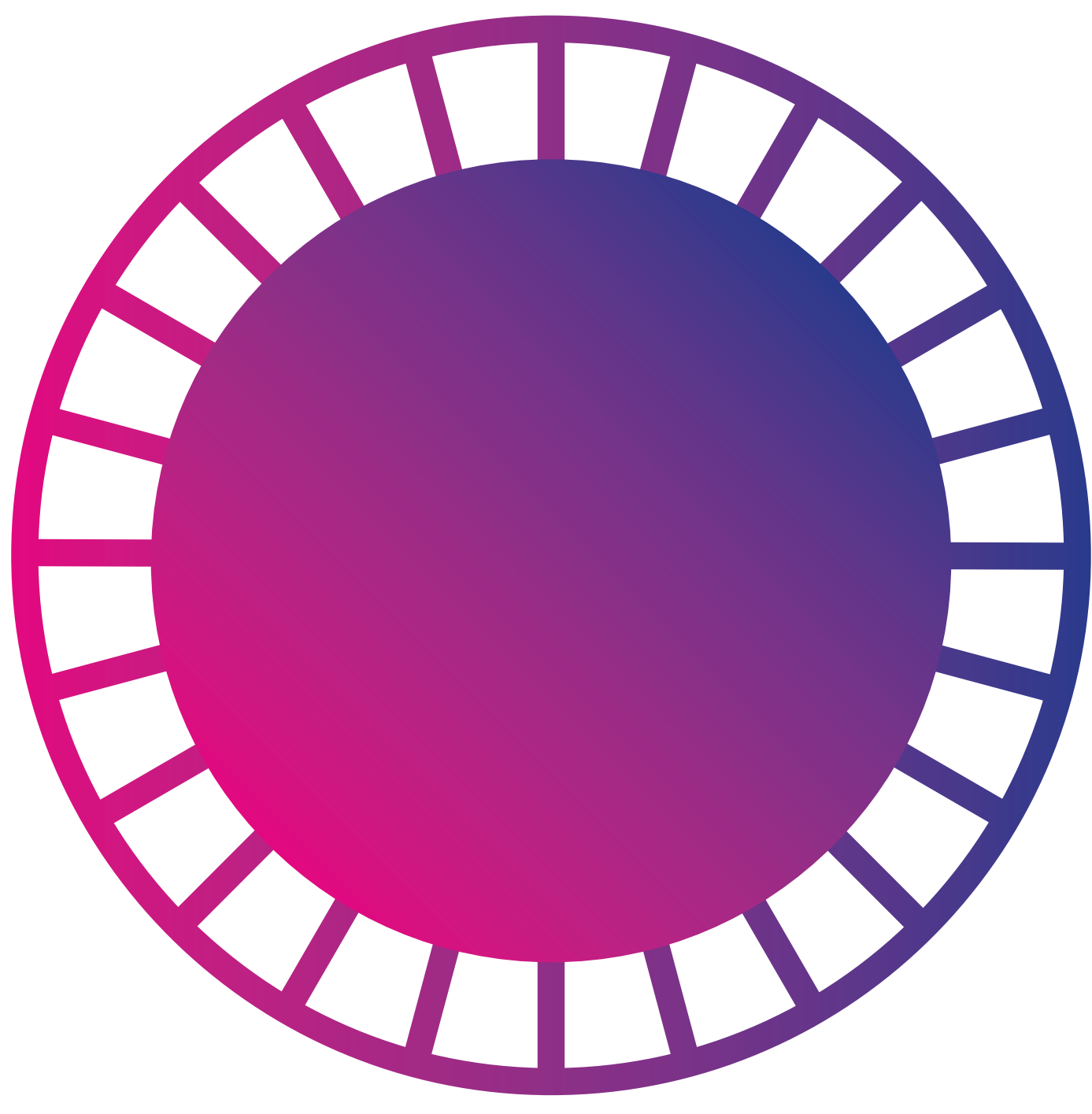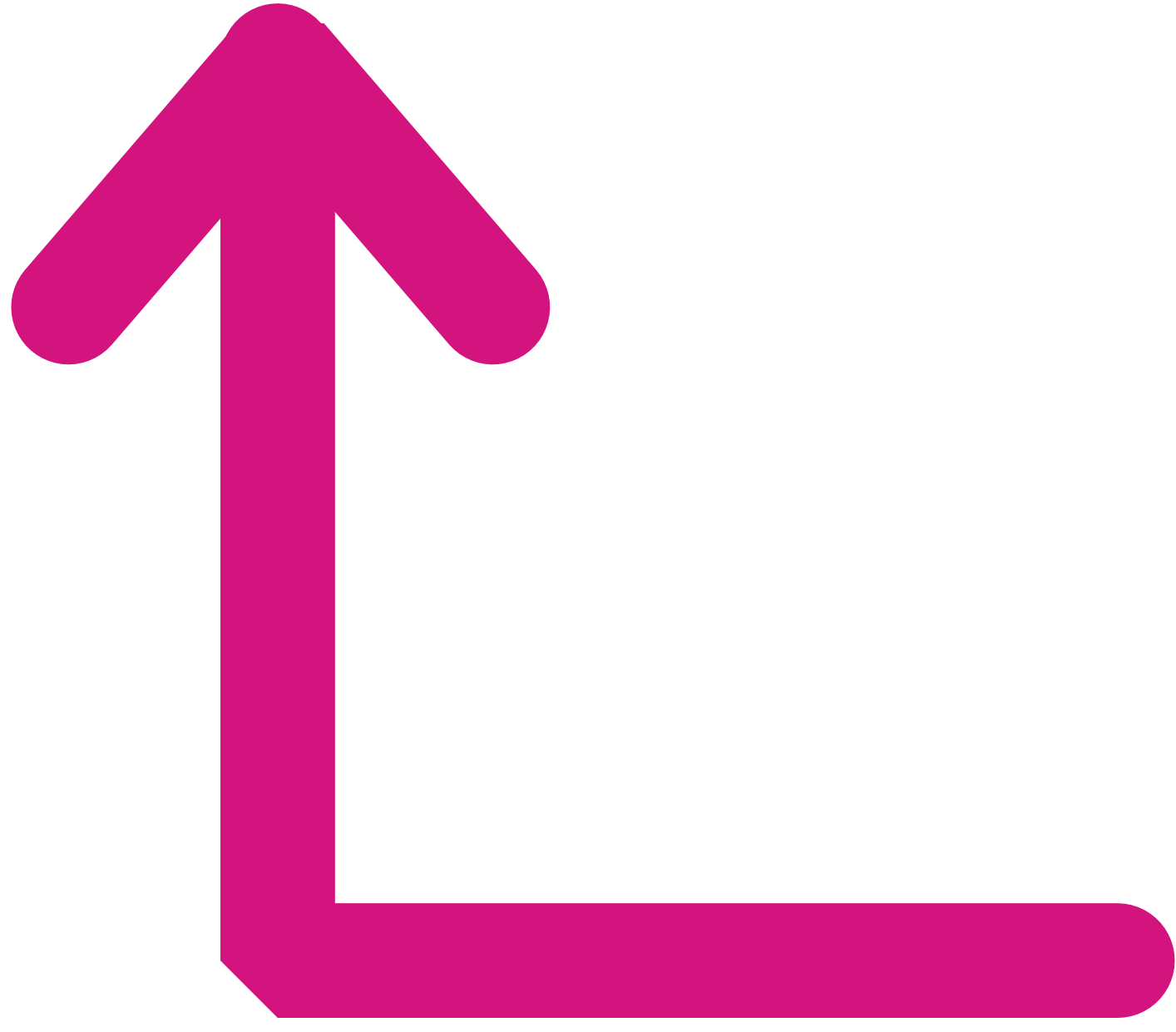Synthetic Biology Art Exhibition

For many, science and art are considered vastly distant from one another, but a scientist knows that their work requires individual artistry, and an artist in many ways understand the science within their art.

Featured in this booklet is art contributed to the exhibition that took place 13-15 May 2019 25 meters below the surface in the old nuclear reactor R1. All kinds of art were accepted, everything from audiovisual video works to petri-dish multiplayer experiences. Some may be funny and beautiful, and others were disturbing and thought-provoking. Everyone was eligible to participate regardless of the artistic level or expertise of synthetic biology.

From the artworks submitted, 5 winners were chosen based on creativity, innovation, and personal motivations. The winners, with one Grand prize winner, were rewarded a presentation in Osqledaren online (KTH magazine) as well as Medicor online (KI magazine). You find the five winning artworks on the first pages.

We hope these artworks will inspire you to start thinking about synthetic biology in new ways and open up for discussion. Posing the question; where do science end and art begin?

iGEM
stockholm

Triple Helix Feeling
## Sergio Pachon-Dotor
Y. Vladimir Pabon-Martinez

DNA can adopt different conformations depending on the base sequence and environment. In the year 1953, Watson and Crick based on the experimental data from Rosalind Franklin described the DNA structure as a double helix formed by two strands. Later in the year 1957, Felsenfeld and Rich demonstrated that a single strand (third strand) could interact with the DNA and create a triple helix structure. The third strand binds the purine-rich strand region into the DNA major groove by Hydrogen bonds (Hoogsteen interactions). Artificially, a synthetic sequence of modified or unmodified DNA or RNA (oligonucleotide) can replace the third strand. This type of oligonucleotides is called Triplex-forming oligonucleotides (TFOs).

TFOs can inhibit the transcription as a consequence of two different mechanisms (i) inhibiting transcription initiation by competing with transcription factor binding or (ii) arresting transcription elongation by binding further downstream in the transcribed gene. These TFO´s features can be used to develop novel therapeutically tools in gene therapy, especially for cancer or other genetic diseases.

Similar to the structure, the track (by Mass!ive Wave) begins with some violin notes which represented a natural instrument (DNA) and evolves until be combined with electronics notes (TFO), which give us the final musical composition (Triplex structure: DNA+TFO).

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youtu.be/ql90jtPGyhY
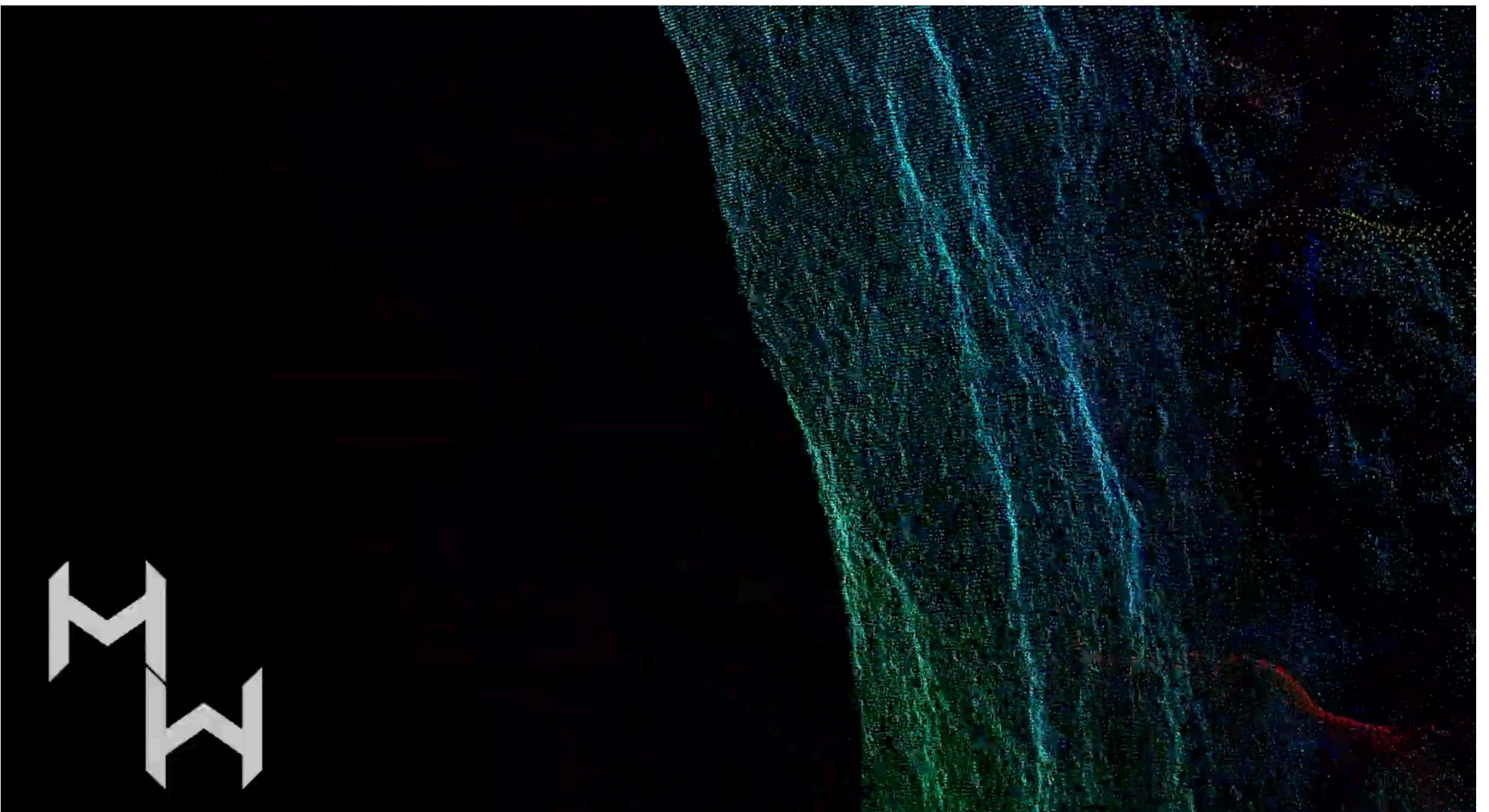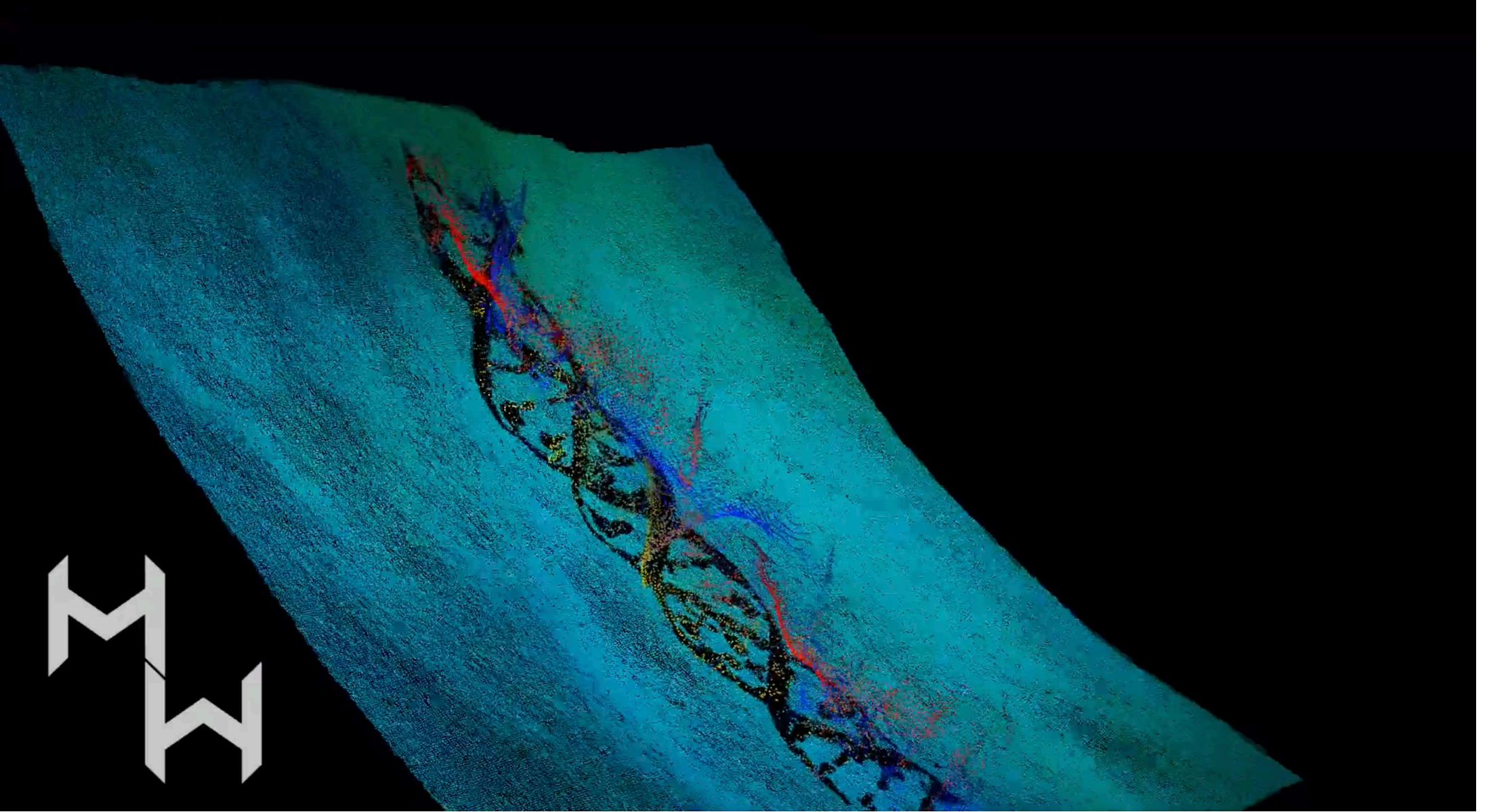
Osmos Kosmos
Linda Nurk

My artwork is aspirational research, a proof-of-concept incorporating natural elements to form embellishment, allure, and couture through the development of homegrown biosynthetic textiles. The textile is derived from the forced symbiosis of yeast and bacterial culture under controlled conditions. I aim to grow a breathing and living organism on the body to create an "Osmos" – The second layer of life, a membrane for exchange. If made from the same substance as the world, the human body does not end with its skin but instead expand into Kosmos.

lindanurk.com
osmoskosmos.com

Being a Dove & Making Senses
Maria Euler

Synthetic biology will challenge us to rethink what we perceive as natural. Biological cells, systems, and (on a higher level) bodies could be augmented and changed. Today we mostly think about cells and bacteria with new properties. But what if we gave ourselves new abilities or senses?

What if humans, like doves, could feel the electromagnetic field?

"Being a Dove" and "Making Senses" allowed the audience to experience the electromagnetic field for which today's humans do not have a "sense" The audience was able to construct their own tactile "magnetic senses" using neodymium magnets as well as exploring the field via augmented reality and sound. Thus we start thinking about the restrictions of our "original" biological bodies and how it would be to augment those with additional abilities and senses.

"Being a Dove" is a free-hanging electromagnetic coil composed of 95 loops of 500 meters of copper cable and a machine "sculpting" the electricity. 12 volt between 1 and 3 ampere and between 0.2 and 10 Hertz can be lead through the coil. The thus created electromagnetic field is slightly stronger than the electromagnetic field of the earth but still in the same order of magnitude and, therefore, perfectly safe. It is also beyond the audience perception. But if the audience explores the sculpture with neodymium magnets in their hands or attached to their body, those start dancing and vibration, allowing for an inherently tactile experience of the electromagnetic field.

Maximilian Karlander (PRO424) developed a sound experience of the electromagnetic field for the coil to allow the audience to perceive the electromagnetic field through other senses and interpretations as well.

We can not know how a new sense would feel like, but we can become aware where our perception currently ends and try to explore beyond it using multiple in and output tools and media to start asking "What would it be like to have new senses", "What would I like to be able to perceive", "Would it change my perception of the world and myself if I would have such abilities" and "What is even 'natural'".

mariaeuler.com
pro424.com

Slime Mould Chess
Håkan Lidbo

The Slime Mould Chess game is a collaboration between one of the most simple intelligence on earth - and the most advanced one. Slime mould and humans. It's inspired by synthetic biology in the sense of co-creation with nature and evolution.

Slime mold is an informal name given to several kinds of unrelated eukaryotic organisms that can live freely as single cells but can aggregate together to form multicellular reproductive structures. In this game, a small colony of slime mould is placed in the middle of each petri dish. Once a day, the players can place one piece of oat (their favorite food) at any of the dots inside the petri dish.

When the slime mold connects to the oat, the piece may move in that direction. The goal of the game is to take the opponent's pieces. Due to the slow movement of the slime mold, the players can move their pieces once a day.

hakanlidbo.com
rumtiden.com
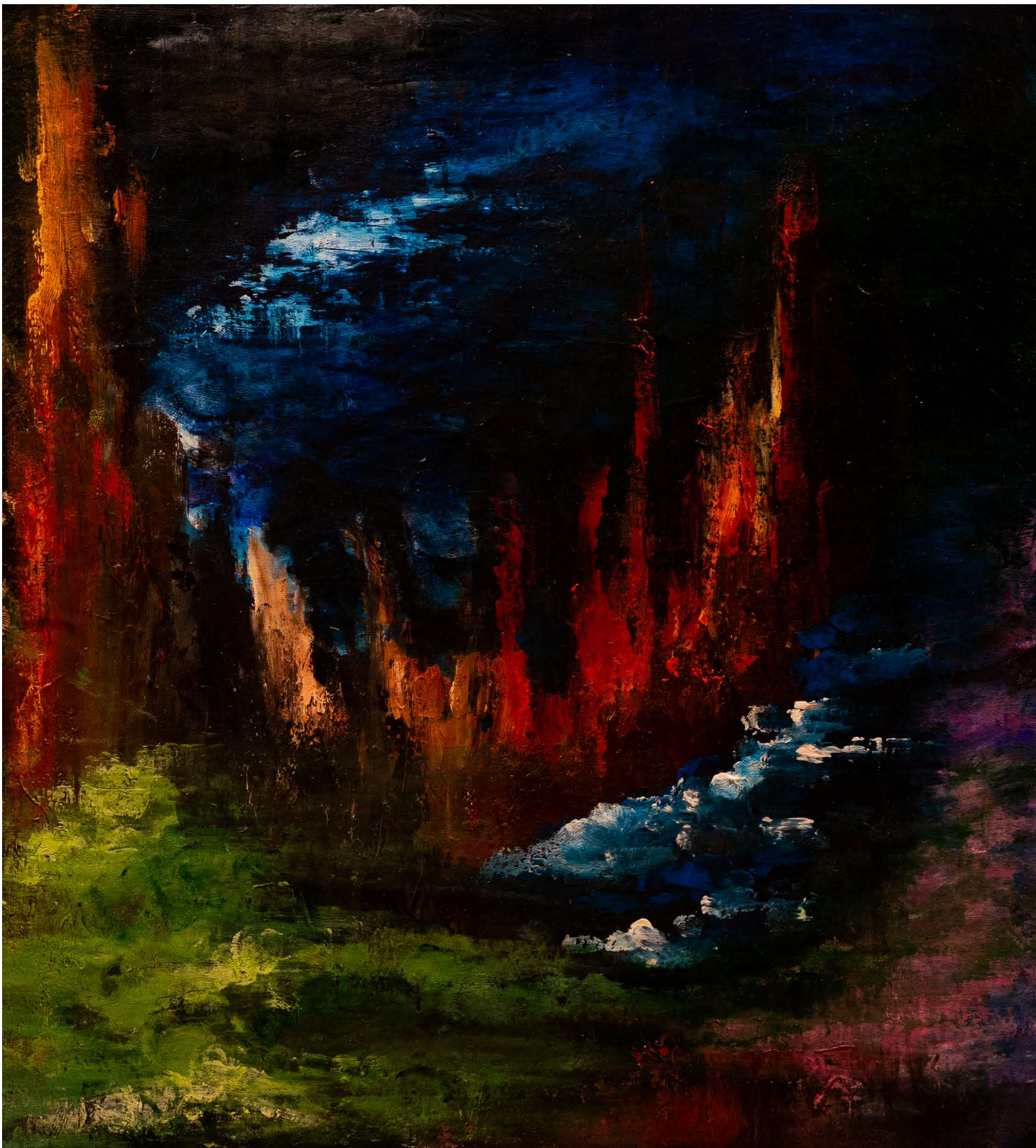
Mechamorphosis / Energy / Reaction
Basstian

Mechamorphosis. A withering collection of drawings, diagrams, and dissections of unknown origin and time. Mechanically enhanced reptiles and insects are impatiently scrawled in ink on parchment. A dragonfly with wings powered by springs and clockwork, and an iguanid driven by pistons and gears.

Alongside the sketches are acrylic artworks of colorful swirls in darkness together with sparse notes about their creation. They are called Energy and Reaction and are inspired by dynamic outcomes of biological modifications. Who is the creator of these observations, and where were they made? What do all the notes say, and what was the conclusion? Well, art is at its best when it asks rather than answers.
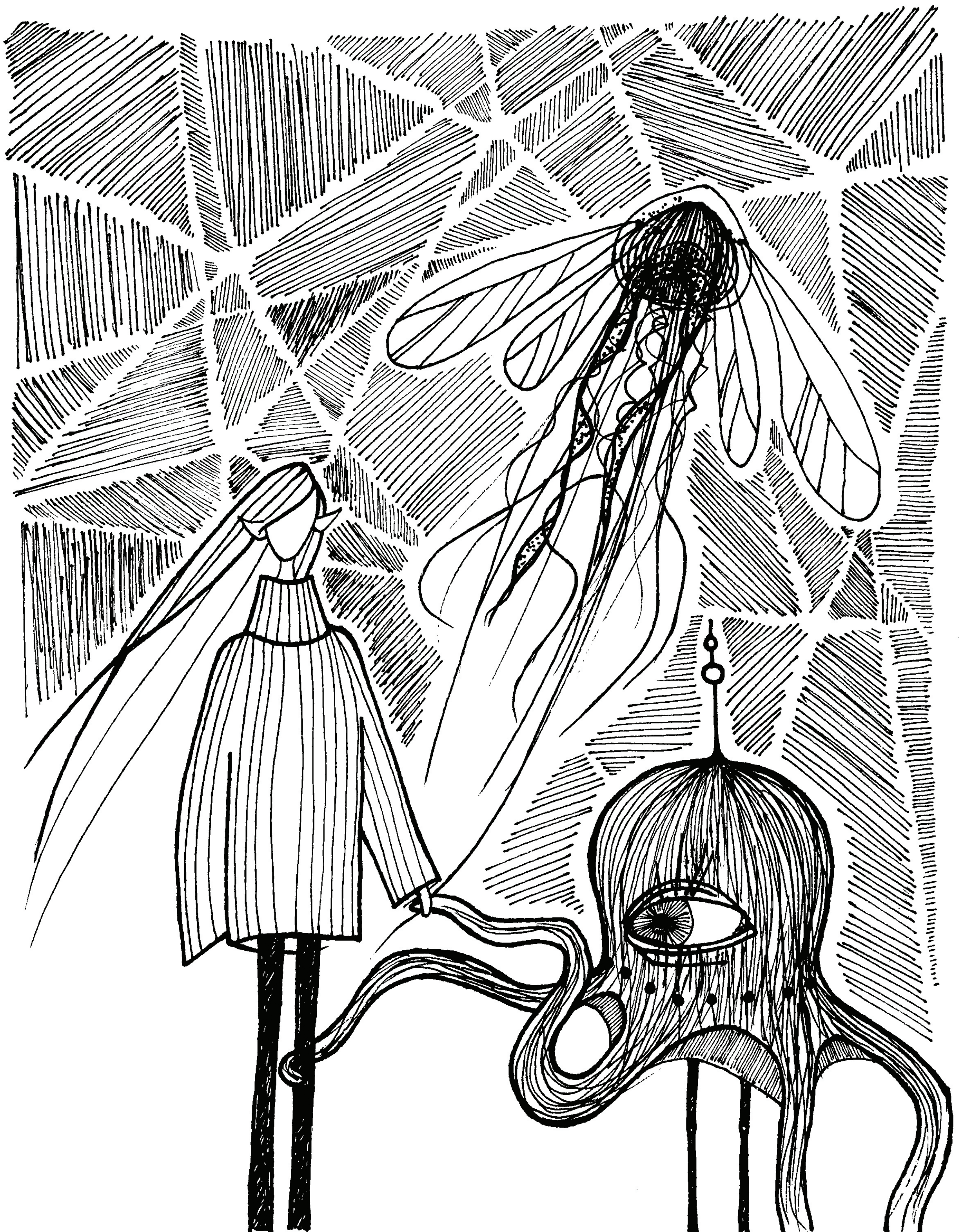
Fifty shades of mucus
Gilai Nachmann

The image displays a dried ovulatory cervical mucus sample.

# Darwin's finches
Hanna Tamas

The art piece is a tribute to Darwin and his study on finches, but it is also a representation of today's synthetic biology. A brief reminder of how organisms tend to lose their overall context when we study them in too much detail. Yet today, we cannot predict evolution nor the long-term impact of engineering skills on nature. But what we can do is to learn from Darwin and be more aware of natural surroundings in order to evade disastrous mistakes potentially created by genetic innovations.

Molter
Elin Kalldin Wikström

The work illustrates the skin that one has outgrown. If we humans could shred skin and grow into more mature giant beings, this would be the residual leftovers. One would feel weaker after the molting. But after some time it would make one stronger, better and more mature.

@konstinsta
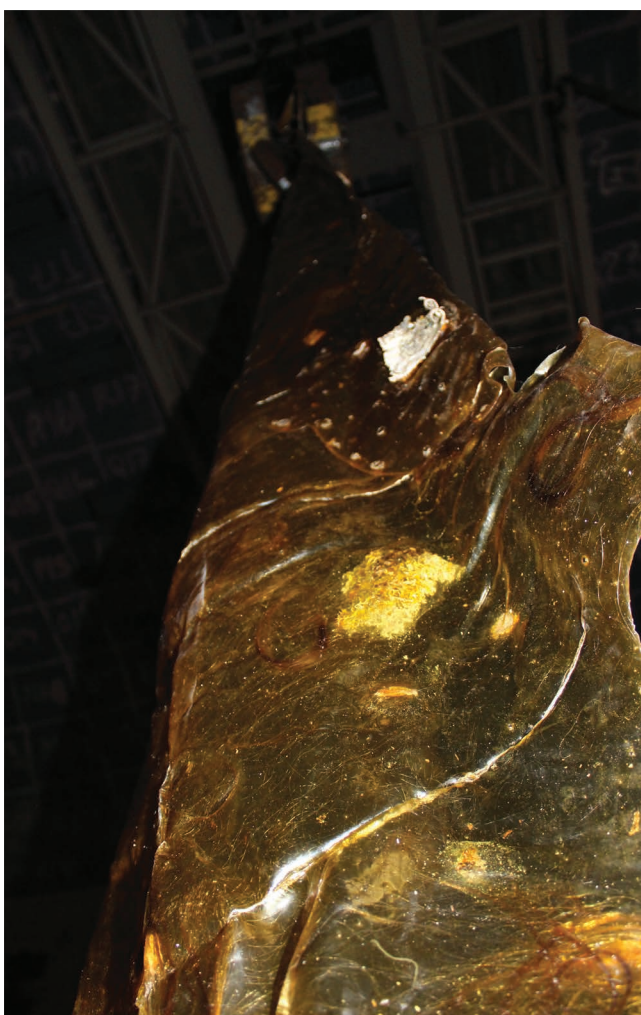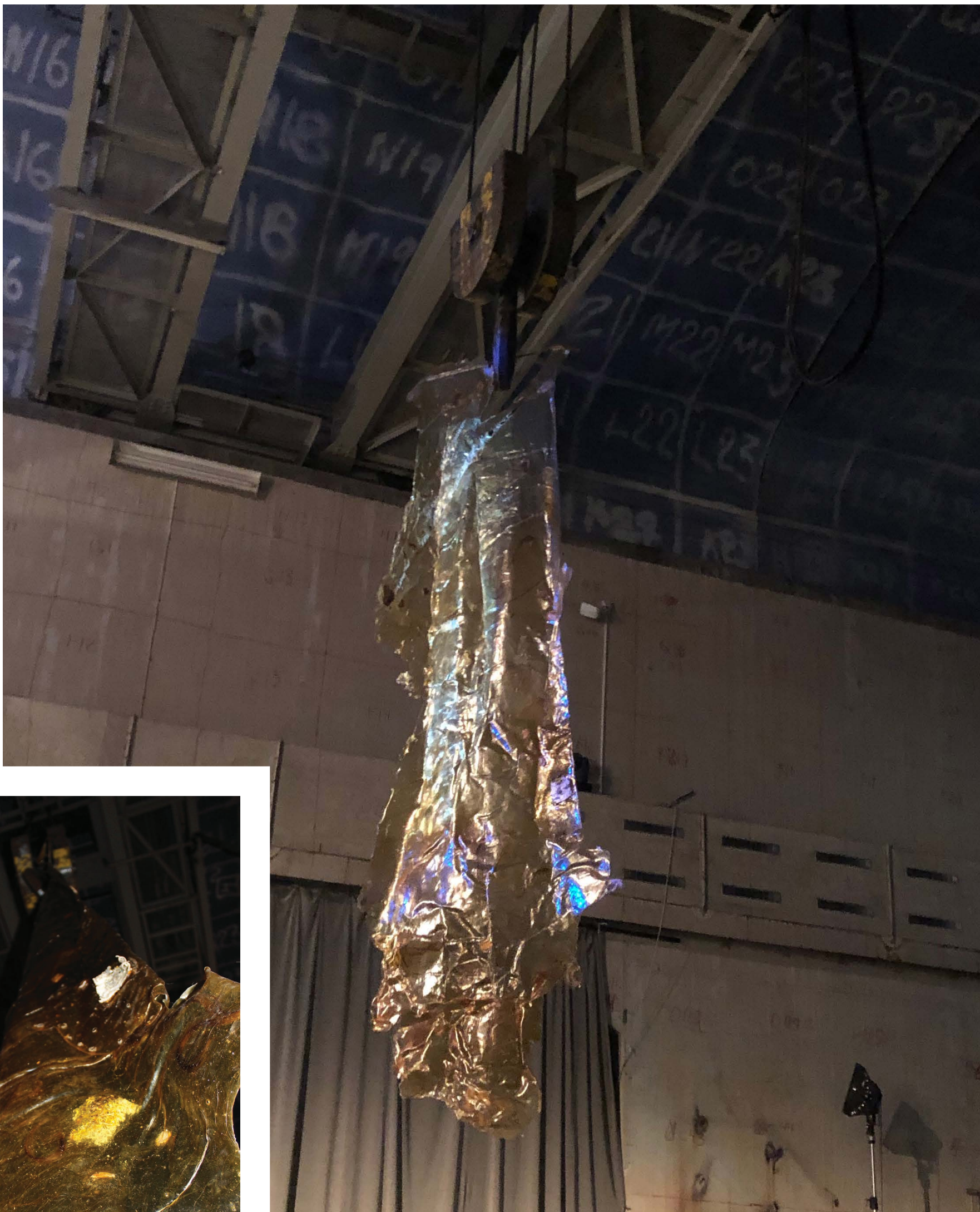
Be an immortal
Rodrigo N. Albornoz

'Be Immortal' is a work based on genetic manipulation of DNA by the use of hosts to produce clones. I decided to 'clone' myself in a hologram, alluding to the digitalization of society through the Internet. Nowadays, we can see the Internet also as a 'host' where people can create their own 'alter-ego' or 'avatar,' which remains eternally in the Network even after the person died. In this way, the hologram alludes to the biological manipulation of DNA as a metaphor for virtual immortality in the social networks.
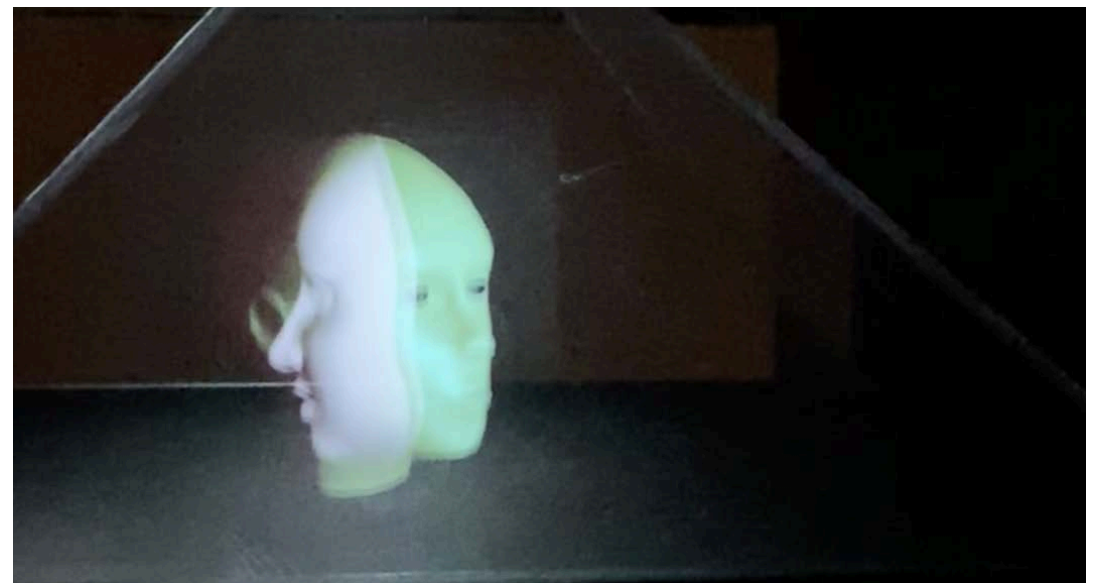
Bio Synth
Håkan Lidbo & Servando Barreiro

It's a synthesizer that is also a biotope for plants, mushrooms and animals.

A Microscopic View of Life
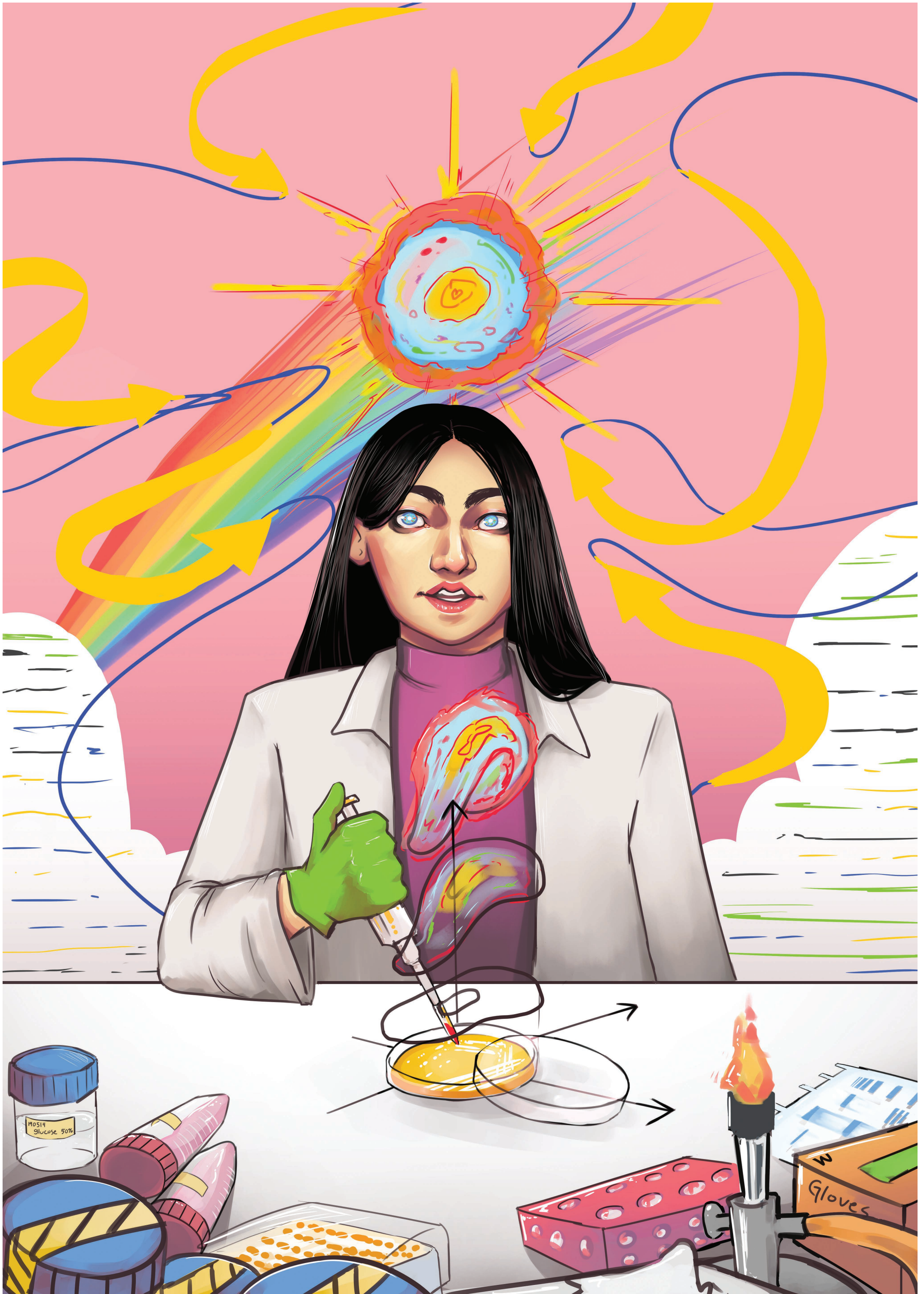## Ragna Lagervall

To enhance the qualities of living things, as is one of the purposes of synthetic biology, one must understand them. The artist created a map over living cells out of clay, as maps help us find the way.

Reborn
Linda Wong

Build-a-Buddy
Sofia Danielson Damne

This manual for creating your very own organism illustrates the wildest dreams of synthetic biology - that it becomes easy enough for anyone to use - but at the same time tries to capture one of its nightmares - with corporations handling its risks irresponsibly and trademarking new discoveries in a way that limits scientific research.

My friends
Alice Franzén

The artwork explores how the human body could be re-composed in different ways. How could the human body look if the arms, head, legs were formed and put together slightly differently? Maybe it would even result in new body functions, such as faster running speed or better predatory abilities. The result is seemingly bizarre, unsettling and a bit comical.

Becoming a goldfish
Paulina Hallencreutz

The film is about water and daydreaming, and what might happen when one drifts away, literally and figuratively. It is about change and creating new ways for oneself. It is also a philosophical question about what kind of creatures we human beings are.

Empathic medication
Rasmus Bengtsson & Jutta Roth

As artists, we challenged the iGEM Stockholm team to push scientific ideas to its limits and create more empathic medication.

Designing a concept of a futuristic medication and remodel an everyday item, such as a pillow, into a protective and caring device that continually monitors our health state. This would be made possible by bacteria, which are always monitoring us and the environment, responding to potential changes. Assuming a patient has a respiratory disease, the bacteria on the pillow would sense malfunctioning airways, and thus initiate the treatment even before the symptoms wake the patient up. Empathic medication means that we can turn medication into personalized systems that react to our individual needs. We imagine that this system could find a much broader application than just in lung diseases. An exploration of the Future of Medication.

Alive Living - Mitesser
## Diana Monsberger & Maria Euler

The artwork is a speculative piece inquiring the future after this stage of synthetic biology. It is a combination of an installation, a video and a performance art piece.A futuristic dinner table is set up with a alive cloth, alive plate and alive glass at the exhibition. The alive glass and plate are of glass and have real yeast or bacterial culture attached under them to challenge the visitor to think about the plate/glass being alive and co-eating their food. The video displays how the alive everyday object works, for example the cloth and the plates are both self cleaning and consist of living cells, that do that work. In order to keep the objects alive, one has to take care of them, feed them and store them in an appropriate manner. Effectively this means the development of new table manners which would seem messy to us but are hygienic and healthy in that new biosynthetic home. The preformance invites guests to have a meal and interact with the table, cloth and plates.

Yeast Babies
Benedicte Smith-Sivertsen

This small collection of drawings called 'Yeast Babies' reflects the motherly aspects of synthetic biology. When you work in the synthetic lab, you are both caregiver and creator. You are synthesizing and nurturing otherly living beings, and your labor becomes their life. You are the medium that allows novel beings to enter this world.
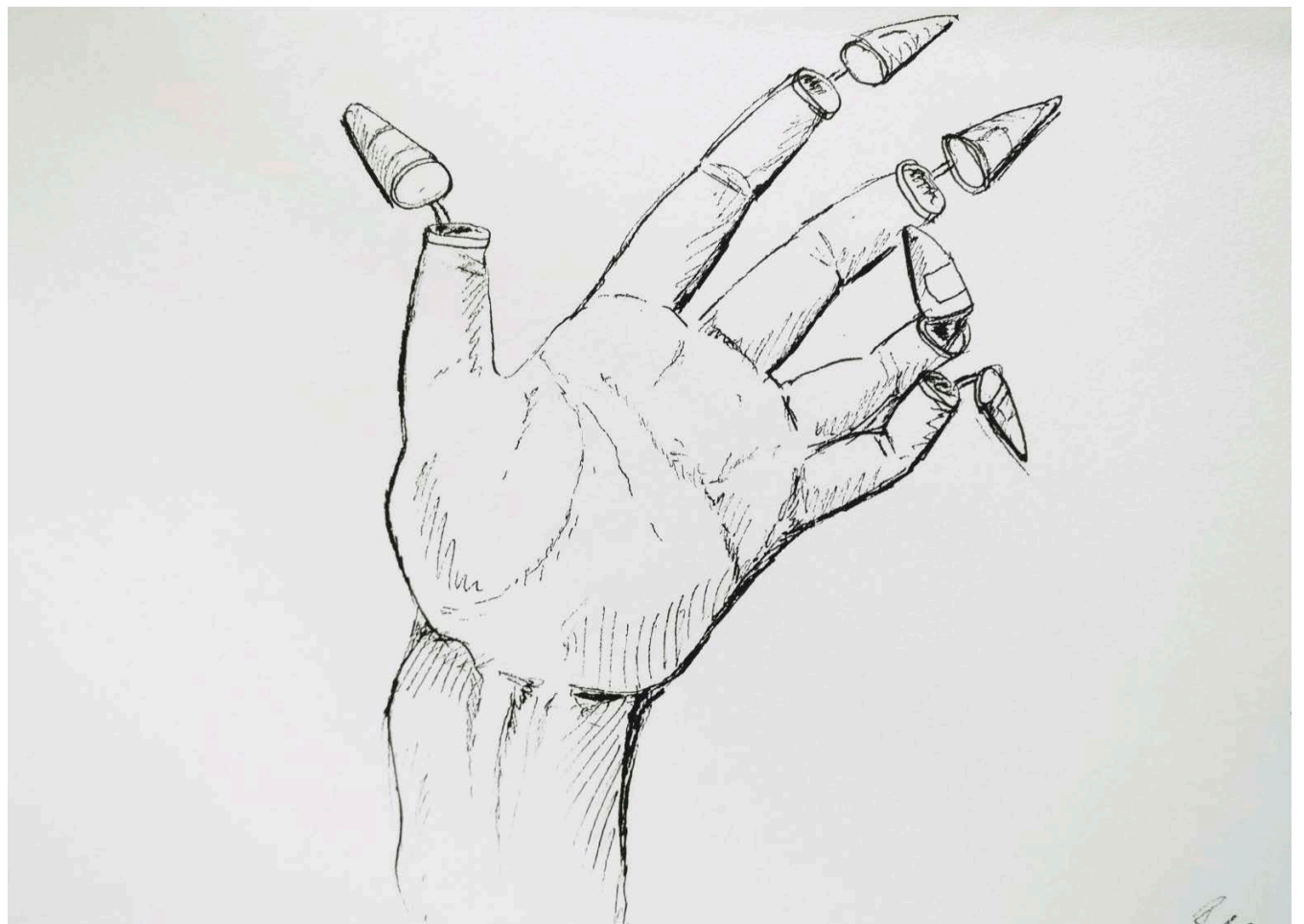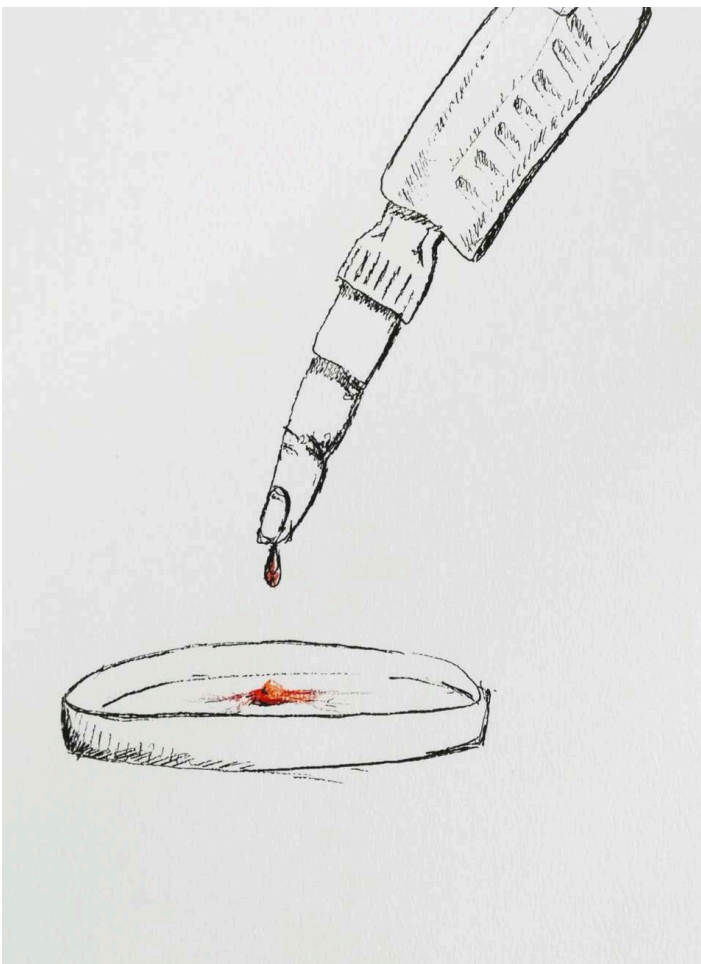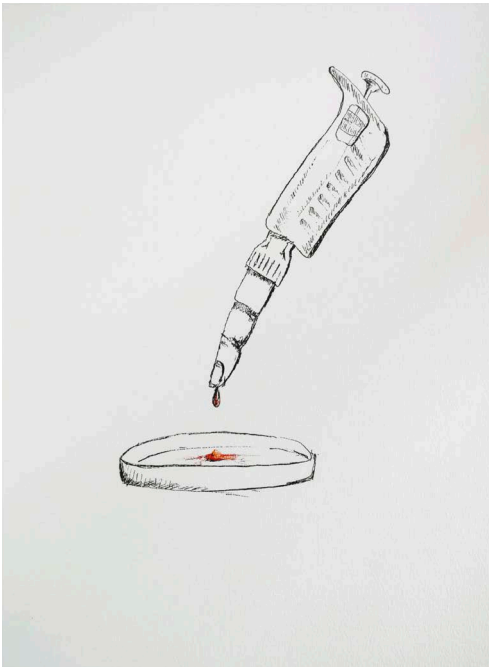
Disrupt & Innovate
Monika Lionaite

The series of my art-pieces 'Disrupt & Innovate' does reflect the process of innovation and the diversity and interconnectivity that is found in synthetic biology, which provides endless opportunities to discover the forms of creating life. The art is here to be explored by the subject who will find new ways that synthetic biology can be used and seen as the disruptor in the industry and the game-changer for the whole scientific field. The contrasts and shapes interconnected and different substances used in the artwork represent the interdisciplinary approach for disruption to be used, which is the key to innovation.

@LionaitePhotography

I Feel You / Diffusion
Stella Axelsson

My two artworks reflect synthetic biology by which they illustrate reimagined bodily functions. "I Feel You" (left) represents an improved connection of a recognition signal in the body, and "Diffusion" (top) represents how one can affect the simple processes in the body through synthetic biology, and it also questions what that could lead to. Potentially something helpful, or it could lead to harm.

"Såsom kroppens celler,
med främmande ämnen, samarbetar vi„
Beata Hagerud & Alexa Kjellber

Our artwork is a constellation of color and shape, blending together the same
way the parts of the body are working with synthetic elements.


AngioGenesis
Irene

iGEM Postcard Project
iGEM Düsseldorf

Each postcard represents synthetic biology or an iGEM project, acting as a bridge between scientists and non-scientists. Quoting iGEM Düsseldorf 2016, the founder of the iGEM Postcard Project, "Raising public awareness not only about our project but also about synthetic biology, in general, was always of high importance for us. We thought that other German iGEM teams may share that thought, so we decided to develop a concept to raise public awareness and make it possible for the other teams to do so as well. But how do you do that?"

Elixir of Life
Christine Shobana Anto

This artwork is vibrant abstract imagery of a surreal vision of a bio-remediation world. The artist grew up in a coastal city of India, which recently witnessed an oil spill destroying sea life. Being a toxicologist and environmentalist, she envisions to create a cleaner and healthier environment. The painting reflects how a programmed cell takes on the process of cleaning the environment.
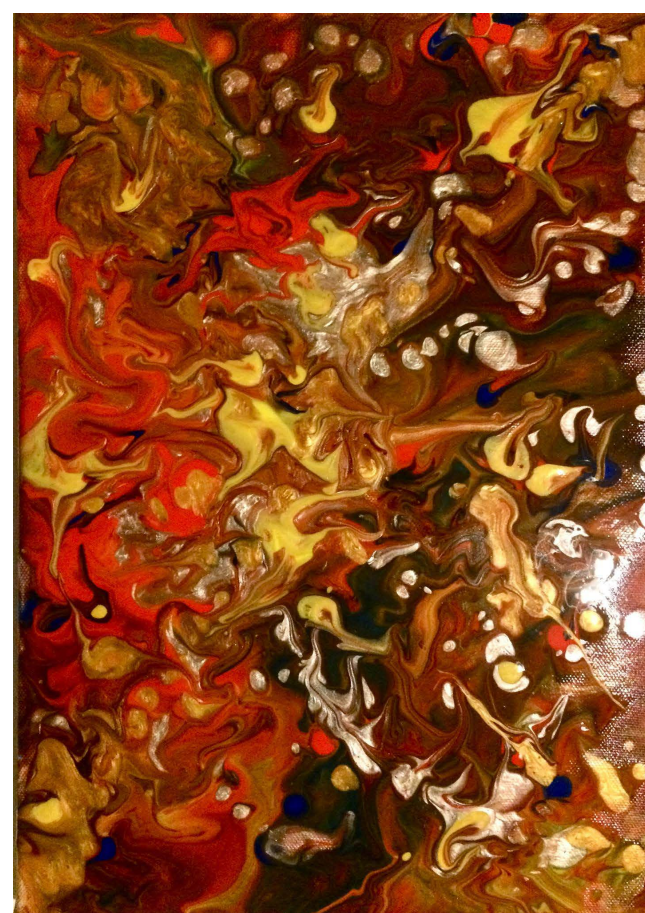
Constructed plant cell
Vendela Bergman
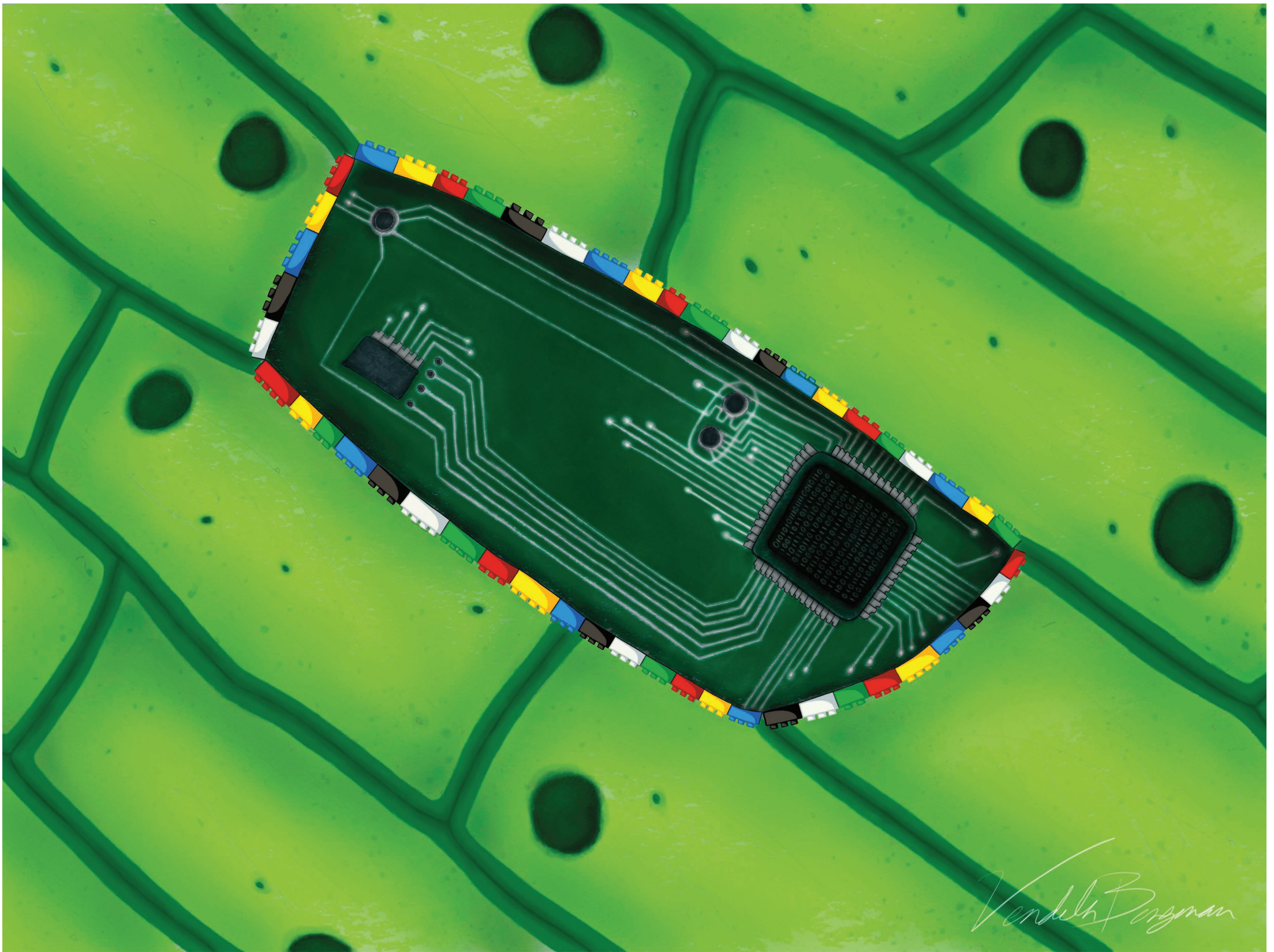
Since synthetic biology creates unnatural processes by using engineering in natural organisms, my artwork reflects an artificial plant cell among real plant cells. The artificial plant cell pictures the inside of electronic devices, something that does not consist of living matter or performs natural processes, but still are capable of creating and manipulating our way of living and our environment. The Lego represents the cell membrane of the plant cell and acts as pieces of a jigsaw puzzle that correctly, even though they are unnatural, fits among everything else.

Nature's Factory
Victoria Muliadi

My artwork depicts a genetically-engineered tree that functions as a plastic processing "factory" for the little forest dwellers. It is meant to show how synthetic biology can be used to modify existing biological systems to achieve new purposes, like reducing plastic waste!

Petri Dish Picasso
Courtney Toth & Natalie Rachel

Examples of molecular cloning and genetic engineering techniques using E. coli. These produce no pigment but can be genetically modified to express proteins that are pigmented. We transformed cells to show Green Fluorescent Protein (GFP), a protein-encoding gene derived from a jellyfish. The striking fluorescence of GFP is best viewed under UV light.

Harnessing Biodiversity
Joel

An essential step in finding novel molecules and using them in synthetic biology is to screen the very own creations of Mother Nature herself. This picture is an agar plate with soil bacteria colonies, ready to be tested in the search for new antibiotics, in an attempt to have more weapons against multiresistant bacteria.
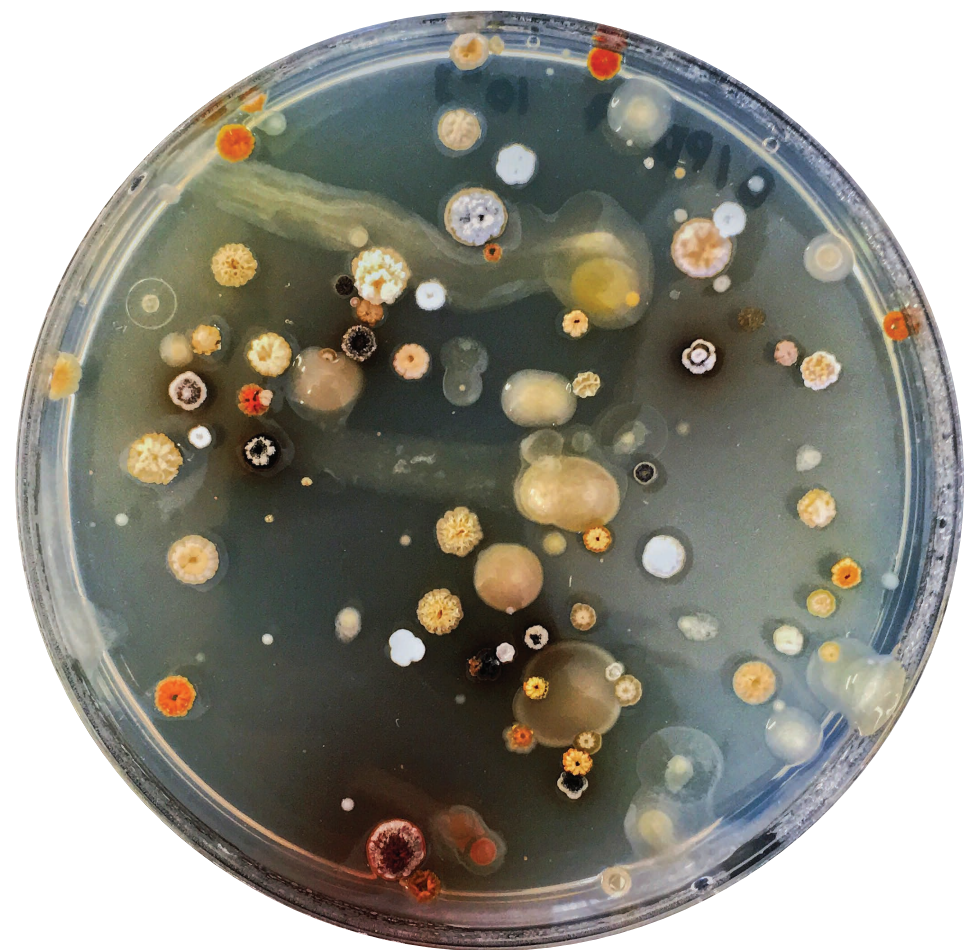
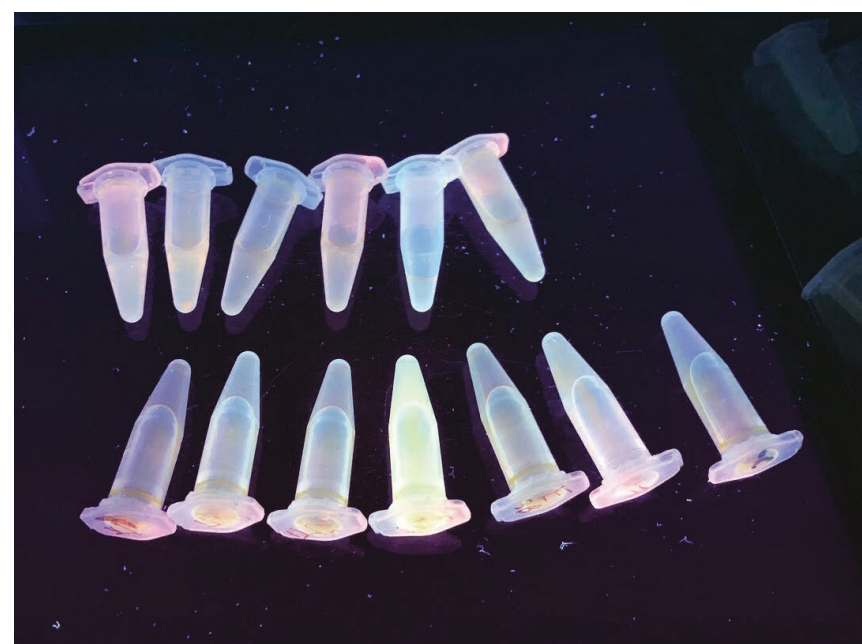# It's a colorful world
Josefine Liljeruhm

ZebraKI
Zahra Dehghani

Zebrafish embryo is a new vertebrate model for molecular biology and other related fields of synthetic biology. The aim of using zebrafish as a model is to follow the three Rs (Replacement, Reduction, and Refinement) in synthetic biology. Having an in vivo model is a crucial step in different parts of synthetic biology, and it is inevitable. Instead of using mouse and rat, zebrafish can be used with the advantages of fast development, small size, transparency at early life stages, availability of whole-genome sequence, cost-effective usage, and human similarities in metabolism. Most of the organs are developed in the first days and can be used for metabolic and genetic engineering techniques as one of the goals of synthetic biology. In the first step, zebrafish can be used for redesigning existing natural biological systems, and at the next steps, it can be used to inspire us how to design and construct novel artificial biological pathways, organisms, or devices. In this artwork, I used zebrafish embryos to depict KI, the initials of Karolinska Institutet.

Guiding light
iGEM Uppsala 2018

A picture from a chromoprotein, UnaG, extraction procedure. The team used UnaG as a part of a reporter system in a project aiming to detect parasites in animal intestines. UnaG fluoresces in the presence of bilirubin, the reporter, and literally becomes a guiding light.

Zoom X3
Lisa Faye

My artwork is a collection of three posters that each represent a vital component of synthetic biology. The three components are shaped on a DNA sequence of the human chromosome X. The color disks refer to what one can see getting closer to the eyepiece of a microscope.

1. DNA is everything.

2. The bacteria Escherichia coli is the most popular chassis organism used in the iGEM competition.

3. Bacteriophages are a promising alternative to antibiotic treatments, and my team, iGEM Stockholm 2019, is working with them to address a global issue: the rise of antibiotic resistance.

Lab on Wheels
iGEM Stockholm

Deep down in the nuclear reactor, more specifically in the control room, Roud-lotul Jannah, together with the team, hosted a "Lab on wheels," an interactive workshop for visitors to try while enjoying the art. The workshop consisted of extracting DNA from strawberries with everyday items you can find in your kitchen. For example, instead of a centrifuge, a plastic bag with manual crushing was used. When done, the visitors were allowed to keep their extracted DNA in an Eppendorf tube to take home and show family and friends.

The idea of DNA is abstract for people in general, how it looks like and how we can see it. In the workshop, we gave them a chance to try out how it feels to isolate DNA and hold it in your hand. Using simple materials and tools that we can find in our house such as strawberries, dish soap, salt, rubbing alcohol, plastic bags, coffee filter and tooth picks. We also showed them general lab equipment such as pipettes and microtubes so they could still feel the working-in-a-lab atmosphere. The strawberries were crushed inside a plastic bag together with a mixture of water, salt, and dish soap. The mixure was finally filtered through a coffee filter to retreave the DNA in the stawberry juice. The visitors could see their isolated DNA inside microtube after ethanol addition. — Roudlotul Jannah

iGEM Stockholm wants to thank all contributing artists, guests, special guest lecturers, Paul Hudson, associate professor, and docent in the Department of Protein Science at the School of Engineering Sciences in Chemistry, Biotechnology, and Health (CBH). Victoria Chu, a former iGEM Stockholm member.

We would also like to show our appreciation to Leif Handberg, associate professor in Media Technology and interaction design, for giving us access and letting us use R1.

iGEM Stockholm 2019