other, to a score that is both scripted and improvisatory, the entity as a whole being primed to compensate seamlessly at any moment for more extreme deviations from the score.

I'm interested in the uncertainty borne of this unfathomable complexity, its stochasticity, in tension with the seemingly contradictory quest for scientific certainty. In some of the artworks in this series I have used 'blur' as a visual language to refer to the uncertainties that hover at the edges of scientific findings. Other works aim to convey the sense of mystery and awe I see in life's inventions, or how questions of scale within the cell confound our human perception.

In all works I have endeavoured to use extracts generated through my collaborating PhD Fellows' research as source material for my works, not to present as scientific data but to express this beautiful uncertainty, and the wonder and reverence I feel for the exquisite entities the Fellows are studying in such intricate levels of detail.

I am also interested in the performative nature of the scientific assays the Fellows have undertaken in their research. The skill required to perform many of these assays requires a high level of craftsmanship and embodied knowledge, accumulated through time and practice. These actions cannot be adequately 'taught' in a scientific paper but must be developed through apprenticeship and slow, incremental self-mastery, with 'failure' being an unavoidable

aspect of the process which occasionally can, with careful attention and openness, provide opportunities for unexpected insights and productive deviations.

The artworks represent collaborations with the Institute of Epigenetics and Stem Cells, Helmholtz Munich: Yicong Chen and Maria-Elena Torres-Padilla, Cell Cycle Laboratory, University of Patras: Alexander Haider and Zoi Lygerou, Functional Organisation of the Genome Group, Centro de Biología Molecular Severo Ochoa (CBM), CSIC-UAM and DNA Replication Group, Spanish National Cancer Research Centre (CNIO): Ran Tong, María Gómez, Joana Segura Martínez and Juan Méndez, Chromatin, Cancer and the Ubiquitin System Lab, Centro de Biología Molecular Severo Ochoa (CBM), CSIC-UAM: Scott Churcher and Emilio Lecona.







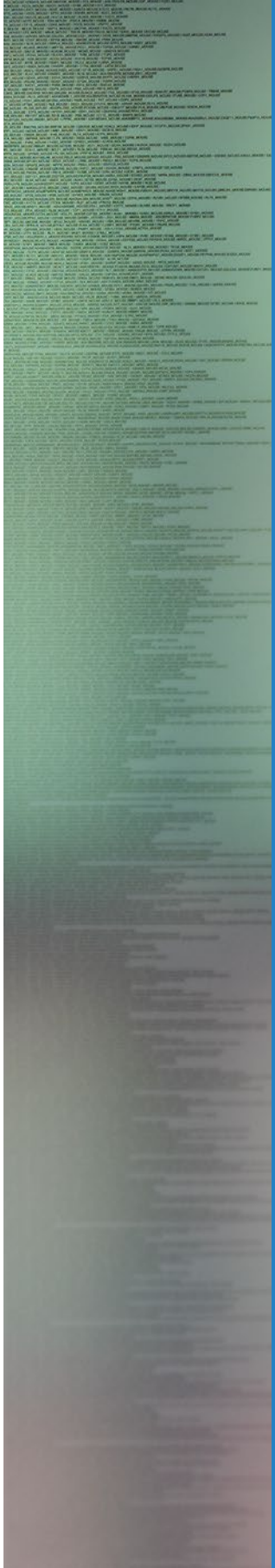
Installation views, Muffatwerk
Early-Middle-Late, Cloud, 2 Metres (left)
Extra series, Spread (top)
Blot series (bottom)
photo credit Helen Pynor



/ Blot series
/ Early-Middle-Late
/ Cloud

The artworks in this series respond to the research work of Scott Churcher.

DNA replication is characterized by its dynamism, complexity and stochasticity. The quest for precise scientific descriptions and understandings of this process requires a kind of 'freeze-framing' of the process – a reaching-in to grab a tiny milli-second of reality removed from this blur and frenzy of movement. Life is messy and baroque, and inevitably there are fuzzy edges to the precise descriptions of such dynamic and (in-part) stochastic processes.
Each of the works in this series offers a visual image of blur, and a metaphoric evocation of soft and uncertain edges.



Blot series (left)
Early-Middle-Late (right)
photo credit Helen Pynor

Blot series

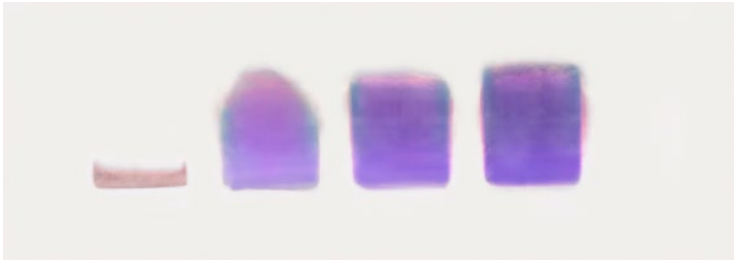
Blot series was developed from highly cropped, detailed macro photography images of a western blot assay as dyes (primarily Coomassie blue and phenol red) moved downwards in a polyacrylamide gel in response to an electric current applied across the gel, the dyes separating out into blurred fields and bands of colour over time.

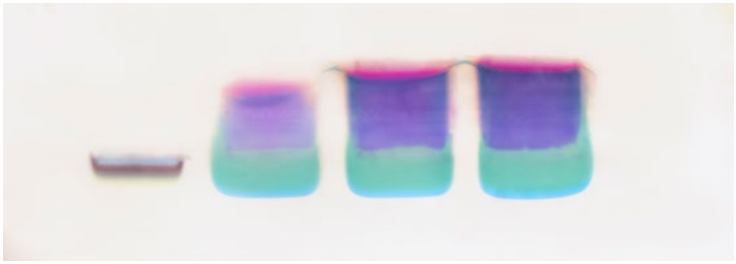
A western blot assay is intended to test for the presence of proteins of interest in a cell sample, the dyes being markers to indicate the progression of the sample down the gel. However I have chosen to image the dyes rather than the proteins. In this everyday tool of the lab I found the dynamic separation of the dyes, with their blurred edges and bleeding colour fields, visually beguiling and metaphorically rich. Like a molecular biology assay, I have also 'freeze-framed' a dynamic process unfolding, choosing precise moments to image and highlight.

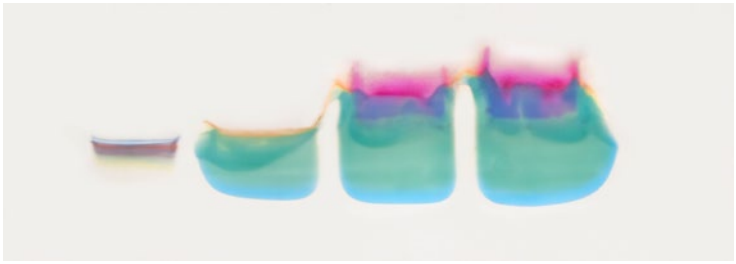
Taking macro photography and videography footage of Scott's western blots gave me an opportunity to observe in minute detail Scott's skill in sequentially dispensing tiny volumes of fluid into equally tiny wells in the top of the western blot gel, a choreography that was mesmerizing to observe up close.

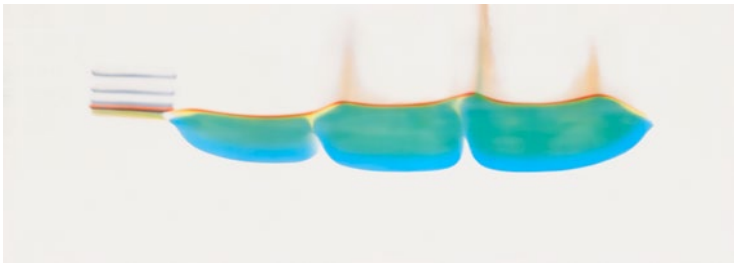
/ Blot series
/ Early-Middle-Late
/ Cloud

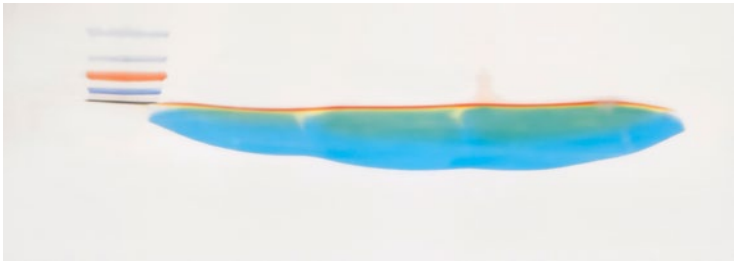
Blot series, sequence of Blot 10, Blot 16, Blot 21, Blot 28, Blot 41, Blot 88 (top to bottom) image courtesy of Helen Pynor

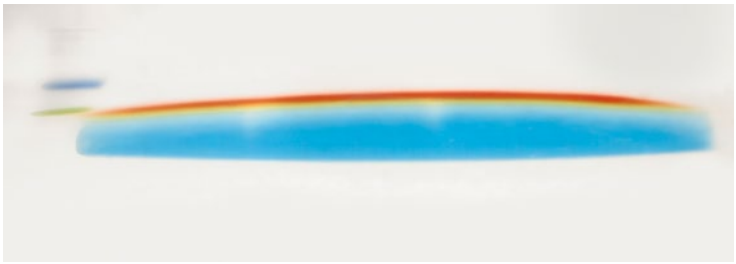












Credit
Artist Helen Pynor in collaboration with scientist Scott Churcher in the laboratory of Emilio Lecona at the Centro de Biología Molecular Severo Ochoa (CBM), Madrid. Macro photography by José Antonio Pérez Gracia
Artwork titles: Blot 10, Blot 16, Blot 21, Blot 28, Blot 41, Blot 88

Materials
Series of 6 pigment prints, mounted on Aludibond

Dimensions
Each print
33cm high x 98cm wide
Edition 1 of 5 + 1AP

Year
2026

Early-Middle-Late

Credit
Artist Helen Pynor in collaboration with scientist Scott Churcher in the laboratory of Emilio Lecona at the Centro de Biología Molecular Severo Ochoa (CBM), Madrid.

Materials
Pigment print
on Glassine paper

Dimensions
170 cm high x 112 cm wide
Edition 1 of 5 + 1AP

Year
2026

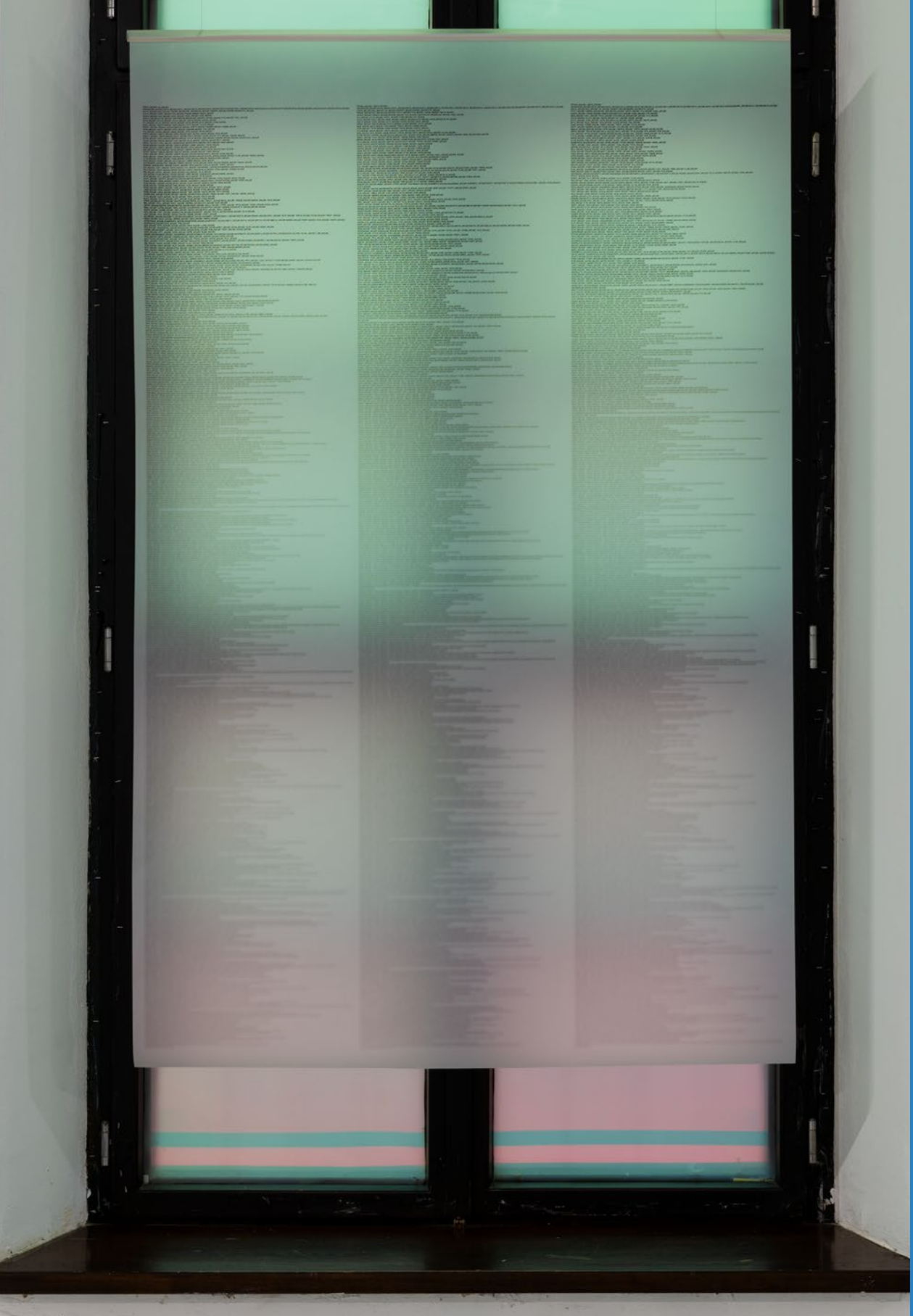
Early-Middle-Late **depicts data Scott obtained through spectrometry, an analytical tool used to identify thousands of protein species present in a cell sample. Scott is interested in the proteins actively involved at different stages (early, middle and late) of the S-phase of the cell cycle, when DNA duplicates itself before the cell divides in two.**

The artwork depicts long lists of the thousands of proteins Scott identified in his samples, arranged in three columns according to the stage (early, middle or late) within S-phase, and printed onto tracing paper. Protein names are arranged by their prevalence in the sample, with the most prevalent at the top of the image, moving sequentially down to the least prevalent proteins. The graphic font is sharp and focused at the top and progressively blurs as we travel down the artwork, with protein names at the bottom becoming illegible. Scott applies statistical tools to decide at what point these incrementally 'blurring' proteins are no longer significant to his scientific story and can be regarded as 'noise'.

There was an unexpected serendipity in the installation at Muffatwerk when lights outside the building washed the translucent tracing paper with soft green and red fields of colour – these being iconic colours used ubiquitously in molecular biology fluorescent microscopy.

/ Blot series
/ Early-Middle-Late
/ Cloud

Early-Middle-Late, installation view
photo credit Helen Pynor



Cloud

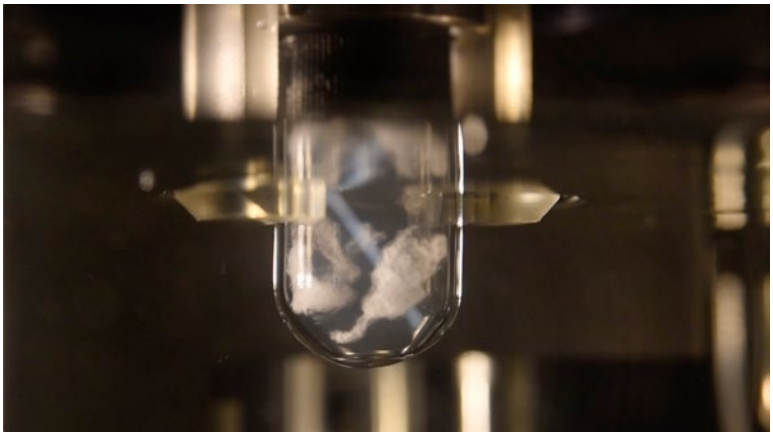
Cloud **is a close-up macro video of a cloud of genomic DNA and its associated proteins being sonicated (exposed to sound waves) in order to break the material into smaller pieces. The process forms part of an iPOND analysis Scott undertook to establish the presence of particular proteins of interest in his cell samples. For me the restless movement of this biological 'cloud', slowed down slightly for the video, offers an evocation of the restless movement of a protein molecule, its conformation switching relentlessly in response to dynamic unfolding conditions in the cell.**

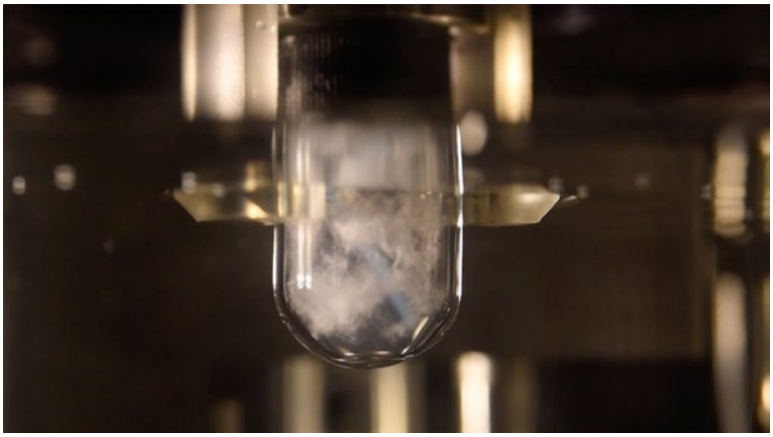
/ Blot series
/ Early-Middle-Late
/ Cloud

Credit
Artist Helen Pynor in collaboration with scientist Scott Churcher in the laboratory of Emilio Lecona at the Centro de Biología Molecular Severo Ochoa (CBM), Madrid. Macro videography by José Antonio Pérez Gracia

Materials
Single channel video on screen (07:31 min) with sound
Edition 1 of 5 + 1AP

Year
2026





Cloud, video stills (top, middle)
Cloud, installation view (bottom)
photo credit Helen Pynor



Scientists' reflections on *Blot series*, *Early-Middle-Late* and *Cloud*

Scott Churcher

Collaborating with an artist during my PhD was interesting for many reasons. It was refreshing to invite somebody to the lab with a different perception of the work, and the lab environment itself. As a result of this difference in perception, many intriguing conversations were had. Helen encouraged me to think more philosophically about the work, the models, and the experiments that we use, often asking questions that I had not considered before and encouraging one to admire the process, instead of always chasing the results.

I found it exciting to see our science data reimagined and presented in an art exhibition. Helen's introduction of the concept of uncertainty complimented the data very well, and I believe made for an aesthetically-pleasing and thought-provoking piece.

I think the language of science and art are inherently quite different, but scientists certainly benefit from engaging with artists in discussions about communicating complex ideas.

Emilio Lecona

I remember conversations Helen and I had about the 'hand-made' nature of science practice. I guess I have always been attracted to the craftmanship of science, as a complement to the more conceptual work involved in the writing of projects, papers and the development of ideas. Somehow I always liked the idea that, at some point, you are the first and only person to see a result, to have a specific piece of knowledge no one else has. That intimate moment resembles the creation of artwork in an artist's studio, only you cannot predict the outcome of your effort when you are performing an experiment. Neither could I predict the outcome of our collaboration and that is why I was so surprised by how well Helen managed to convey those ideas in our conversations and the concepts that drive our experiments in her art. As the dyes reveal the hidden nature of protein separation in an electrophoresis, Helen's works revealed the hidden nature of our experimental efforts. I was really amazed by the use of blurriness to reflect what is hidden and what is revealed by a mere list of proteins, the overwhelming effect of complexity being compensated by the clarity.

I am convinced this experience enriched Scott's vision on science and helped him reflect on his own work. To me, it was an amazing experience, and I felt so happy to have had the opportunity to be a part of the program. During the exhibition and in the meeting, I could see the positive results of the interactions of the network on the *RepliFate* artists, Pei, Solveig and Helen. It definitely helped *RepliFate* (and me) grow and I hoped Helen benefited from it too.

2 Metres

2 Metres **is based on DNA fibre assays undertaken by Ran Tong during her research.**

A DNA fibre assay depicts DNA molecules that have been released from nuclei and 'unfurled' (stretched out into long fibres) along the length of a microscopy slide. The DNA is labelled with fluorescent markers to indicate regions where new DNA has been synthesized, allowing the progression of DNA replication to be visualized and measured.

2 Metres **is a composite of around 30 of Ran's DNA fibre assays, modified in various ways and with their colour changed from the iconic fluorescent red and green of molecular biology to hues of silver and gold. The two partial spheres at the top of** *2 Metres* **depict two cell nuclei that have burst and spilt their DNA contents onto the microscopy slide. There is something powerfully visceral about this moment of rupture, which is not normally included in a DNA fibre assay image, but which Ran imaged because of its beauty, resembling two jellyfish with dangling tentacles. I composited many additional images to lengthen these small 'tentacles' down the 2-metre height of the artwork, to create fictional extended strands of DNA.**

The artwork alludes to DNA's elongated linear form, and in particular to the fact that there is 2 metres of DNA in every human cell if the DNA molecules were unravelled and joined end-to-end. This seems wondrous to me – such extensive linearity compacted into such tiny packages of space, confounding our commonsense logic of how space works. An intention of the artwork was to highlight this spatial anomaly, bringing into proximity the 2-metre height of the artwork with the bodies of exhibition viewers. The aspect ratio of the artwork replicates the elongated aspect ratio of the glass microscopy slides on which DNA assays are performed.

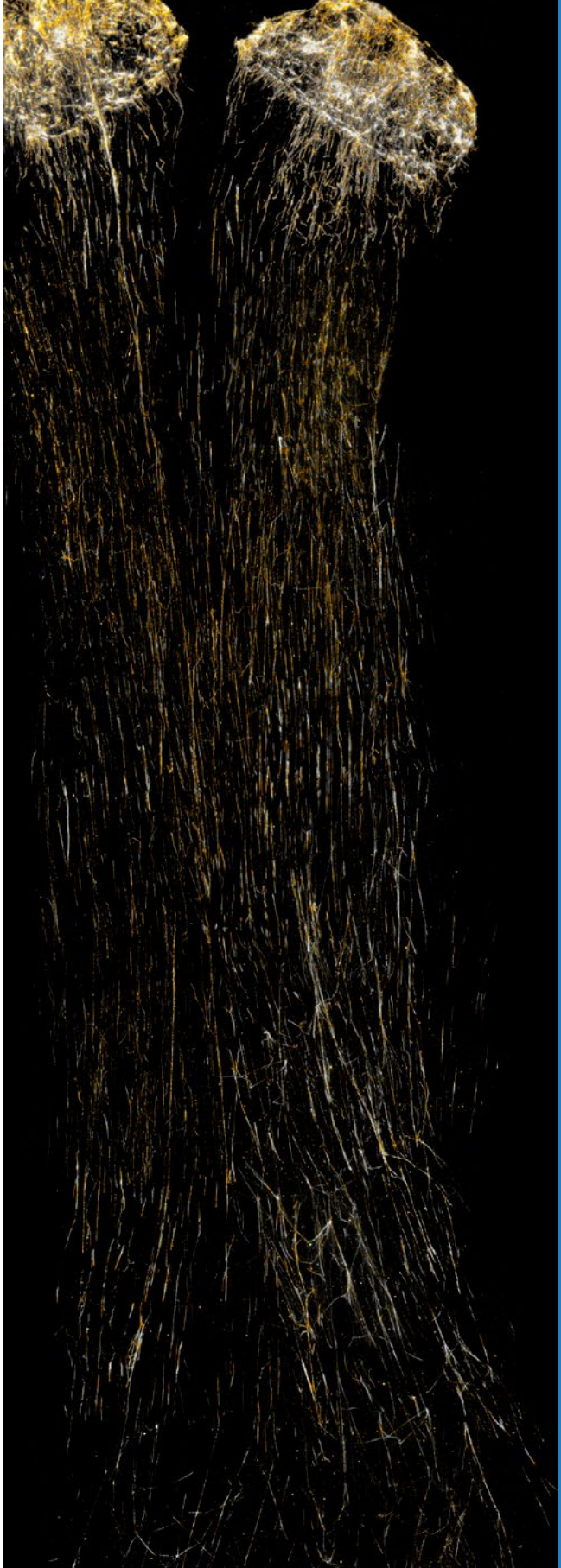
To create a DNA fibre assay Ran releases a drop of fluid containing meticulously prepared cell nuclei, from just the right height, onto a microscopy slide placed at just the right angle, in order for this miraculous and unlikely process to yield useful scientific data. Failure is an inevitable part of the process and Ran and I also spent time talking about failure – the many unexpected insights and learnings that come paradoxically through the experience of 'failed' experiments, and their rich productive potential in both scientific and artistic practice.

Credit
Artist Helen Pynor in collaboration with scientists Ran Tong and Joana Segura Martínez in the laboratory of María Gómez at the Centro de Biología Molecular Severo Ochoa (CBM), Madrid.

Materials
Pigment print, mounted on Aludibond

Dimensions
67cm wide x 200cm high
Edition 1 of 5 + 1AP

Year
2026



2 Metres
image courtesy of Helen Pynor

Scientists' reflections on *2 Metres*

María Gómez

Understanding cells is veeeeeeery difficult because living organisms are not digital entities and neither them nor the molecular mechanisms that govern their behaviour follow deterministic nor predictable rules. So approaching biological problems is intrinsically difficult because the experiments we design rarely gave us a clear answer. This is why we need to approach the problem we want to understand through multiple angles and, still, the answers are never black-and-white. This can be very frustrating, especially for PhD students at the beginning of their careers, but it really reflects how life works. And I think this is the beauty of it.

Reflecting on how scientific imagery and artistic representation function, our brains work with images representing the world surrounding us. To try to understand it (and this includes biological systems) we tend to represent it with images of how we think things work. And images are so powerful, and leave such a strong imprint on our brain, that is very difficult to not see things that way. In my view the problem is that, as I said above, biological systems are so complex and we still understand so little about them, that we are not capable of capturing their complexity with images. I believe here is where art can help scientists, since art works do not pretend to be the real thing, but a representation of it, and we immediately understand this when looking at a piece of art, while we expect a scientific model or cartoon to be reflecting the real thing ..... The artistic representation suggests to the viewer to see beyond the piece of art, while the scientific representation is perceived as the final statement. I enjoyed a lot our collaboration because it prompted me to reflect on this.

Ran Tong

I was very excited to see artworks related to my research displayed in a gallery. The idea behind the artwork is so beautiful, and I think the association between DNA molecules residing in the nucleus and the idea of space is wonderful. During the collaboration, I shared not only the scientific background and findings of my research with the artist, but also the difficulties, obstacles, and failed experiments I had encountered along the way.

One of the most interesting aspects of the collaboration was seeing my research from a completely different perspective. Discussing my work with someone outside my scientific field made me realise how differently the same research process can be interpreted and understood.

I was particularly struck by the idea that failure is not simply the opposite of success. Failed experiments can also contain valuable information, and successful results are often built upon many unsuccessful attempts and the accumulation of what we learn from them.

Juan Méndez

On the art-science interactions at RepliFate

The idea of scientists and artists collaborating is far from new – painters and photographers were a vital part of the naturalist and geological expeditions of the 18th and 19th centuries, and since the mid-20th century many research institutions have hosted art programs and artists-in-residence. One tangible result of these partnerships is aesthetic: sculptures, paintings, and installations remain on campuses worldwide, creating a sense of beauty and sparking curiosity.

For me, collaborating with Helen Pynor, who spent some time in our laboratories in Madrid, went a step deeper. It offered a rare opportunity to witness how an artistic mind may process the data generated by scientists in the lab. It begins with a fierce curiosity about the core concepts behind an experiment. I imagine that this new information is woven into her lifelong explorations of deep biological and philosophical questions -symbiosis, chimerism, and the threshold between life and death. Finally, in a creative leap that feels somehow similar to a scientific breakthrough, she reinterprets electrophoretic images, stretched DNA molecules, and raw datasheets: scales are inverted, the microscopic becomes monumental, and the dark corners of our biology come into the light. We are not just moved by the beauty of her visual work; we are also compelled to look inward, wondering at the intricate molecular machinery inside ourselves - both body and mind.

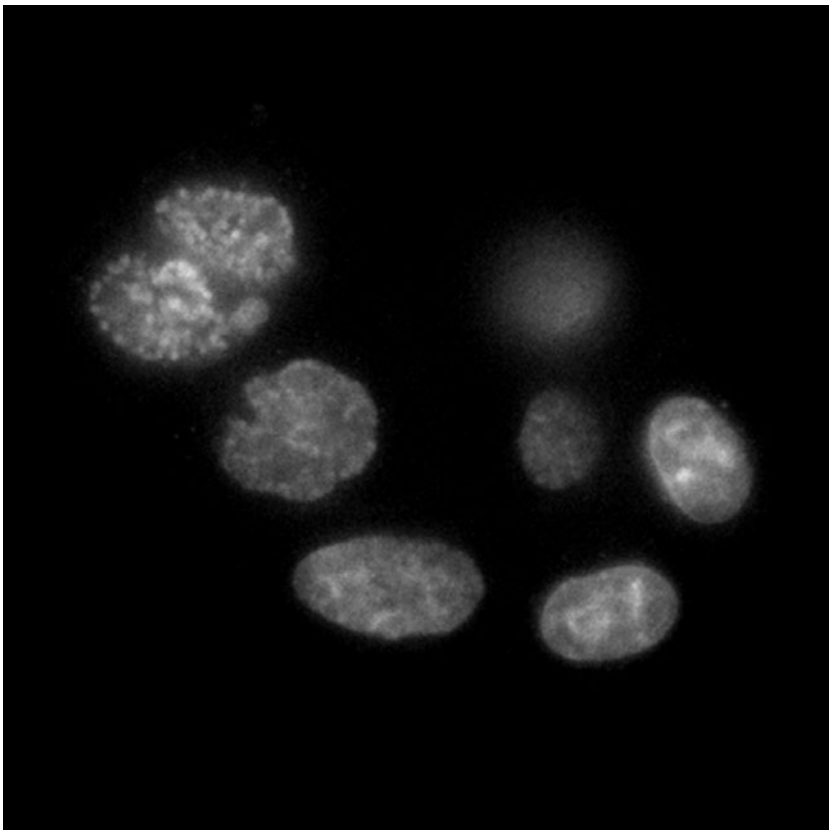
Beyond all the exciting science generated within the RepliFate network, the opportunity to meet Helen and her fellow artists has been a genuine privilege that has even influenced how I look at my own work.

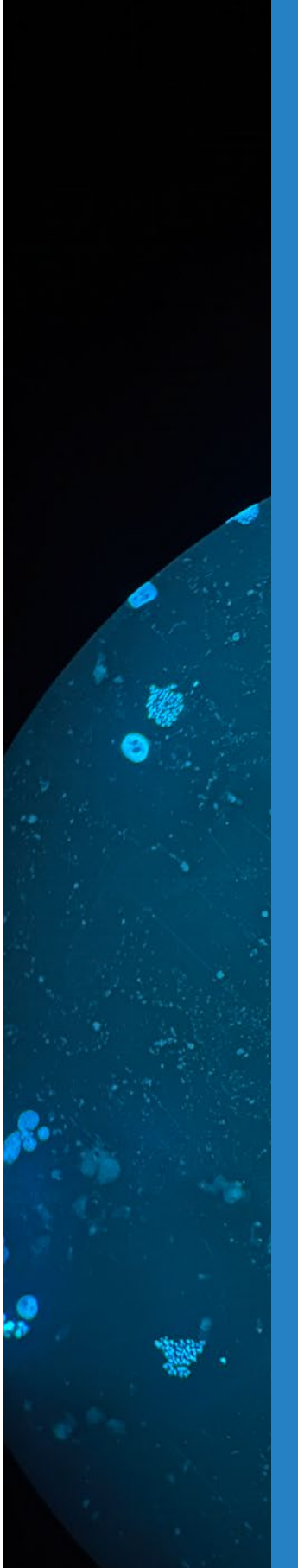


/ Extra
/ Spread
/ Metaphase

The artworks in this series are based on the work of Alex Haider and experiments we undertook together whilst I was in residence in his lab.
Thank you to Alex for the preparatory work he undertook before my residency that allowed me to gain hands-on experience of microscopy processes during my residency.

Extra series (left)
Metaphase, video still (bottom)
Spread (right)
photo credit and image courtesy of Helen Pynor







Extra

Extra **explores the enigmatic phenomenon of extra chromosomal DNA (ecDNA), tiny pieces of DNA that reside in the cell nucleus alongside, but separate to, the cell's chromosomes, often forming into tiny circles. Their biological significance is poorly understood but they are more often present in cancer cells.**

The images in *Extra* are taken from a recent scientific paper Alex sent me with some of the highest resolution microscopy images taken to date of these elusive entities. I have manipulated, coloured and made dye sublimation prints of the microscopy images onto translucent, layered and frayed voile fabric. The transparency of the images references the elusiveness of these entities, with the frayed fabric metaphorically echoing the way in which ecDNA has 'frayed away' from the main DNA genome.

Credit
Artist Helen Pynor in collaboration with scientist Alexander Haider in the laboratory of Zoi Lygerou at the University of Patras.
Artwork titles: Extra 1, Extra 2, Extra 3, Extra 4

Materials
4 dye-sublimation prints on synthetic voile

Dimensions
42cm high x 40cm wide
Edition 1 of 5 + 1AP

Year
2026

/ Extra
/ Spread
/ Metaphase

Extra series, installation views
photo credit Helen Pynor





Spread

Credit
Artist Helen Pynor in collaboration with scientist Alexander Haider in the laboratory of Zoi Lygerou at the University of Patras.

Materials
Pigment print, mounted on Aludibond

Dimensions
90cm wide x 120cm high
Edition 1 of 5 + 1AP

Year
2026

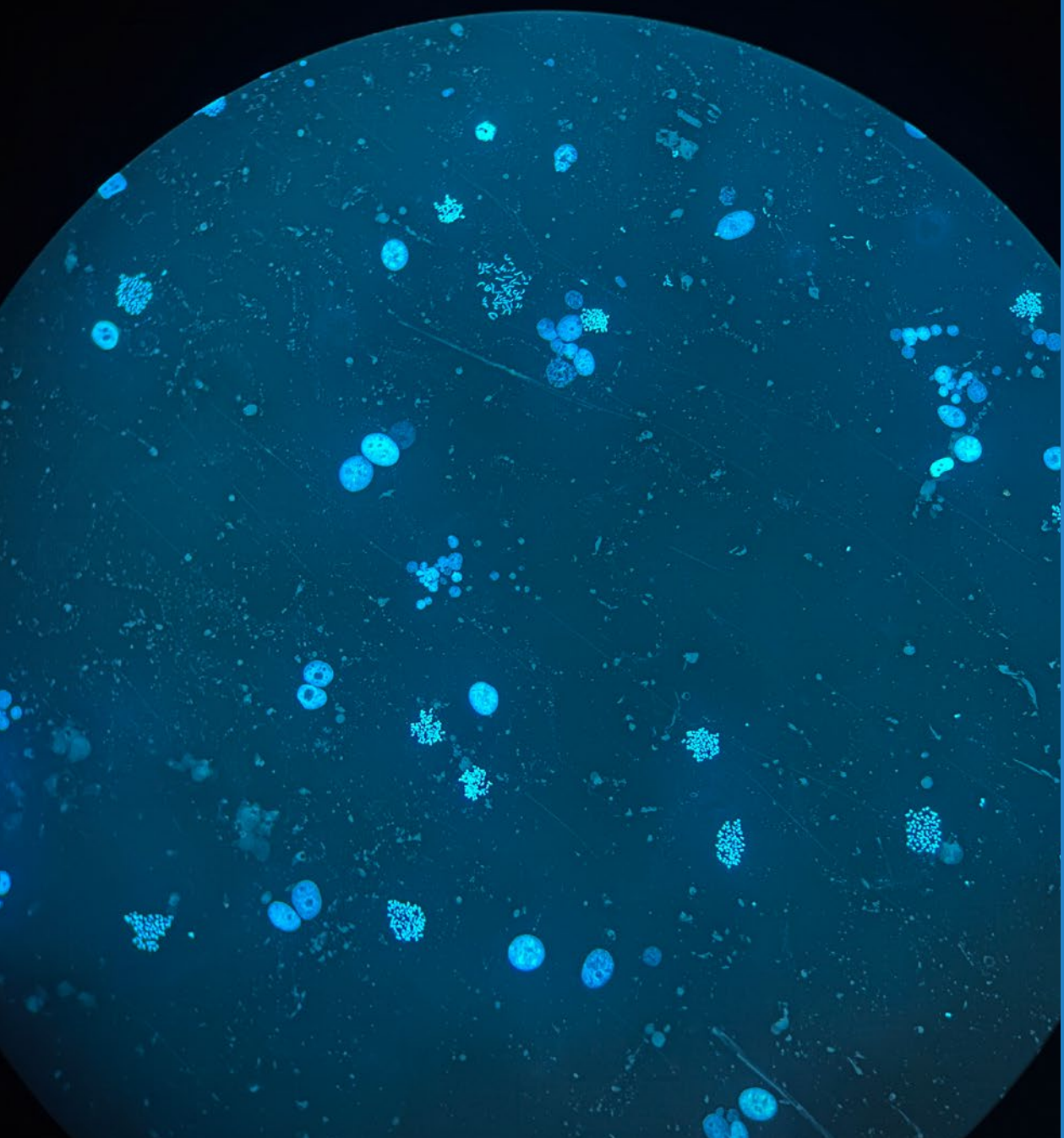
Spread **depicts a 'metaphase spread' created by Alex and I during my residency. Metaphase spreads are created by releasing a drop of fluid from a large height onto a glass microscopy slide. The drop of fluid contains meticulously prepared cell nuclei, whose membranes have been weakened and whose chromosomes have been halted in metaphase of the cell cycle, when chromosomes are in their most condensed state. The impact of the drop hitting glass ruptures the nuclear membranes, spilling chromosomes onto the glass slide in a 'spread' and allowing the chromosomes (and potentially ecDNA) to be observed.**

In this particular 'spread' many nuclei have laid their chromosomes beautifully and legibly onto the microscopy slide. I enjoy the way scales seem to collide in the image – a planet floating in deep space, or the tiny world of chromosome spilt from a cluster of cell nuclei.

I enjoyed observing and undertaking the performative practice of making metaphase spreads alongside Alex. In one dramatic step we raised our arms as high we could to release the single drop of fluid onto the microscopy slide far below. Like other techniques I observed during my residencies, performing this successfully requires the kineasthetic 'feel' of an embodied knowledge, a skill developed with time and practice.

/ Extra
/ Spread
/ Metaphase

Spread
image courtesy of Helen Pynor

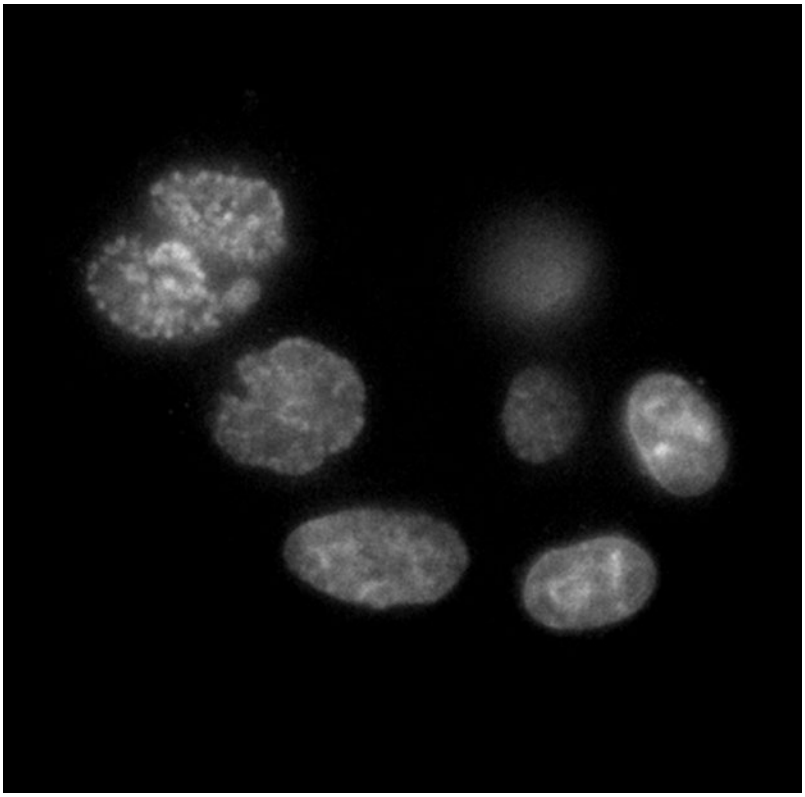


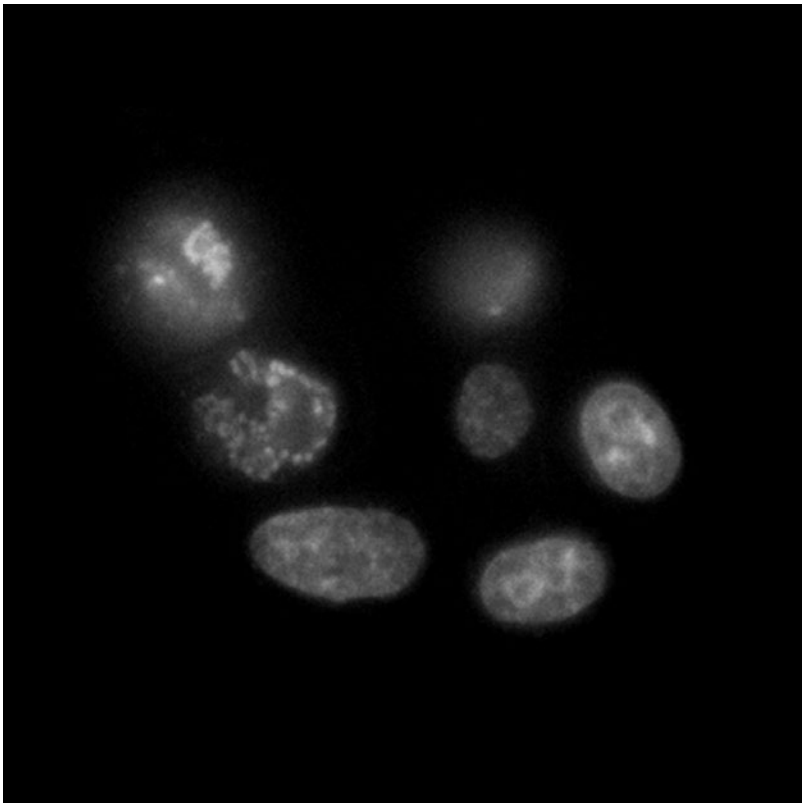
Metaphase

Metaphase **is a time lapse microscopy video created by Alex and I in the lab, depicting a cell undergoing cell division. Although difficult to see, it depicts the build-up and apparent instantaneity of the moment when chromosomes split apart and migrate to each end of the nucleus – a beautiful and improbable choreography – followed by the division of the cell into two daughter cells. Just discernible in the video is the cytokinetic bridge, a gossamer thin thread spanning the two daughter cells immediately after division, like an umbilical chord evidencing the cells' shared ancestry and, metaphorically at least, their reluctance to finally separate.**

Alex informed me that the bridge is evidence of cellular stress due to a flawed division of the chromosomes, most likely due to cellular damage caused by the laser light used in the live imaging microscopy process. This presents a paradox: cell division is something esquisite to observe, but observing it will inevitably damage this fragile life system. This paradox is common in science – observing life moving at high speed requires us to slow it, pause it, subject it to toxic levels of light, and so forth, actions that are usually lethal for the living system being observed.

Metaphase, video stills
image courtesy of Helen Pynor





Credit
Artist Helen Pynor in collaboration with scientist Alexander Haider in the laboratory of Zoi Lygerou at the University of Patras.

Materials
Single channel video on screen (00:16 min)
Edition 1 of 5 + 1AP

Year
2026

Scientists' reflections on *Extra, Spread* and *Metaphase*

Alex Haider

Over the course of the *RepliFate* project Helen and I had many conversations that circled around the question of scientific certainty and uncertainty, a topic of interest to me, and one of the main focuses of Helen's work in this project. Below are some reflections on our collaboration.

Reproducability failure
'Reproducability failure' is a phenomenon increasingly discussed in the scientific literature that describes the difficulty labs frequently have in reproducing published experimental results obtained by other labs.

There are many potential causes for reproducibility failure, including variability in experimental protocols. For example, MCF7 cells are a breast cancer cell line I work with extensively. The scientific literature reports a plethora of types of media that MCF7 cells will grow in, and there is a significant question about whether these cells behave differently in different media, which could potentially affect experimental outcomes. Other variables that can affect scientific results include the cell line you choose to work with, the precise temperature and humidity of your incubator, the medium you use (eg. 10% BSA versus 20% BSA), and so forth. All of these variables compound and suddenly what you're dealing with is a whole different beast. Experiments need to be repeated multiple times to be confident of their outcomes, and are preferably repeated in quick succession, because between experiments everything changes, for example cells are passaged several more times, the reagents go through several more freeze/thaw cycles, etc.

But it is not only that conditions are different in every lab. It is standard in the field to not report all the micro factors (I just invented a term) in scientific papers. So the humidity, temperature and other factors are not reported when papers are published because it's assumed they have minimal impact on the experiment. But each lab has its own conditions and these conditions change the genetics of the cell lines that we assume to be identical. There was a study that took 10 different U2OS cell lines (a bone cancer cell line) from 10 different labs around the world and sequenced them. No two were identical, but when reporting in papers we always simply quote 'U2OS,' assuming uniformity. So it's not only the 'micro factors' but also the genetics (the nucleic acid sequences) that vary between batches of cells, between experiments, and between lab locations.

This is not to say that the published research is not true, but more that the systems are so impossibly complex that a 10%

difference in a range of small, seemingly insignificant factors can be magnified to a 50% difference in the specific micro environment of a particular lab. When you make claims for your data, it might only apply to your unique set of conditions, that combined together create a very unique environment – and therefore a unique scientific result.

The complexity of living systems themselves is an implicit challenge to creating reproducible experimental results, a complexity that includes, but is not limited to, the 'drift' of nucleotide sequences described above. I believe that this is implicitly understood by scientists and doesn't need to be overtly acknowledged as a factor that contributes to 'reproducability failure.' However Helen and I debated this – she agreed that it is an obvious point, but thought it may still be underacknowledged in the scientific literature as a factor leading to variable experimental results. I think that it is more acknowledged now, and it's understood that if you want to reproduce something another lab has published, you will need to fiddle a bit with the parameters in order to get it to work. This brings in another aspect, the community. If you can't get it to work, it is quite common to contact the researchers that published the results to ask them to help you optimize the experiment. It seems to me that there is less competition and a more collaborative spirit happening in the field now than there was in the past.

Metaphase spreads
Metaphase spreads offer a great example of the potential for variability in an experimental protocol. There's a choreography involved in creating a metaphase spread, and a kind of violence (DNA fibre assays are far more gentle). The drop of fluid in a metaphase spread is dropped from a great height, and it's the force of the impact when the drop hits the glass slide that breaks the cell nuclei open, allowing the chromosomes to spill onto the glass slide. Metaphase spreads are very crude in some ways, so many factors affect the outcome, including ambient humidity and temperature, how many cells there are per µL of fluid, and the skill of the scientist. There's a high degree of intuition and 'feel' required to perform a metaphase spread successfully, it's an art more than a science.

'Choreography' and 'feel' are central even in more 'rigorous' protocols. For example the protocol that is regarded standard for qPCR (a technique to amplify and measure the quantity of a DNA or RNA target in a sample) can be further optimized with minor tweaks and by the scientist acting more like a 'robot,' employing more precise and repetitive movements to obtain more precision from the results. It can appear that a lot of protocols in science are set and you just follow the steps, but in actuality people with more experience will almost always obtain better results (that is, higher quality results at a technical level, as opposed to results with higher levels of biological significance). In experiments there is always technical noise on top of the biological significance, but the more experienced the scientist, the less that noise from the technical aspect of the protocol is a factor.

Complexity
Biological systems are unfathomably complex and cannot be understood by the human mind. You create these ideas and concepts in your mind about how things are, but biology is

always far more complex. Systems biology, a relatively new branch of biology, is attempting to use a systems-based approach to understand this complexity – I believe that the computational systems used in this field may eventually succeed in bringing us closer to understanding the complexity. I think this is where AI could help us out. There is a lot that is known but it's very difficult to integrate all the known information and build a real model. I think that there will be a new branch of science that will arise, that will be something like 'integrative biology' where AI scientists will try to build biological models that take into account thousands of mechanisms acting in concert, a model that may begin to approach the real complexity of biological systems. So yes, the human mind by itself cannot do it, but the human mind could also not light a fire by itself, allegedly. As a species we have always been dependent on tools we have created to understand and optimize the world around us, maybe in the future there will be tools to help us make sense of the complexity of the cell.

The notion of 'truth' in biology
I follow the work of Karl Popper, who argues that truth is always provisional. When scientists prove that something is 'true' and then at some later stage it's disproven, it's not necessarily that the original idea was 'untrue'. It's more that the biological system being described is far more complex, so new knowledge is added to augment the previous knowledge.

So you can prove that something is 'statistically significant' and we argue that it's true, but actually it only means that the entity we are studying tends towards that; there is always variation. So why, if it's 'true,' are there variations between individuals? Why are biological systems not uniform? Because biological systems are so complex, we cannot isolate all the individual parameters at play in the life of a cell. Without effectively isolating every parameter, we can only ever observe trends, and this is where statistics come into play. Statistics are a tool to describe 'trends.'

I believe that absolute truth exists, but all we're able to do in experimental practice is to keep 'estimating' the truth – getting closer to it all the time, but never arriving at it. Tools in biology will keep getting better, but they'll continue to reveal more and more complexity, creating a paradoxical situation where truth will continue to be approached, ever more closely, but never arrived at.

Having said that, I believe the only way to fully isolate parameters would be to do in silico analysis –
do it in a computer that simulates a biological system.
This already exists and it's quite impressive (see Blue Brain Project, where researchers build a supercomputer model of mouse brain neural column at a molecular level, modelling millions of neurons and billions of synapses) and it's the future for sure. Because there you can tell the model to not include this or that protein. There we will be able to estimate the impact of a certain gene or molecule. Cool stuff.

The value of working with an artist
I believe there are many benefits to scientists working with

artists. Firstly, there is the benefit of talking and explaining your project with someone that is of a completely different field. That requires you to push the understanding of your own project in order to explain it correctly. Also, as you are explaining it in a different manner to how you do with your colleagues, your mind thinks at the same time and can come up with different avenues of exploration. In addition, the artist can ask a completely different question (as their perspective is totally different from that of colleagues) than the ones you are used to, and it can really highlight parts of the project that you either don't understand well enough or don't know enough about.

There is also the obvious point that the artist can really highlight the beauty of the science that we are doing or help you focus on the different parts of the science that are beautiful. The reality of science is that it's really difficult, not only in the conception but also on the researcher. I personally know many colleagues who are totally burned out by their PhD work and simply want to finish. I think that if one doesn't take the time to appreciate the beauty and philosophical interest in the work we are doing, it's really easy to get lost in the day to day and in the multiple failures that occur on a daily basis. So I think the artist can definitely offer a fresh perspective on the work and could potentially bring back some joy to the work.

Furthermore, artists have a keen eye for details and can point out things that draw their attention, that a scientist could miss because they are managing their project on many fronts and haven't taken the time to dig deeply into their most recent findings.

For me I already see the beauty in the work that I am doing, so throughout our collaboration I was eager to share this with Helen. The most interesting part of the collaboration for me was the philosophical discussions we had, without a doubt. Science first started in ancient times simply through philosophy. There are ideas that the Buddha understood about how the brain functions, 2500 years before there was functional brain imaging. In contemporary times these technologies have confirmed what he hypothesised. Scientists should, before anything, be great at philosophy, but I feel that nowadays many scientists get lost in the day to day and in their projects. I feel that throughout the collaboration with Helen I had a great conversation partner to go deep into some philosophical discussions about science and the meaning of the work. I understand that artists also need to engage with philosophy, this shared engagement with philosophy is a great meeting point for scientists to collaborate with artists.

Zoi Lygerou

The artist-in-residence project offered a new way of seeing the work we do every day: images and ideas were transformed into forms of artistic expression. For Alex and the whole team, the exchange prompted new ways of thinking about the research and what it might mean beyond the bench. Seeing the final collection of artworks from across the participating labs was especially inspiring — a vivid reminder that science can spark ideas far beyond the questions it first set out to answer.

Scatter

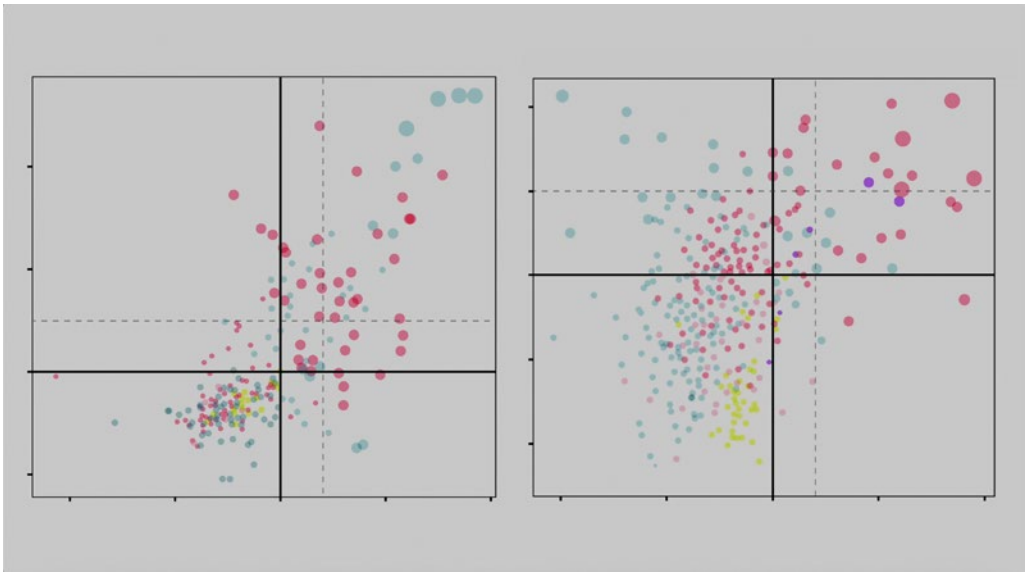
Scatter, based on the research work of Yicong Chen, is an embellished video animation centred on two data sets relating to DNA replication, that were generated by Yicong and presented as 'scatter plots.'

When a genome replicates itself, DNA duplication is initiated in thousands of sites all over the genome simultaneously. Replication spreads outwards from these sites, until the entire genome is eventually duplicated. These sites of initiation, or so-called 'origin sites,' have features in common but which particular sites serve as origin sites varies each time a cell replicates.

Yicong's scatter plots – one for mouse and one for human – depict the likelihood that particular identified sequences of DNA, that have viral origins in the evolution of the mouse and human genome, can serve as 'origin sites' during DNA replication. This sits within a broader question: the extent to which viruses that have been incorporated into the genome have been co-opted for useful purposes, such as assisting in DNA replication.

At the beginning of the *Scatter* animation graph lines are laid down, followed by sequentially appearing data points that eventually form a constellation of dots – positioned, sized and colour-coded according to Yicong's original scatter plots. The dots begin with sharp edges but gradually blur, dots most supportive of Yicong's hypothesis (in the top-right quadrant of each graph) blurring the least, dots least supportive (in the bottom-left quadrant) blurring the most. The degree of blur becomes an indicator in this animation of scientific certainty or uncertainty in relation to Yicong's data and his hypothesis.

Yicong works extensively with bioinformatics (or computational



biology) and of the four scientists I collaborated with in the *RepliFate* project, Yicong's work took me furthest into realms I was unfamiliar with, my background being in 'wet' biology. I was interested to learn from Yicong how scientific uncertainty might operate and be managed within the seemingly cut-and-dried, 'objective' domain of bioinformatics, and we had many conversations focused on this.

Yicong's work engages with the uncertainties and stochasticity shared across all domains of biology that result from the complexity of biological systems and the small, unavoidable variations in parameters used in experimental protocols (as described by Alex Haider on page 94ff.). However Yicong describes forms of stochasticity specific to computational biology, including the particular methods used to generate randomness in data sets (methods which continue to evolve), the random selection of fragments read in DNA or RNA sequencing which can only ever be a fraction of the whole sample, and a subjective element in the choice of which statistical methods are applied to experimental data, amongst multiple options available. Yicong described statistics as a technique that allows you to 'prove' that something is 'most likely right,' a paradox I greatly enjoy. No technique employed to study living forms evades life's fuzzy edges, we could say that all data has blur at the edges.

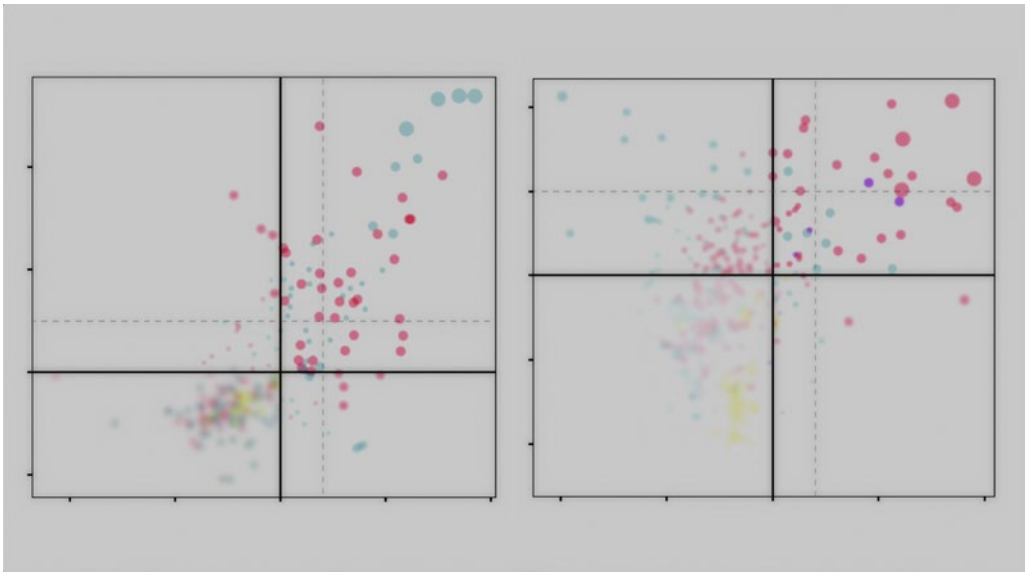
Bioinformaticians employ techniques to manage and co-opt uncertainty that are also specific to working with data sets. These include using best practice coding methods that generate a high degree of randomness in the data sets as a control to identify potential biological certainty, employing protocols of transparency such as publishing in scientific papers the code used in experiments so others can replicate results and acquire certainty, as well as employing community-wide, consensually-agreed cut-off thresholds for what is considered biologically significant to be certain in experimental work.

Credit
Helen Pynor in collaboration with scientist Yicong Chen in the laboratory of Maria-Elena Torres-Padilla at the Helmholtz Munich.

Materials
Single channel video on screen (01:00 min)

Edition 1 of 5 + 1AP

Year
2026



Scatter, video stills
image courtesy of Helen Pynor

Scientists' reflections on *Scatter*

Yicong Chen

This was my first time working closely with an artist, and I had really a lot of fun. Artists view a project from a broader, more general perspective, and this reshaped my understanding of my own project from a different angle.

It's different from what I'm used to with scientific figures, where the science comes first and the aesthetics are secondary. Here, the art itself is what catches the eye at first glance. But with a bit of scientific context, the artwork can reveal much more than expected. At the same time, this kind of work makes it much easier to draw the general public in and get them interested in the science behind it.

Maria-Elena Torres-Padilla

As an artist, Helen has been interested in exploring the borders, the ends. My discussions with her made me think that perhaps the 'ends' that we think are ends, are not ends after all. Our work on transposable elements, which are bits and pieces of viral infections that have accumulated in the human genome over millions of years of evolution, made me reflect on Helen's view. In fact, we tend to put them as 'outsiders' or 'invaders' of our genome. But the truth is that they are now absolutely a part of us. They are so much a part of us, that we can't do without them. This raises a lot of interesting questions about our scientific quest. For example, how did we even keep them in our genome – and, what is the extent to which we use them to grow and survive from the beginning of our life, at fertilization. This is precisely the nature of the work we do in my lab. We had a lot of common points of thoughts with Helen, and certainly her vision on edges has changed how we are interpreting our findings with such former viral particles which in fact have lost their identity to become human.

Curatorial reflection

Claudia Schnugg

The selection of the four research groups that were presented to Helen Pynor had a catch: while Pynor is also trained as a biologist and developed an intricate artistic practice that intertwines a philosophical to the topics she is engaged with, an aesthetic investigation into the artistic medium she is working with, and a background knowledge in wet lab procedures, she was presented with most striking microscopy and some unusual, visually interesting experimental techniques in the biological laboratory, as well as with their translation to data and computational models. Thus, while both, the individual research topics of the RepliFate researchers caught her attention, her artistic research was drawn specifically to the meaning of such visual techniques to learn about biology, how those become data, how this data can represent an ever-becoming process, and what this means within a scientific environment that needs to deal with uncertainties and a subject matter that never holds still. Biological replication is therefore less like a fixed script than a choreography that is constantly adjusting as it unfolds.

Helen Pynor's work emerges from a fascination with the molecular processes that take place at scales and speeds far beyond human perception. Developed through the RepliFate residency, her research follows the processes of DNA replication and the visual techniques used to make these processes accessible to scientific observation. Microscopy, DNA fibre assays, Western blots, live imaging, and other laboratory methods become both source material for an artistic investigation into what we can see and what remains just beyond visibility, reflecting also the conceptual starting points for her work. At the heart of Pynor's practice is a tension between precision and uncertainty. Biological systems are extraordinarily complex: even a single cell contains countless interacting processes, constantly responding to changes in its environment. Replication is not a perfectly repeatable choreography, but a dynamic and stochastic process in which molecular events unfold with variation, flexibility, and occasional deviation. Scientific methods are designed to measure, stabilize, isolate, and interpret these processes, yet what they reveal is always a particular view: a momentary registration of something that is fundamentally in motion.

Pynor is interested in this gap between what happens and what can be seen. A microscope image or scientific diagram can appear precise and authoritative while simultaneously being an abstraction, a translation, or a snapshot of a much more fluid reality. Scientific images are never simply transparent windows onto biological reality. They are produced through instruments, protocols, selections, thresholds, processing, and visual conventions, and they are read through the experience and knowledge of those who work with them. Scientists learn to recognise patterns, fluctuations, artefacts, colours, and forms that may remain opaque to an untrained eye. What appears to us as blur or visual noise can contain information for someone familiar with the visual language of the laboratory.

In this sense, uncertainty is not something that appears only at the edges of scientific knowledge. It is already embedded in the ways biological phenomena are observed, measured, translated, and represented. Even the most precise image is the result of a particular method and a particular moment of looking. What

becomes visible is therefore always partial, shaped by the tools and techniques through which it is produced. The image does not simply reveal the biological process; it also carries the traces of the process of making it visible.

This becomes central to Pynor's aesthetic language. Blur, flicker, shimmer, distortion, and partial visibility are not simply atmospheric effects, but ways of thinking about how knowledge is produced. Rather than treating uncertainty as something that science needs to eliminate, Pynor approaches it as a structural condition of working with living systems. Her use of blur does not make scientific images less meaningful or less precise. Instead, it draws attention to the complexity already contained within them, making visible something of the instability, variability, and processes of interpretation that scientific images usually conceal. As an example, this is strongly present in the video work Scatter, a translation of data into graphs where blur becomes language to read the data. The process in this video represents statistical methods, computational modeling, and scientific processes that translate visual language into code and interpretations of realities in and of the cells.

The artworks produced in this body of work draw directly on material generated in the laboratory, but they do not present it as scientific data nor do they completely present them as they are produced in the laboratory. The aesthetic qualities of scientific images are therefore inseparable from the questions they raise. Colours produced by different imaging techniques, the iconic shapes of chromosomes, the lines and marks of a DNA fibre assay, or the movement captured through live imaging all carry traces of highly specific experimental procedures. Pynor extracts these elements from their original scientific context and reworks them as visual and material language. They are no longer presented as data to be decoded, but neither are they entirely fictional. Their connection to the laboratory remains present, allowing the works to hover between evidence, abstraction, and speculation. Partially they are still present in the artworks, some traits are reinforced through artistic intervention, others are alienated through intervention in colors or reinterpretation and stitching and patching of visual material.

In this sense, Pynor's practice does not seek to visualise biological uncertainty directly. Instead, it makes uncertainty felt. Her works transform scientific traces into spaces of ambiguity, where precision and indeterminacy can coexist. The resulting images invite us, both any audience as well as scientists familiar with the scientific visual language and dealing with uncertainty with statistical methods, to look longer, to question what we think we are seeing, and to become aware of the gap between an image and the living process it attempts to capture.

Pynor describes the molecular world as an intricate choreography, highly orchestrated yet constantly adapting. Her works respond to this paradox. They draw on the language of science while gently unsettling its apparent clarity, revealing a biological world that is at once extraordinarily precise and fundamentally unpredictable. What emerges is not a failure of scientific knowledge, but another way of understanding it: knowledge as something that must continually negotiate complexity, variation, and uncertainty.

BIOS

Helen Pynor

Helen Pynor is an Australian artist and researcher whose practice explores philosophically and experientially ambiguous zones such as the life-death boundary and the human/non-human boundary. She works with living and 'semi-living' cells, organs and biomolecules such as DNA, and in a previous work her own surgically excised bone material. She works across installation, media art, photography, video, sculpture, microscopy, wet biology, sound and performance.

Pynor's work has been exhibited widely internationally including at ZKM | Center of Art and Media Karlsruhe; Tekniska Museet (National Museum of Science and Technology) Stockholm; Experimenta International Triennial of Media Art, touring Australia; National Taiwan Museum of Fine Arts; Beijing Media Art Biennale; FACT (Foundation for Art and Creative Technology) Liverpool UK; Science Gallery Dublin; Science Gallery London; Museum of Applied Arts and Sciences, Sydney; and ISEA (International Symposium on Electronic Art).

Pynor frequently undertakes in-depth residencies and collaborations with scientists in scientific and clinical institutions, such as The Max Planck Institute of Molecular Cell Biology and Genetics, Dresden and The Francis Crick Institute London. Pynor has received an Honorary Mention in the Hybrid Arts Category at Prix Ars Electronica, Linz, and national awards in Australia. Pynor has completed a practice-based PhD at Sydney College of the Arts, The University of Sydney, a Bachelor of Visual Arts at Sydney College of the Arts, The University of Sydney (Sculpture, Installation, Photography) and a Bachelor of Science (1st Class Hons) at Macquarie University, Sydney (Cell and Molecular Biology).

www.helenpynor.com/works.html

Yicong Chen
Yicong Chen is PhD student at the Institute of Epigenetics and Stem Cells in the laboratory of Prof Dr Maria Elena Torres Padilla at Helmholtz Munich. His doctoral research within the RepliFate doctoral network focuses on the analysis and role of replication features in early mouse embryos and during reprogramming to totipotency.

Scott Churcher
Scott Churcher is PhD student at Centro de Biología Molecular Severo Ochoa (CBM), CSIC-UAM in the laboratory of Prof Dr Emilio Lecona. His doctoral research within the RepliFate doctoral network focuses on investigation of replisome components' influence on cellular identity. He holds a Master of Science in Biotechnology from Imperial College London. Previously he was Research Assistant at Vanderbilt University.

María Gómez
María Gómez is a molecular biologist driven by a fascination with how our genomes work and how cells decide what they will become. She leads the Functional Organization of the Genome laboratory at the Centro de Biología Molecular Severo Ochoa in Madrid, Spain, where her team studies the fundamental processes that keep our genomes stable and healthy. Throughout her career, she has combined curiosity-driven research with a strong commitment to mentoring young scientists, having supervised numerous students and early-career researchers. Beyond the laboratory, she enjoys sharing science with broader audiences and inspiring new generations to explore the wonders of biology and biomedical research.

Alexander Haider
Alexander Haider is PhD student at University of Patras in the Cell Cycle Laboratory led by Prof Dr Zoi Lygerou. His doctoral research within the RepliFate doctoral network aims to investigate the intricate connections between DNA licensing aberrations, cellular inflammation, and the formation of extrachromosomal DNA. In his master studies at the University of Geneva he focused on characterizing the molecular mechanism known as DREAM and its impact on transcription in olfactory sensory neurons, conducting research in both mice and flies.

Emilio Lecona
Emilio Lecona is the head of the Chromatin, Cancer and the Ubiquitin System lab, where they try to unravel how the post-translational modification of proteins by ubquitin and SUMO regulates DNA replication and the response to replication stress. Emilio obtained his PhD in Biochemistry and Molecular Biology in the Universidad Complutense de Madrid. After a postdoc in the lab of Danny Reinberg in NYU, he started working on DNA replication in the CNIO, as part of the lab of Óscar Fernández-Capetillo. In 2018, he established his independent research group in the Centro de Biología Molecular Severo Ochoa.

Zoi Lygerou
Zoi Lygerou heads the Cell Cycle Laboratory at the University of Patras. The lab studies the control mechanisms which safeguard genomic stability, by ensuring once per cell cycle replication in eukaryotic cells, and how defects in this control may lead to tumorigenesis. The process of duplication of a cell's genetic content must be precisely regulated in time and space, and must promptly respond to intracellular and extracellular cues such as DNA damage or differentiation signals. We combine diverse experimental approaches: molecular-cell biology studies in human cells, genetic studies in fission yeast, analyses of tumor specimens, advanced live cell imaging and modelling of biological networks.

Juan Méndez
Juan Méndez is Group Leader at the Spanish National Cancer Research Centre (CNIO). His lab studies the process of genome duplication and its molecular alterations in cancer cells. Recent research by the lab has defined new regulatory elements of replication origins—the genomic regions that serve as starting sites for DNA synthesis- and has expanded our understanding of how DNA replication can still take place on damaged DNA molecules. From 1997-2004 Juan was a Postdoctoral Fellow at B. Stillman's Group, Cold Spring Harbor Laboratory, New York (USA), studying functions of a number of human DNA replication proteins and the replicative process in cancer cells.

Claudia Schnugg
Dr. Claudia Schnugg is an Austrian curator and artscience scholar exploring the intersections of art, science, and technology. Founding curator of the Universe Pavilion in Venice, she develops international exhibitions, residencies, and research initiatives. She is the author of Creating ArtScience Collaborations (Springer, 2019).

Ran Tong
Ran Tong is PhD student at Centro de Biología Molecular Severo Ochoa (CBM), CSIC-UAM in the laboratory of Prof Dr Maria Gómez Vicentefranqueira. Her doctoral studies within the RepliFate doctoral network focus on replication dynamics, nascent transcription and chromatin conformation changes upon cell commitment.

Maria-Elena Torres-Padilla
Prof. Dr. Maria-Elena Torres-Padilla is Director of the Stem Cell Center; Director of the Institute of Epigenetics and Stem Cells; Director of Biomedicine at the Helmholtz Pioneer Campus; Professor for Stem Cell Biology, Faculty of Biology of the Ludwig-Maximilians-University Munich (LMU). Throughout her scientific career, Maria-Elena Torres-Padilla has been interested in understanding the mechanisms that regulate cell fate and underlie cellular identity. Her research focus lies on the epigenetic mechanisms that regulate the transitions of cellular plasticity and epigenetic reprogramming after fertilization in mammals, with the long-term goal of understanding how totipotency is established, maintained and how it can be experimentally manipulated.

Anna Dumitriu

The Mutability of Memories and Fates

First artistic residency at the IES at Helmholtz Munich

IN FORMATION



The Mutability of Memories and Fates, installation view, Alte Schmiede Hallein
photo credit Alex May

In spring 2020, artist Anna Dumitriu was invited to the IES as its first artist-in-residence, with her project proposal *The Mutability of Memories and Fates*. Taking up the scientific language used to describe the research conducted in the laboratories, the project responds to the concepts of "cell memory" and "cell fate". The resulting exhibition presents a series of artworks developed through artistic research into epigenetics and stem cell biology. Dumitriu explores the scientific meanings of these terms while drawing connections to their cultural, philosophical, and poetic resonances, opening up ideas of alchemical transformation, myth-making, and the creation and transformation of life.

At the centre of the project are questions concerning the coding of living matter and the mutability of cells: Are cellular pathways predetermined, and what determines their constancy, flexibility, and potential for change? How might our growing ability to understand and intervene in cellular processes transform our ideas of life, care, and the human body? The work also considers the implications of a deeper understanding of cell biology for healthcare and disease prevention, as well as broader questions about the nature and limits of life.

All the cells in our body have exactly the same DNA, but different cell types are very different from one another because they are expressing different genes. The study of how this works, how the cell packages DNA and what impact that has, is known as epigenetics. An important aim of epigenetics and stem cell research is to develop regenerative medicine, to extend life and perhaps to even create 'spare parts' for humans. From a cultural perspective this work links back to ancient mythologies and alchemy. Thus, not only key questions and insights of the scientific research influence the development of the artworks, but they are brought in dialogue with key concepts such as



Dr Clara's Jumping Genes, installation view,
Alte Schmiede, Hallein
photo credit Alex May



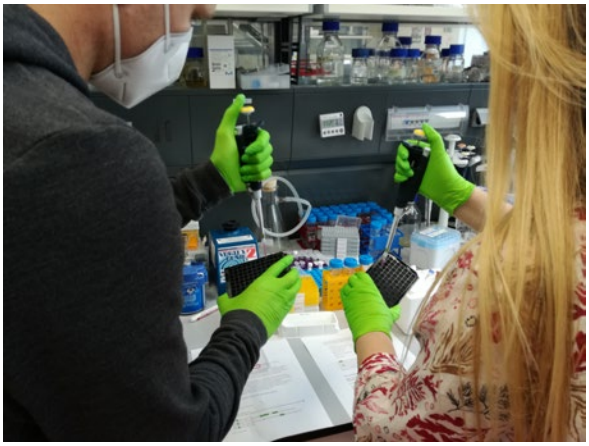
Workshop Cellular Reprogramming Necklace
photo credit Anna Dumitriu

philosophical questions of what it means to be able to re-create replacement parts for living bodies, prolonging life, and what it means to create life.

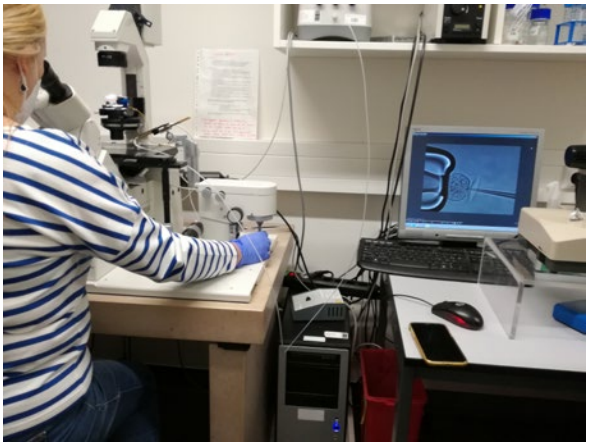
From a cultural and historical perspective, these scientific developments resonate with much older ideas of transformation, regeneration, and the creation of life. Dumitriu's work therefore brings scientific research into dialogue with mythologies and alchemical traditions, particularly with the idea of the philosopher's stone as a substance capable of transformation and regeneration. Alongside the scientific questions emerging from the laboratory, the artworks engage with philosophical questions about the possibility of creating replacement parts for living bodies, prolonging life, and intervening in the processes through which life is created and transformed.

Over more than four years of collaboration with the scientific groups at the IES and with numerous individual researchers, Anna Dumitriu developed a comprehensive body of work informed by scientific questions, laboratory experiments, philosophical discussions, and hands-on exchanges between artist and scientists. Her artistic process connected experiences and observations from the laboratory with extensive cultural and historical research. The resulting works bring scientific language, laboratory processes, and visual experiences into dialogue with cultural symbols and historical references, including the philosopher's stone, the golden egg, and the recurring colours blue and gold. References to alchemical processes and beliefs further connect contemporary cellular research with longstanding human attempts to understand, transform, and shape life.

Throughout the process of the residency, the body of work unfolded through a series of on-site residencies, hands-on experiments in the lab, experiments the scientists performed inspired by a guiding question presented by the artist, artistic workshops for the scientists, and virtual discussions and interactions.



Anna Dumitriu and Stephan Hamperl in the lab, photo credit Claudia Schnugg



Hands-on work in the lab, photo credit Claudia Schnugg

List of all artworks developed in the residency:
Cellular Reprogramming Necklace (2021)
Father and Mother (2021)
Cell Division (2021)
Dr Clara's Jumping Genes (2021)
Cellular Memory (2021-24)
Performance of Care (2023)
Totipotence (2023)
Identity in Flux (2023)
The Mutability of Memories and Fates – video installation (2024)
The Mutability of Memories and Fates – framed slides (2024)
The Mutability of Memories and Fates – bottle with cells (2024)

The residency was coordinated by Professor Maria Elena Torres-Padilla (Director of the IES), Amelie J. Kraus (Scientific Coordinator of the Epigenetics @HMGU community) and curated by Dr Claudia Schnugg.

Exhibitions and Outcomes

A work-in-progress showcase of the Cellular Reprogramming Necklace and Cellular Memory took place at the Deutsches Museum in Munich for the 60th Anniversary of the Helmholtz Zentrum on 18th November 2021.

Works from the series are on permanent display in the foyer at the Institute of Epigenetics and Stem Cells in Munich, Germany since November 2021.

The Cellular Reprogramming Necklace was part of "BioArt Alchemy", a solo exhibition of works by Anna Dumitriu at Spazju Kreattiv in Valletta, Malta, from 16th September 2022 – 30th October 2022.

The Cellular Reprogramming Necklace and Cellular Memory were exhibited at the EPIC Conference, a joint conference by the three specialist science networks: EpiGene3Sys, ChromDesign and INC-Spain that took place from 17th to 20th October 2022 in Granada, Spain.

The Cellular Reprogramming Necklace was part of BioArt Revolution/ Revoluția BioArt, an innovative solo exhibition by Anna Dumitriu which brought together contemporary artistic approaches and modern scientific experiments to address issues of global relevance such as infection, climate change, and diversity. The show took place as part of Timișoara 2023 European Capital of Culture, from 30th September to 1st October 2023. The exhibition, which was created in collaboration with the Romanian Science Festival, took place in the stunning setting of Bastionul Maria Theresia, Galeria 2, Str. Hector, nr. 1, Timișoara, Romania.

The Cellular Reprogramming Necklace was part of BioArt Knowledge: A Solo Exhibition by Anna Dumitriu at the Yarrow Gallery in Oundle, Near Peterborough, UK, from 9th November – 6th December 2023.

The Cellular Reprogramming Necklace was part of "The Alchemist" BcmA Gallery, Berlin, Germany, 22nd January – 9th February 2024

The project was presented at LMU Biozentrum (Munich, Germany) on 12th June 2024 as part of the "Encounters in Art and Biology" Symposium.

"The Mutability of Memories and Fates" brought together all the works from the series of the same name, including new never before presented works, for the first time at Alte Saline in Hallein, Austria from 5th – 20th September 2024. The exhibition presented a series of artworks resulting from artistic research of epigenetics and stem cells. The artist, Anna Dumitriu, picks up the scientific expressions of "cell memories" and "cell fates, drawing connections between scientific uses and cultural or poetical meanings of these terms playing with notions of alchemical transformation and myth-making. There was an accompanying events programme. The exhibition was a collaboration with Schmeide, in cooperation with The Helmholtz Zentrum Munich and subnet, curated by Claudia Schnugg.

A fireside chat with Anna Dumitriu took place at Converge\SXSW London at Hoxton Arches, London, UK, on 4th June 2025 7-10pm and "The Mutability of Memories and Fates" and "The Cellular Reprogramming Necklace" were exhibited.

The project was presented in BioArt Transformations: A Solo Exhibition by Anna Dumitriu at the Regency Town House Basement Annexe, Brunswick Square, Brighton.

The Mutability of Memories and Fates and the Cellular Reprogramming Necklace were part of "In Formation", Muffatwerk, Munich, Germany, from 5th – 8th July 2026. The exhibition uncovered hidden layers that shape life and knowledge: those where biology and science are not fixed, but constantly shifting and reforming. The exhibition was curated by Claudia Schnugg with scientific partners Helmholtz Munich, Institute of Epigenetics and Stem Cells.

Anna Dumitriu led an in-person workshop at the Institute of Epigenetics and Stem Cells at the Helmholz Zentrum in Munich (Germany) exploring cellular reprogramming and cell memory, as part of her art residency, on 10th August 2022.

Awards
"The Mutability of Memories and Fates" was a finalist in Falling Walls 2024 (Berlin) competition in the Art and Science Category.

Scientist's reflection on the experience of working with artists-in-residence

Adam Burton

Our Institute of Epigenetics and Stem Cells collaborated with Anna Dumitriu on the project titled *The Mutability of Memories and Fates* between 2020 and 2024. I was particularly involved in the piece *Cellular Reprogramming Necklace* which we envisaged, planned and prepared together. More recently we collaborated with Helen Pynor on a project titled 'Transformation through Replication' as part of the Replifate European Union-funded research network between 2024 and 2026. Over the course of these collaborations, I had many interactions with Anna and Helen, which were always highly stimulating.

I found the discussions I had with Anna Dumitriu over the realization of the *Cellular Reprogramming Necklace* very thought-provoking. The necklace is based on the structure of the Oct4 gene, a key pluripotency gene that can also be used to reprogram various cell types to induced pluripotent stem cells (IPS cells). The process of converting the data we had to a physical model of the Oct4 gene generated numerous questions which pushed me to think beyond the data and to imagine what it represents in the real world.
For example, the DNA in our cells is wrapped around histones to form chains of nucleosomes. To more accurately model the gene, we needed to determine the number of such nucleosomes present on the Oct4 gene, a relationship I had not previously considered. Similarly, we also used additional datasets to model different conformations of the nucleosome and three-dimensional organisation of the gene. I came to realize that the discussions and considerations involved in converting the data to a physical model can be extremely illuminating for the interpretation of data. Importantly, this process also highlighted an appreciation of what we don't know and the area of uncertainty.
This is an extremely important element of scientific enquiry that should be better communicated to the wider community. This principle was masterfully highlighted through the collaboration we recently had with Helen Pynor as part of the Replifate network (see pages 68ff.).

A highly productive discussion as part of the *The Mutability of Memories and Fates* **work centered around the process of cellular reprogramming. We discussed with Anna Dumitriu the possibilities of reprogramming and programming cells to different lineages. Anna asked the simple question of how many times this could be done and whether it could be achieved between different cell types. This question was extremely original and thought-provoking to the scientists in the room. This is because across current research this process is performed only once and in one direction. Generally, a single lab specializes in one cell type and thus the question of converting back and forth between different cell types was entirely new to us.**

We thus initiated a project spearheaded by Dr. Federico Pecori to attempt such an ambitious experiment.
Finally, after 9 months of optimization, we succeeded; one cell culture dish of IPSCs, became brain cells (neuronal progenitor cells), were turned back to IPSCs, then became lung cells (alveolar epithelial cells), were turned back to IPSCs, became heart cells (cardiomyocytes that actually beat in cell culture), turned back to IPSCs, and became liver cells (hepatocytes), finally ending up as IPSCs again.
This project also opens up numerous additional opportunities to reveal deeper insights into the foundations of cellular plasticity and cell fate. Thus, as is generally the case, the true impact of such a collaboration is not just about the outcome but about the process. It resides in what we learn, how boundaries are broken down and new horizons come into view. In this way, I have become firmly convinced that such interactions with persons who hold different outlooks and experiences from outside the established corridors of scientific inquiry can challenge dogmas and self-imposed limits and strike inspiration into the process of research.



The Mutability of Memories and Fates, installation view, Muffatwerk
photo credit Alex May

The Mutability of Memories and Fates

The central artwork resulting of Anna Dumitriu's residency is *The Mutability of Memories and Fates.* By responding directly to central scientific research questions and experiments in the laboratory, Dumitriu provoked an ambitious and challenging experiment: challenging ideas and lab protocols, unfolding through several months of trial and error, acquiring new skills, and several months of procedures. Weaving scientific and artistic work, the artwork was realized as a trilogy.

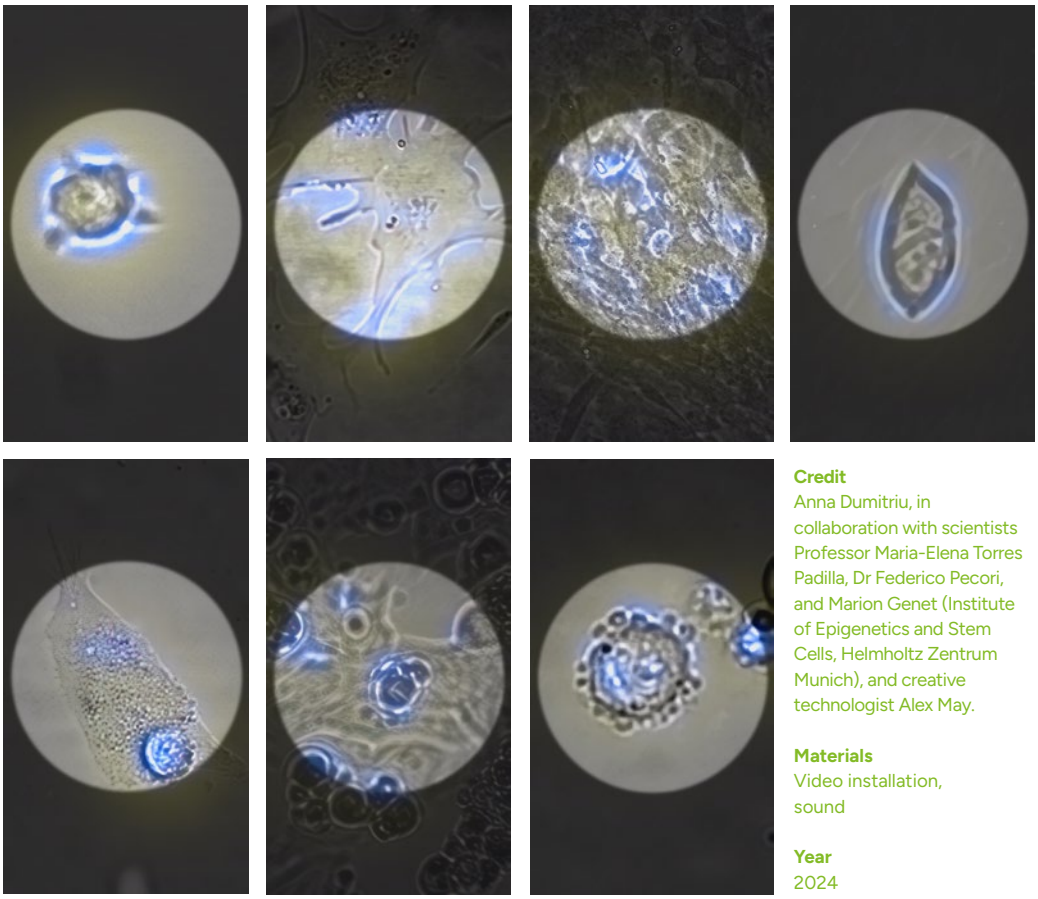
The trilogy unfolds through three elements: a video installation with sound that follows the continuous transformation of the cells throughout the experiment; a framed work that captures cells at different moments in this process, preserving each stage of their transformation; and a bottle containing half of the cells that lived through all these different lives. The remaining cells are still kept in the freezer, awaiting their return to future experiments.

Do induced pluripotent stem cells (IPSCs) still have 'memory' (traces of previous differentiated cells that they once were that remain in the chromatin structure of their DNA)? Pluripotent cells stem cells are a condition of stem cells that other body cells can be reversed to. Poetically speaking their fate of being a neuronal cell can be changed or removed, and their new fate might be to become a heart cell. How are cell memory and cell fates connected? Research in this field contributes to the development of regenerative medicine.

Dumitriu proposed a groundbreaking and ambitious experiment to take the exact same population of IPSCs, differentiate them into four different cell types and turn them back to IPSCs in between each stage to see what would happen. An experiment like this has never been done before, and the research collaborators considered it to be very challenging and exciting idea.

So, the cells in this video lived four different lives, from IPSCs, they became brain cells (neuronal progenitor cells), were turned back to IPSCs, then became lung cells (alveolar epithelial cells), were turned back to IPSCs, became heart cells (cardiomyocytes that actually beat in cell culture), turned back to IPSCs, and became liver cells (hepatocytes), finally ending up as IPSCs again.

This idea of 'transformation' of cells echoes the aims of the alchemists, and their desire for immortality. But if we had immortal lives, what would we do with them? Would we constantly transform our selves to stave off boredom, would we be artists for 100 years, the decide to become scientists for a while, or sleep for decades like ancient vampires might?



Credit
Anna Dumitriu, in collaboration with scientists Professor Maria-Elena Torres Padilla, Dr Federico Pecori, and Marion Genet (Institute of Epigenetics and Stem Cells, Helmholtz Zentrum Munich), and creative technologist Alex May.

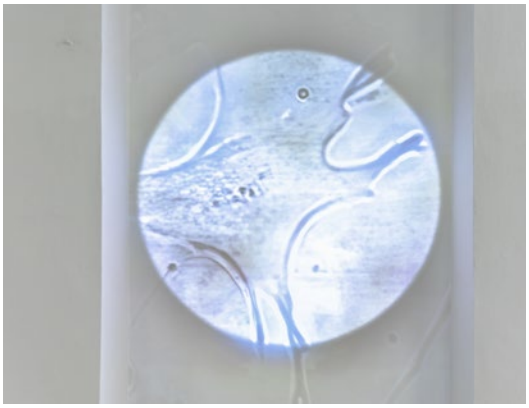
Materials
Video installation, sound

Year
2024

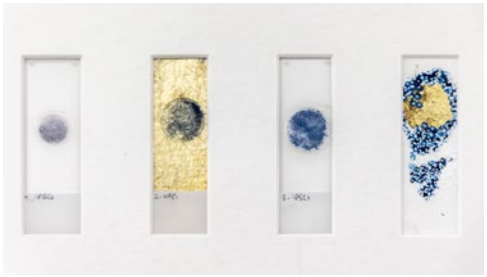
The Mutability of Memories and Fates, video stills
image courtesy of Anna Dumitriu

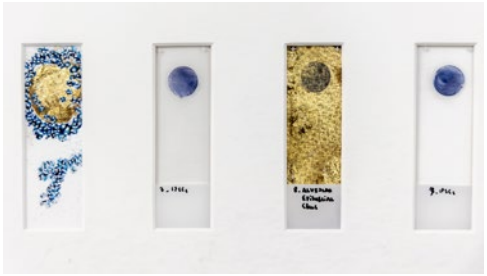
This work contains microscope slides of the actual cells from *The Mutability of Memories and Fates* that have lived four different lives, alongside pen drawings, the gold leaf highlights the transformed cells.
Gold was symbolically associated with immortality and eternal life in ancient Egyptian mythology and in the Middle Ages alchemists sought to transform base metals into gold, viewing it as a means to achieve the philosopher's stone, which was believed to grant eternal life and immortality.











The Mutability of Memories and Fates,
installation view video work (top),
framed work, details microscope slides (bottom)
photo credit: Stefanie Winkler

Credit
Anna Dumitriu, in collaboration with scientists Professor Dr Maria-Elena Torres Padilla, Dr Federico Pecori, and Marion Genet (Institute of Epigenetics and Stem Cells, Helmholtz Zentrum Munich).

Materials
Microscope slides with brain cells, lung cells, heart cells, liver cells, and Induced Pluripotent Stem Cells, pen drawings, gold leaf

Year
2024

This antique bottle contains the remains of actual cells from *The Mutability of Memories and Fates* that have lived four different lives, in their final form as induced pluripotent stem cells. The bottle is reminiscent of a genie's bottle, containing mystical knowledge. It is sealed with gold sealing wax with copper sulphate-soaked ribbons. The cells in this bottle have been allowed to die, however another vial of cells is frozen, in a state of suspended animation, ready to be re-awoken, in the lab at the Institute of Epigenetics and Stem Cells, Helmholtz Zentrum Munich.



Credit
Anna Dumitriu, in collaboration with scientists Professor Dr Maria-Elena Torres Padilla, Dr Federico Pecori, and Marion Genet (Institute of Epigenetics and Stem Cells, Helmholtz Zentrum Munich).

Materials
Antique bottle, Induced Pluripotent Stem Cells, sealing wax

Year
2024

The Mutability of Memories and Fates, ornamental antique bottle containing cells
photo credit Alex May

Scientists' reflections on The Mutability of Memories and Fates

Maria Elena Torres Padilla

The experiment idea that arose during our conversations with Anna is highly original. It is like a way of putting very 'simple' questions into a rather complex biological approach. I was very surprised when this came during our conversations – so the people in my lab, Federico Pecori, Adam Burton and Marion Genet. I guess that the reason why I liked it was because I thought to myself: "Ah, why has no one attempted this before?" Then I started to think about what the experiment represented and started to understand why. There were several steps on the experiment, all rather complex (and thus prone to failure). However, the importance of the question and the simplicity by which it was being asked struck me. This is definitely something that the field should think of, and the approaches that come from the conversations with Anna are thoughtful – in essence, what we, scientists, need, are questions that we can 'break down' in pieces, experimentally, so that we can address them.

Reflection on The Mutability of Memories and Fates

Federico Pecori

Working with Anna on the project "The Mutability of Memories and Fates" has been an intellectually and experimentally stimulating task. Many of the protocols we used for this project had to be optimised in the lab and required several months of testing. Nevertheless, I think that her question, that sparked from a philosophical perspective, served also a scientific pilot experiment, opening interesting avenues in the field of stem cells reprogramming.

Totipotence

The DNA of a differentiated cell can be wiped in the lab to create an induced pluripotent stem cell. These cells can become almost any cell type, for example skin, or heart cells but they cannot become placenta cells. Only a 'totipotent' (wholly potent) cell, like a human zygote, can become any cell type whatsoever. But so far, the ability to create totipotent cells in the lab is elusive.

Dumitriu was interested in whether a bird's egg would be considered a totipotent cell, and this artwork explores that philosophical question. A golden goose egg (alluding the to the idea of the goose that lays the golden egg, and the importance of gold in alchemy), encrusted with copper sulphate crystals (that Dumitriu used in culturing cells in the lab), sits on a handmade bird's nest impregnated with 2-cell-like-cells. These cells sometimes appear in cell cultures and are subset of pluripotent stem cells that closely mimic the gene expression and characteristics of the 2-cell stage of embryos. Their study provides crucial insights into early embryonic development, epigenetic regulation, and the potential for advancements in stem cell therapy and regenerative medicine.

This artwork is also a reference to a philosophical discussion Anna Dumitriu and Maria-Elena Torres-Padilla led:

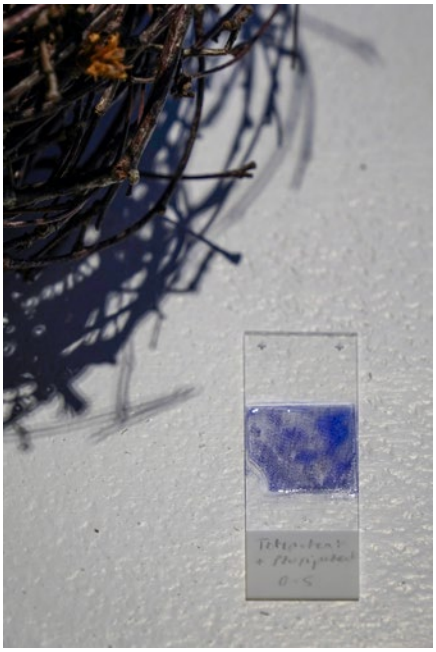
An induced pluripotent stem cell (IPSC) can be differentiated into almost any type of cell (except placenta). But totipotent cells (zygotes) can differentiate into every cell type (including placenta). To be able to create totipotent cells in vitro would be the gold standard for this research field, but at the moment this is difficult. Sometimes 2-cell-like-cells arise in vitro but they cannot be cultured in the same way as IPSCs. Anna Dumitriu collaborated with Adam Burton on this piece. The discussion between the artist and Professor Maria Elena Torres Padilla can be found below: "I'm sorry if this is a silly question, but are bird's eggs totipotent? Or how does it work?"

Anna Dumitriu

"In principle the answer is, I would say yes (e,g any egg which will generate a full organism is totipotent) – BUT – the concept is rather used in mammalian embryology rather than in e.g. frogs, chicken/duck etc. this is where it becomes semantic/philosophical – the egg itself is already 'partitioned' into two parts: the yolk and the 'embryo' – it has already two identities, so to say – the yolk will provide the food, as we know – and only a tiny part in the yellow (the embryo, sometimes seen as 'blood' spot in the yellow) will actually form the embryo – this is, I would say, why the totipotent word is not used here, because there are already two identities within the 'egg' whereas in mammals it is one single cell (the zygote) which will further split into two before implantation (the trophectoderm and the inner cell mass), and the support of the embryo (the trophectoderm, which will form the placenta) is only emerging later from this one cell (as opposed to the other species)."

Maria Elena Torres-Padilla





Totipotence, exhibition view (left), Totipotence microscope slide detail (right)
photo credit Alex May





Totipotence exhibition view (left), close-up (right)
photo credit Stefanie Winkler

Credit
Anna Dumitriu, in collaboration with scientist Professor Dr Maria-Elena Torres.

Materials
Handmade bird's nest form with copper sulphate covered blow goose egg

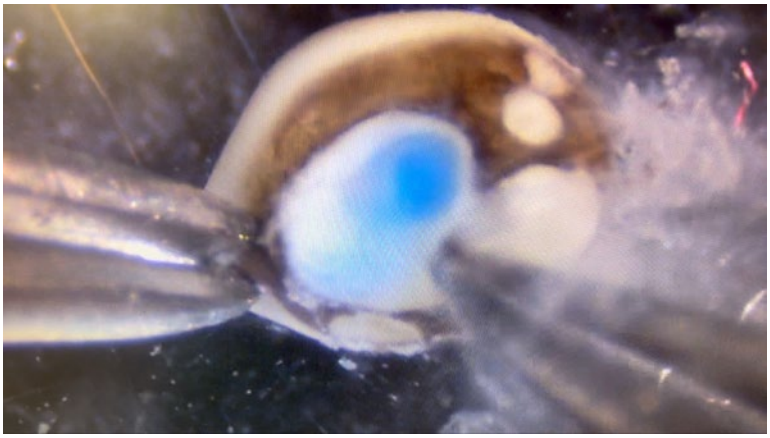
Year
2023

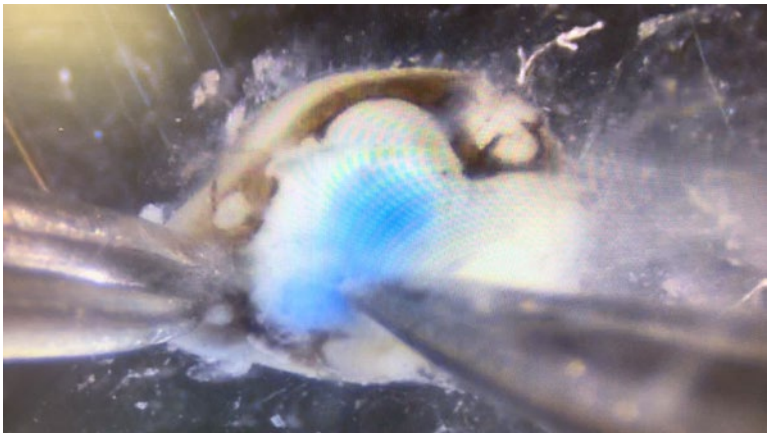
Identity in Flux

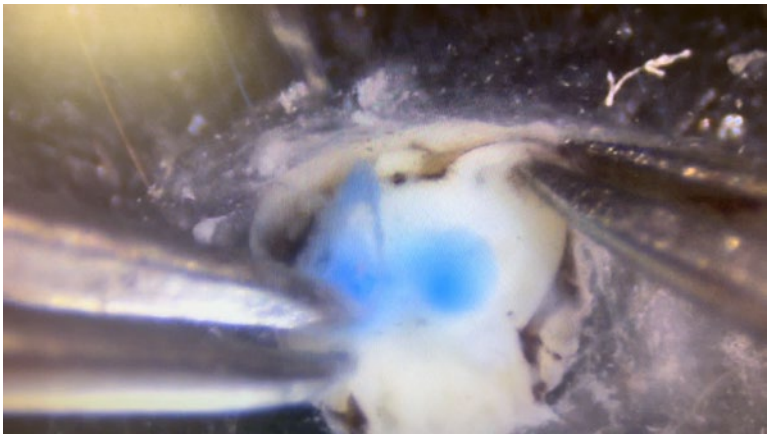
Anna Dumitriu performed and filmed the fiddly process of extracting the nucleus from a tiny surrounding frog (xenopus) egg through a microscope and using tweezers.
The nucleus was injected with blue dye in order to make it more visible (a normal process for teaching this skill to lab trainees).

She tears and rips at the outer rips at the sticky outer layers of the cell in an almost violent way to reveal the prized blue nucleus, attempting (and failing) to keep it fully intact.

This technique is used by the scientists to create nuclear transfer embryos where the nucleus is removed from an egg cell and replaced with the nucleus from another cell to create a viable, reconstructed embryo.It erases the cellular memory of the previous cell identity and allows for the establishment of totipotency which can give rise to any type of cell in the body. This technique has a fundamental impact on regenerative medicine and how, in the future, we might be able to create 'spare parts' for humans..







Identity in Flux, video stills
image courtesy of Anna Dumitriu

Credit
Anna Dumitriu,
in collaboration with scientist
Dr Eva Hörmanseder
(Institute of Epigenetics
and Stem Cells, Helmholtz
Zentrum Munich).

Materials
Video installation

Year
2023

Cellular Reprogramming Necklace

This sculpture in the form of a tangled necklace physically explores the chromatin structure of the OCT-4 gene. The OCT-4 gene is important for inducing an embryonic stem cell-like state, in effect wiping the memory of the cell (at least to a degree) and giving it the potential to become a different kind of cell. For example, the memory of a heart cell can be wiped in the lab, and it can be reprogrammed to be a brain cell.

Chromatin is a complex of DNA and proteins in our cells that packages long DNA strands into a more compact, dense shape, making it possible for the cell to control which genes are accessed and used. In eukaryotic cells (cells with nuclei) DNA is wrapped around histones and the tightness of this binding either prevents or allows the expression of genes. Heterochromatin is tightly packed and genes there are hard to access so are not expressed euchromatin, on the other hand, is loosely packed and the genes there are usually expressed.

The necklace, which brings a tangible and physical form to what is normally an abstract scientific model, is embedded with extracted chromatin from the OCT-4 gene. Copper sulphate was frequently used in the lab to help cells grow and so the artist has soaked the necklace in this other-worldly material which speaks to the alchemical processes she witnessed and participated in.



Cellular Reprogramming Necklace
photo credit Pei-Ying Lin

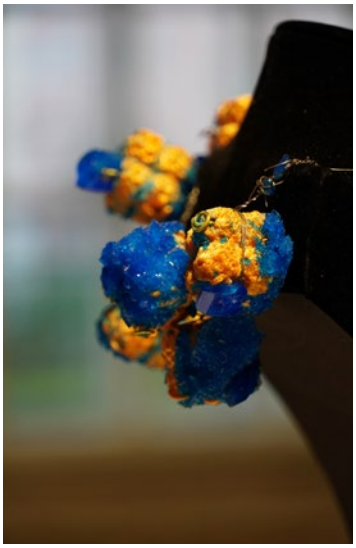


Cellular Reprogramming Necklace, close-up
photo credit Audrey Rose Mizzi

Credit
Anna Dumitriu,
in collaboration with
scientists Professor Maria-Elena Torres Padilla and Dr Adam Burton (Institute of Epigenetics and Stem Cells, Helmholtz Zentrum Munich) and creative technologist Alex May.

Materials
3D printing, jewellery wire, ribbon, copper sulphate, DNA

Year
2021



Cellular Reprogramming Necklace, detail
photo credit Alex May



Cellular Reprogramming Necklace, exhibition view
photo credit Stefanie Winkler

Curatorial reflection

Claudia Schnugg

When Anna Dumitriu was invited in early 2020 to become the first artist-in-residence at the Institute of Epigenetics and Stem Cells (IES) at Helmholtz Zentrum München, neither of us knew that the residency would develop into a collaboration lasting more than four years. Initially planned as an opportunity for the lab to experience an artist-in-residence program for the first time, to develop a small artwork for the Helmholtz 60 year anniversary, and for Anna Dumitriu to explore epigenetics and stem cell research, the residency soon became a much more reciprocal process. The pandemic meant that it started as one of the first online residencies, with conversations between the artist and scientists across all groups at the IES. Over time, this developed into a hybrid residency combining online exchange, laboratory visits, experiments, workshops, and continuous discussion.

What I found particularly interesting was that not everything that happened during the residency needed to become an artwork. Dumitriu proposed questions and experiments, followed connections between different research groups, and sometimes challenged assumptions or protocols. One introductory experiment, for example, produced an unexpected result that did not fit easily into the existing research framework. Rather than simply being dismissed, it led to further discussion and additional experiments. For me, this was one of the most interesting potentials of the collaboration: neither the artist nor the scientists did simply have to provide answers, but could introduce questions from a different perspective and make connections that might otherwise remain unnoticed.

This became especially tangible in the making of the *Cellular Reprogramming Necklace*. The artwork translates the OCT-4 gene and its chromatin structure into a three-dimensional sculpture. The first prototype was developed together with Dr. Adam Burton and later produced in a workshop with several members of the IES. The workshop became an important moment for both sides. For the artist, it opened up the artistic process to the scientists and created another space for discussion. For the scientists, abstract structures that they normally encountered as drawings, models, or animations became something they could physically construct and touch. Interestingly, the materialisation of the model also exposed details that were less visible in its usual representations. Scientists questioned whether certain distances were correct, and discussions emerged about details of chromatin binding that were not fully known in the detail of how it could be translated to a physical sculpture. The sculpture therefore did not simply illustrate existing knowledge. In the process of making it, uncertainties and open questions became more apparent. This is one of the aspects of art-science collaboration that I find most valuable: translating knowledge into another form can also reveal where that knowledge is incomplete.

The same dynamic can be found in *The Mutability of Memories and Fates*, which grew out of Dumitriu's question of how often a cell can be reprogrammed from one fate into another and whether traces of its previous identities might remain. What sounds like a simple question resulted in a highly complex experiment involving different cell fates, protocols, and areas of expertise. Bringing these together also revealed differences in terminology and laboratory practice. Protocols

that were self-evident within one specialised context were not necessarily so when transferred to another. In the process for this artistically initiated project, the protocols needed to be refined and scientific questions were prompted that led to further investigation. The experiment took more than a year to realise and generated observations that the scientists are now interested in following up through further experiments. For me, this is where the residency became more than an artistic response to scientific research. The artistic question entered the research process itself and, in doing so, created new situations in which scientists could look at their own work differently and open up new avenues in the laboratory and to keep in mind for potential future research.

Looking back, I see the value of this residency not simply in the artworks that were produced, or in their ability to communicate complex scientific ideas to a wider audience. It lies also in the conversations, experiments, and moments of uncertainty that emerged along the way. Art became a way of making things tangible, of asking seemingly simple questions, and of creating situations in which assumptions could be examined from another perspective. This, to me, is one of the particular strengths of bringing artistic practice into a scientific research environment.

From this scientific and artistic research process more emerged: an artistic body of work that draws from art historical references, cultural historical ideas, and philosophical questions on the core of the research in the laboratory. The very poetic and artistic take on the scientific language of "cell fates" and "cell memory" become entangled into those questions that have captivated humankind for millenia: what constitutes life? Can life or living entities be created? Is it possible to prolong life? Through these connections, Dumitriu's research moves beyond the immediate scientific questions of the laboratory and enters a much older cultural and philosophical terrain, one shaped by human desires, dreams, fears, and attempts to understand, transform, and perhaps extend the conditions of life.

Science does not operate outside of societal and cultural discourses. Dumitriu brings these questions into the work through a visual language in which scientific knowledge meets cultural memory. The relationship to alchemy, the philosopher's stone, and the golden egg evokes long histories of transformation, creation, immortality, and the search for forms of life beyond what is given. These references do not simply illustrate scientific research. They open it towards a wider field of cultural knowledge and imagery. This entanglement is also present in the visual language of the work. Dumitriu brings together cultural and historical references such as the egg and the use of gold, alongside historical elements in medicine, including the importance of certain organs in medieval medicine as well as in Alchemy which translates to the references to the heart, lungs, brain, and liver in the video work.These are placed in dialogue with the laboratory itself: the intense blue of copper sulfate, microscopy images, and scientific 3D models. Familiar symbols and scientific materials begin to occupy the same visual space. The laboratory becomes, in this sense, not only a site of experimentation, but a contemporary space of transformation, where ancient desires and speculative futures meet the very precise practices of contemporary science.

BIOS

Anna Dumitriu

Anna Dumitriu is an internationally renowned pioneering British contemporary artist who works with BioArt, sculpture, installation, and digital media to explore our relationship with nature and technology focussing on infectious diseases, synthetic biology, AI and robotics.

Past exhibitions include ZKM, Ars Electronica, BOZAR, The Picasso Museum, Kunstlerhaus Vienna, MIT Museum, HeK Basel, the Nobel Prize Museum, Science Gallery Bengaluru, MOCA Taipei, Art Laboratory Berlin, the History of Science Museum Oxford, the 6th Guangzhou Triennial and Eden Project.

She holds visiting research fellowship/artist-in-residence roles at the University of Hertfordshire, the University of Cranfield and the National Institute of Health Research Leeds Biomedical Research Centre, and an artist-in-residence roles with Modernising Medical Microbiology at the University of Oxford, and the Wellcome Sanger Institute. She was the 2018 President of the Science and the Arts Section of the British Science Association. Her work has featured in many significant publications including Frieze, Artforum International Magazine, Leonardo Journal, The Art Newspaper, Nature and The Lancet.

Dumitriu was artist in residence at the Institute of Epigenetics and Stem Cells at the Helmholtz Zentrum in Munich from 2020 to 2024 where she created the project “The Mutability of Memories and Fates”.

www.annadumitriu.co.uk

Maria-Elena Torres-Padilla
Prof. Dr. Maria-Elena Torres-Padilla is Director of the Stem Cell Center; Director of the Institute of Epigenetics and Stem Cells; Director of Biomedicine at the Helmholtz Pioneer Campus; Professor for Stem Cell Biology, Faculty of Biology of the Ludwig-Maximilians-University Munich (LMU). Throughout her scientific career, Maria-Elena Torres-Padilla has been interested in understanding the mechanisms that regulate cell fate and underlie cellular identity. Her research focus lies on the epigenetic mechanisms that regulate the transitions of cellular plasticity and epigenetic reprogramming after fertilization in mammals, with the long-term goal of understanding how totipotency is established, maintained and how it can be experimentally manipulated.

Adam Burton
Dr. Jonathan Adam Burton is the Deputy Head of Institute for Epigenetics and Stem Cells. Throughout he collaborated closely with Anna Dumitriu for the development of residency at the IES and worked closely with her in hands-on projects, microscopy techniques and for the development of the Cellular Reprogramming Necklace and other artworks in this series. He was also engaging with Helen Pynor throughout her residency at the IES.

Federico Pecori
Dr. Federico Pecori is a postdoctoral researcher at the Institute of Epigenetics and Stem Cells at Helmholtz Munich. In his research he investigates the genome architecture in mouse embryos. Throughout the residency of Anna Dumitriu he worked closely with her on The Mutability of Memories and Fates project.

Claudia Schnugg
Dr. Claudia Schnugg is an Austrian curator and artscience scholar exploring the intersections of art, science, and technology. Founding curator of the Universe Pavilion in Venice, she develops international exhibitions, residencies, and research initiatives. She is the author of Creating ArtScience Collaborations (Springer, 2019).

Additional scientists who have been working with Anna Dumitriu throughout her residency are Marion Genet, Dr Stephan Hamperl, Clara Hermant, and Dr Eva Hörmanseder.





Exhibition space showing works by Anna Dumitriu and Helen Pynor, Muffatwerk
photo credit Stefanie Winkler



Exhibition view showing works by Helen Pynor, Muffatwerk
photo credit Stefanie Winkler