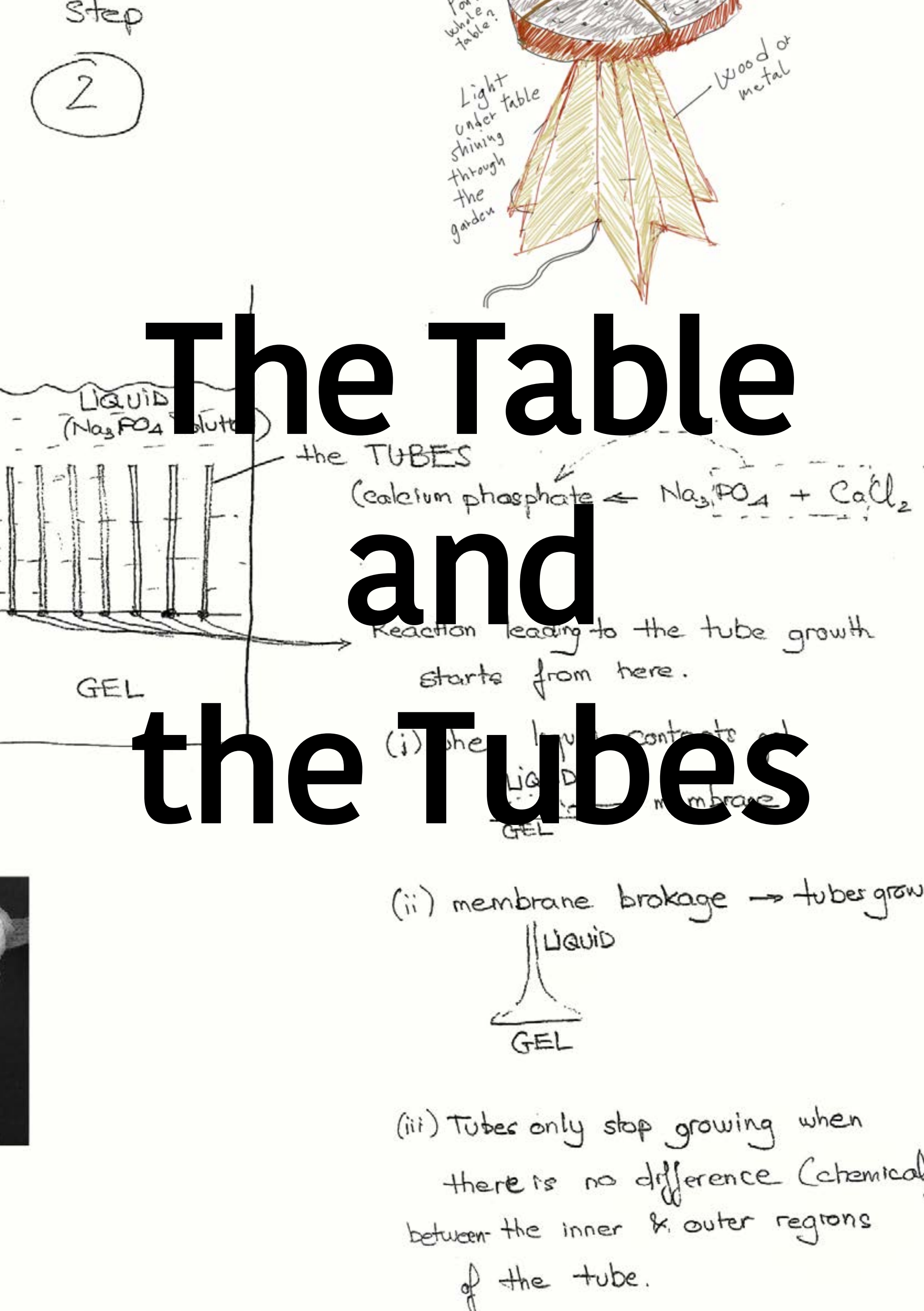
The Table and the Tubes

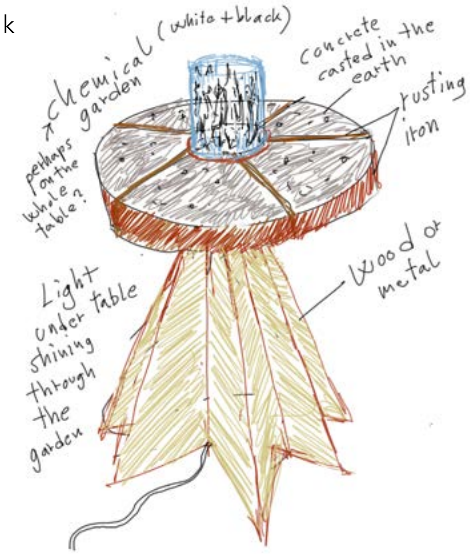


The Table and the Tubes

VISUAL ARTIST JAN-ERIK ANDERSSON AND RESEARCHER TAN PHAT HUYNH WITH ASSISTANCE OF RESEARCHER ANNA FOGDE.

This project is a part of *Avtryck i det Okända – Forcing the Impossible*, a multidisciplinary research project led by post-doctoral researcher Laura Hellsten where science and art are combined in order to explore science communication. Within the frames of the project, cutting-edge researchers at Åbo Akademi University meet artists. The scientists get to practice communicating their research outside of the scientific community, and the artists get to interpret and illustrate what they see/hear/touch, using their respective media. Within their different groups the researchers and artists have independently decided if the final presentation is a joint endeavour engaging both the researchers and artist on equal terms or if there is more emphasis put on describing the artistic and research project as parallel tracks.

In the project The Table and the Tubes, the booklet you are currently reading is what was collaboratively created by the researchers and artists to engage with you, the audience. The Table and the Tubes further include a table/sculpture by visual artist Jan-Erik Andersson and a chemical garden presented in a vase on the table by Dr Tan Phat Huynh and doctoral student Anna Fogde.



Drawing: Jan-Erik Andersson

Jan-Erik: For me, the question of what life is, what is "alive" has always been of key interest. When I was young in the 1960ties the education in the school never really stressed the fact that many concepts and borderlines are very vague and instead of sharp unquestionable truths, the world is made up of floating spectrums, with endless variation. At least when you give things a closer look, nature produces new variations all the time.

Now when AI (Artificial Intelligence) is questioning the uniqueness of the human "mind", also the origin of life and the border between non-living and living have been questioned. Some researchers talk about "inorganic biology" when they are trying to create self-replicating, evolving inorganic cells, which even can store electricity, just in the same way as organic, biological, carbon-based cells do.[1] In the words of Albert Szent-Gyorgi: "Life is nothing but an electron looking for a place to rest."

It was fascinating to take a first look at the Chemical Gardens created by Phat and Anna to discover the visual beauty of the inorganic, growing structures. Like the organic nature is considered, at least earlier, to hold the ultimate "beauty", also the inorganic structures possess beauty.

Phat & Anna: What are these Chemical Gardens? Literally, they are "Gardens of precipitated chemical forms". A chemical garden is the result of chemical reactions and physical processes that give rise to upwards growing structure that exhibit plant-like features. Usually, metal salts with beautiful colours are used and as a result the experiment is very popular in science classrooms. And why are we talking about tubes? Because tubular structures are a basic characteristic of the chemical gardens. The growing process of the garden makes the structures hollow, and therefore they can be regarded as tubes (image right).

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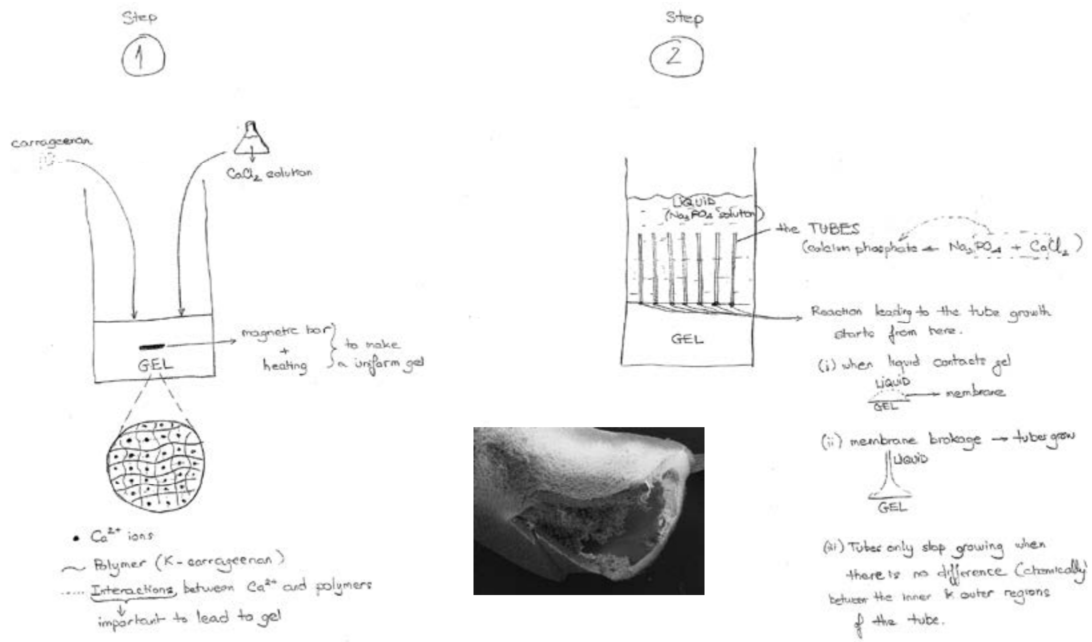
We are talking about our structures as growing. Does that mean we are considering them to be alive? When can something be considered being alive and living? Chemical gardens and the origin of life share some common elements in the way the membrane is formed. Let us therefore continue our intriguing journey regarding the question of life by taking a look on some quotes discussing Chemical gardens from the book Mechanism of Life written by Stéphane Leduc.

"The phenomena of osmotic growth show how ordinary mineral matter, carbonates, phosphates, silicates, nitrates, and chlorides, may imitate the forms of animated nature without the intervention of any living organism. Ordinary physical forces are quite sufficient to produce forms like those of living beings, closed cavities containing liquids separated by osmotic membranes, with tissues similar to those of the vital organs in form, colour, evolution, and function… During these long ages an exuberant growth of osmotic vegetation must have been produced in these primeval seas. All the substances which were capable of producing osmotic membranes by mutual contact sprang into growth, the soluble salts of calcium, carbonates, phosphates, silicates, albuminoid matter, became organized as osmotic productions, were born, developed, evolved, dissociated, and died. Millions of ephemeral forms must have succeeded one another in the natural evolution of that age, when the living world was represented by matter thus organized by osmosis".[2]

The question about what life is and what it means to be alive fascinates many, scientist and non-scientist alike. Another interesting question is that of the origin of life, where did life begin? In science the term Origin of life is often used to depict how non-living matter has turned into life by processes still not completely known or understood. It is however known that hydrothermal springs, deep down on the ocean floors, are places where the oldest known life-forms have been found. The environment of the hydrothermal springs have access to all the important prebiotic molecules (hydrogen, methane, ammonia, carbon dioxide and nitrate) needed for biosynthesis to emerge. An interesting feature is that we can also find the same kind of processes here as in the chemical garden systems, with different gradients across membranes that drive fluxes of for examples electrons and protons. Furthermore, scientists have managed to demonstrate reactions that open the gates to autotrophic metabolism.[3] Yet many questions remain to be answered about how life evolved from the prebiotic molecules. And the endeavour to answer some of these questions will call upon further careful study of flows through chemical garden-membranes.

We would like to invite audiences further into this fascinating topic by giving you the opportunity to observe the tubes (or with another name, the chemical garden), here made of calcium phosphates, growing in the vase in the center of the table. Like for grass growing in a backyard, a favourable environment and nutrients are required for the tubes to grow. In our case the "soil" consists of a biopolymer-based gel containing "nutrients" in the form of sodium phosphate. This gel stays in the bottom of the vase, while another nutrient, sodium phosphate dissolved in water, is included in the liquid fraction in the top of the vase. The tubes can vary in diameter from ~30 to 40 micrometer (the same size of the human hairs) and this can be observed under light microscope.

*autotrophic: a living thing that can produce its own food from simple chemical substances such as carbon dioxide.



Drawing: Tan Phat Huynh

Jan-Erik: I thought a lot about how to approach this challenge. I didn't want to make an illustration of the Chemical Gardens using art. Likewise it was very hard to make some kind of interpretation of the Chemical Gardens because of the difficulty and abstraction of the underlying chemistry. Instead, I chose to make a *presentation* of the Gardens, or in this case one garden. My aim was to somehow uplift the beauty of the garden and put it on a platform, in this case a table, which also creates a place where communication takes place.

I have a long-lasting interest in the communication aspects of a table. Usually, at least before Corona, most of the communication takes place around, over and under a table! So, what would fit Laura Hellsten's research theme mentioned in the introduction better! I also thought that it would be great if people would accidentally stumble on our project, as would be the case if the table would be placed in a normal commercial café and be in use there.

In the centre of the table a cylinder made of glass, would hold the Chemical Garden. No complex philosophy, or an attempt to visually "explain" very complex chemical processes, but just a place to honour the beauty of inorganic growth.

Initially I wanted to make the whole table out of inorganic material, but later I decided to make only the surface out of concrete, earth and steel and base it on legs made of recycled wood, painted in six shades of green.

I divided the surface in three parts (for which I have no actual explanation!). Then I made a mould to pour the concrete in, which I put towards the earth to get traces of it on the table surface. Between these concrete parts I inserted iron plates which will start to rust if somebody spills water on them.

The rough concrete would be a demanding surface for the café visitor, who would have to search for a safe (plain!) place to put down the cup. A kind of symbol for the uncertainty we all feel at the moment concerning the future of the organic life on our planet.

Anna: I have always loved and been fascinated by chemical reactions and processes that can be observed visually. And as a teacher with a keen interest in science communication this opportunity to expand the horizons of my research and love of science to new dimensions has been a wonderful adventure. It has been a privilege to take part in the thought process that our chemical work awakens in other people and it has also been very interesting to follow Jan-Erik's work around our chemical gardens.

Jan-Erik: I talked about our project with a person and tried to explain the differences between the organic and the inorganic by saying that the organic chemistry is about coal-based compounds, which make up all "living" things and that the inorganic chemistry is about all "dead" things. She got very upset and said that all stones are "alive". I wonder how outdated my concepts of chemistry and life are, in this posthumanist period, where humans are not supposed to be the primary species on our planet anymore.

Jan-Erik, Phat & Anna: We now invite you, the reader and observer, to share your thoughts around our project. Share it with us, your friends or just as silent thoughts to the rest of the universe. We hope you have the opportunity to take some time and enjoy the beauty of the world through our project.

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1. Geoffrey J. T. Cooper, Philip J. Kitson, Ross Winter, Michele Zagnoni, De-Liang Long, Leroy Cronin. Modular Redox-Active Inorganic Chemical Cells: iCHELLs. Angewandte Chemie International Edition, 2011; DOI: 10.1002/anie.201105068
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Photo: Jan-Erik Andersson

Photo: Robert Seger

I am Jan-Erik Andersson a visual artist working broadly with installations, sculptures, media works, environmental works and architecture. I was born in Turku and Turku is still the centre of my universe; I live on Hirvensalo island in the Life on a Leaf house, a total artwork which also is my Doctoral work at the Academy of Fine Arts, Helsinki.
I am very interested how life and research can be integrated in my artistic practice. I am very happy to enjoy the state artist pension, which gives me freedom to explore whatever I want! At the moment I am planning a new experimental hexagonal log house with artistic interventions.

I have a background in natural sciences (BSc) at the Åbo Academi University where I studied Organic chemistry, Biology, Botany and Art history. I also graduated from the Turku Arts Academy and have a Doctorate in Fine Arts (DFA) from the Academy of Fine Arts, University of the Arts, Helsinki, where I am an affiliated postdoc researcher at the moment. My main interest is how art can create architectural space and in the collaborative processes between an artist and an architect.

My name is Tan Phat Huynh from Vietnam. I currently live in Turku with my wife (Polish citizen) and my 18-month daughter.
My research is about supramolecular materials and "supra" here means "higher". These supramolecular materials developed in our group possess not only advanced structures and functions allowing them to be used in medical and environmental research but also an outstanding beauty (e.g. chemical gardens). Apart from research, I like enjoying nature with my family. I also like to spend time with friends and have a beer together.

My name is Anna Fogde, and I'm a happy and curious doctoral student within the field of physical chemistry. I come from Mariehamn on Åland, but I have lived in Turku since the beginning of my university studies. I find the world filled with fantastic and exciting phenomena, and even if my early school years are far away, my childlike enchantment for red cabbage juice, soap bubbles and pressing buttons is intact.

In my research, I'm particularly interested in what happens on surfaces and at interfaces. Currently, I'm investigating characteristics of materials originating from the interfaces of gels and liquids. I'm collaborating with Tan Phat Huynh. Like he notes in his presentation, our materials do not only exhibit interesting characteristics but are also beautiful to behold. I'm also interested in testing the limits for how simple materials and methods one can work with (without compromising results). In addition to being a chemist, I have an education as a subject teacher, and I'm always on the lookout for different ways to introduce what I'm researching into different educational environments. I regard employing simple means and methods as a gateway for bringing research into classrooms without the hindrance of great expense or being reliant on complicated equipment.

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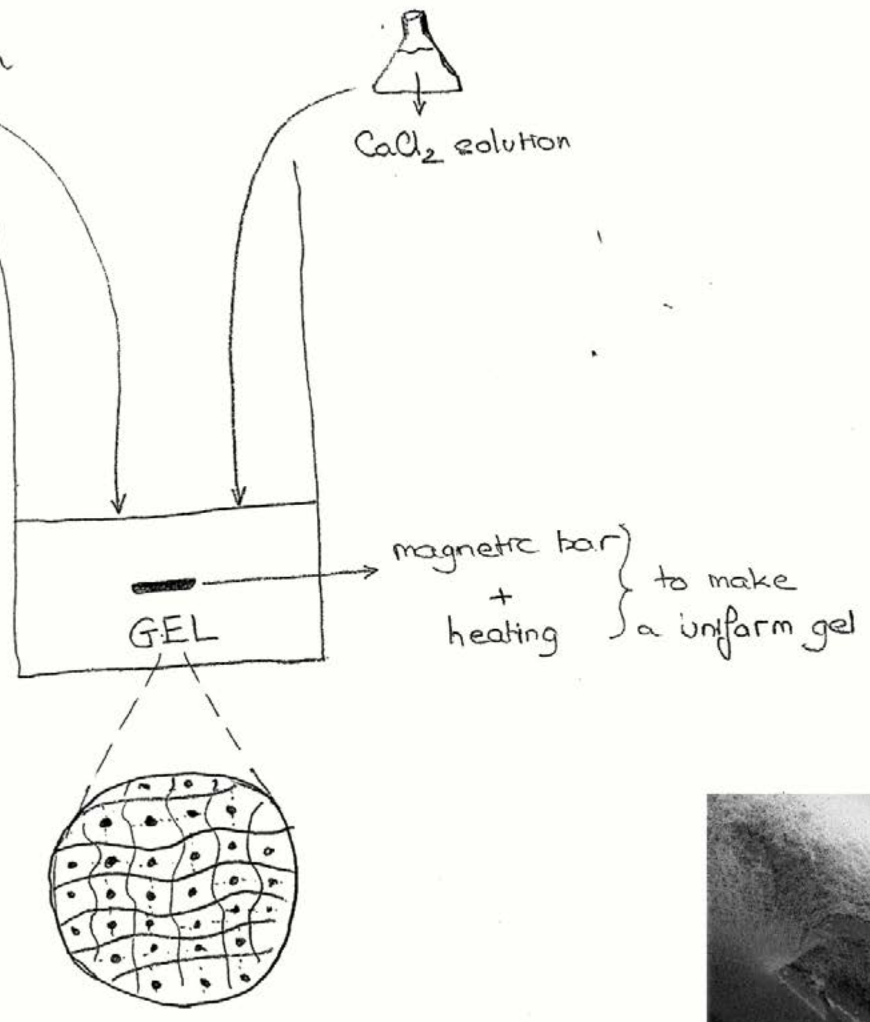

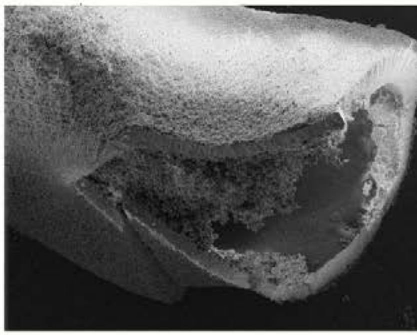

Ca^{2+} ions

Polymer (K - carrageenan)

$\underbrace{\text{Interactions}}$ between Ca^{2+} and polymers

↓

important to lead to gel