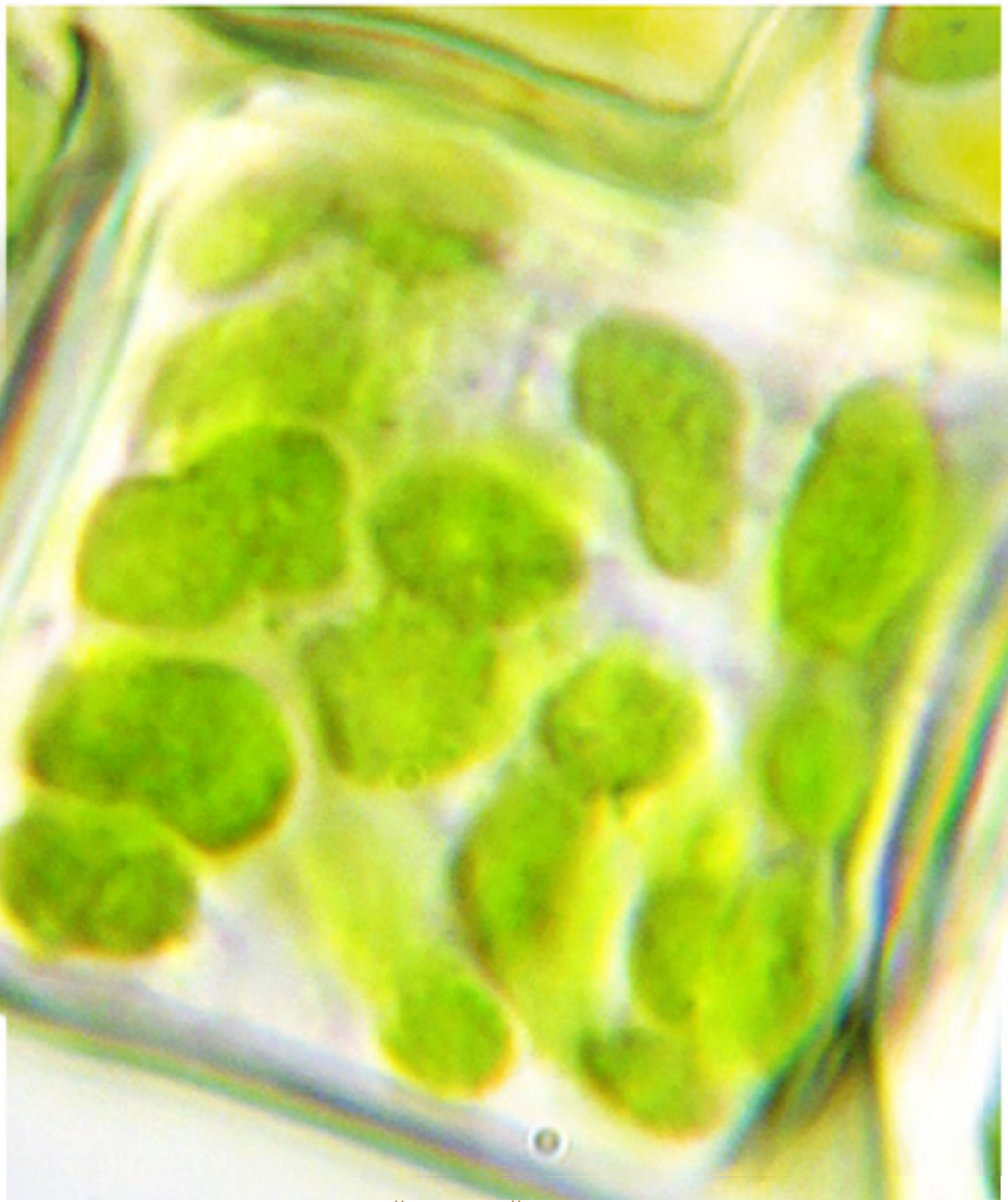
mRNA



YEAR 3 // ISSUE 3 // JUNE 2018

HISTORY OF VEGETARIANISM // IMPROVING PHOTOSYNTHESIS // TANJA'S FRIDGE // INTER-MRNA-TIONAL // DIY INCUBATOR // SUMMER EDITION: EXTRA PUZZLES

Source: dribble.com

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EDITORIAL

NIELS WERIJ

Dear reader,

For the last edition of the year, we wanted to centralise the articles around a theme, and what better theme is there than one that is studied in some way or another in each faculty. Therefore, my favourite Nanobiology buzzword is applicable: bridging the gap. Thus we hop on the environmental bandwagon.

In the last few months, I have been trying to minimise my plastic use, ever since I have noticed that avoiding plastic is rather hard; it is simply everywhere: most vegetables in supermarkets have needlessly large packages, bread comes almost exclusively in a bag, and I have no idea how to get detergent without a plastic container. Granted, I could probably obtain all these products in a more environmentally friendly way, but I have not looked hard enough for such alternatives. I could possibly do groceries at the market to avoid needless packaging, buy bread at a smaller bakery, and make my own natural detergents. However, I am not acting to my ideals as much as I want to. Fortunately, scientists reach beyond cargo bike hipsterism, and environmental research will (hopefully) make a change.

Speaking of change, mRNA will be mutated again during the summer. Nico, Aisha, and I will leave the committee, and three new people will replace us. I think I can speak for all of us if I say that we have learned a lot as mRNA members. Unfortunately, we still miss errors even if we proofread every article multiple times. I hope you can forgive us for any mistake you may find and that this edition will be as enjoyable to read as it was to make.

Do not forget to put on sunscreen,

Niels Werij, Editor-in-Chief mRNA 3

Source: Pinterest.com

FROM THE BOARD
MYRTHE SMIT

Dear members,

Being in a board is like driving on a roundabout. I still remember the first time I had to take a roundabout during my driving classes. Checking your surroundings, finding the right timing, making your intentions clear to other drivers: doing all this at the same moment was quite a challenge in the beginning, but - like with most things - practice makes perfect, and taking a roundabout feels completely natural to me right now. The same applies to my tasks as a board member such as organising activities, supervising committees, and writing 'From the board'. Everything that was challenging in the beginning of the year has eventually become routine.

As we are driving on our roundabout, new exits appear at each turn. A company visit to Gent with first- and second year students, a new board office, new privacy laws for organisations, and a photo contest for members; all of these events unexpectedly popped up on our roundabout this year. Exploring these refreshing ideas and putting them into reality makes it so much fun to keep on driving.

Roundabouts are designed to ensure continuous traffic flows. As much as I love to keep driving on my roundabout, I eventually have to take an exit. Five new cars are approaching fast and are very excited to take over and lead our study association next year. I take a look in my rear-view mirror, in my side-view mirror, and over my shoulder; what I see is a wonderful year with wonderful people. With pain in my heart, but fully confident that the drivers behind me will do just as fine, I indicate direction and take the next exit from my roundabout.

I have spoken,

Myrthe Smit
President of S.V.N.B. Hooke

RENÉ KLEIN LANKHORST: IMPROVING PHOTOSYNTHESIS

INTERVIEW

The Dutch national photosynthesis research program Biosolar Cells was a seven-year program launched in 2011. Within this program, scientists conducted research on photosynthesis in plants, photosynthesis in microorganisms, and artificial photosynthesis. There were nine Dutch universities (including the TU Delft) and 45 companies involved. The program had a budget of about 45 million euros. The main goal was to gain knowledge which could be used to improve the efficiency of photosynthesis. This would potentially be of tremendous benefit for the environment and our planet.

Dr. René Klein Lankhorst is the former director of Biosolar Cells. He currently works as research program developer for the Plant Sciences Group at Wageningen University. We interviewed René on the Biosolar Cells program, their research, goals, and future prospects:

Especially in the plant photosynthesis part, we had some breakthroughs. Apart from identifying some new plant genes that are involved in photosynthesis, we also did a lot of experiments on the physics of photosynthesis of plants on the atomic level. It is a very complex system we are trying to disentangle, so we really need a lot of fundamental knowledge. I think we came rather far with this.

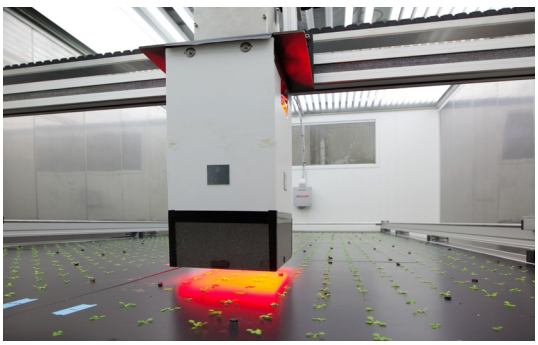
How much potential do you think this research has?

I would say this has enormous potential, but you have to see that within a perspective. We are really facing some serious problems in the world. For example, there is the problem of feeding the human population. Currently we have to feed about ten billion people, which is an enormous amount. By 2050, if agriculture would carry on as it is now, we will never produce enough food to feed everybody. Therefore, you have to increase the production of agriculture. Basically, you have two options. The first option is to dedicate more land to agriculture which means that you would have to chop down all rainforests. I personally do not think this is a good idea. The other option is to double the productivity of agriculture. But how to improve a plant to produce the double amount of biomass per square metre?

There is a lot of potential in photosynthesis. In the past, people did not realise that photosynthesis had a really low efficiency in agriculture. In a potato field for example, only a half percent of the sunlight is actually converted into biomass. This is probably due to the fact that agriculture is just too young. In the forest, the photosynthesis

efficiency of these plants was probably optimal. However, we started domesticating plants maybe ten thousand years ago. In the field, the plants always have enough water, sunlight, and minerals, so their potential is much higher than it was in the forest. If you would wait a million years, the crops would adapt by evolution and they would probably increase their photosynthesis efficiency. But well, 2050 is fairly close and we do not have time to wait that long. Therefore, we now conduct research on how to improve photosynthesis by manipulation in order to produce enough food.

Of course there is more to it as we also have this climate problem: we would like to turn our fossil economy into a bioeconomy, in which you can produce all your feedstocks for industry from biomass instead of oil and gas. Also, regarding transportation, we do have electric cars, but I do not think we will ever see a full jumbo jet on batteries. Therefore, we need some sort of very high density energy carrier which you can make out of biomass, but for this you need to produce enough biomass as well.
Then there is this third thing called carbon dioxide. Everybody knows that we are heating up the atmosphere, which is caused by carbon dioxide. There is no way to reduce these large quantities except by photosynthesis.



Robot meassuring the fotosynthesis activity of 1400 Arabidopsis plants.

Regarding all these aspects, you could say that photosynthesis has a large potential to tackle many problems. So I think this research is indeed very promising and very relevant.

Do you think we can save the world with these kind of scientific solutions?
No, there is no silver bullet solution. We are plant scientists, so we can design the blueprints of these new plants and say how they should be developed. But it is a long way from our blackboard to an african farmer who may in thirty years grow the plants we drew. First, a lot of changes have to be made. Furthermore, there is quite some resistance in the world against biotechnology, so you would also have to change people's attitude. We can show that our plans are theoretically possible, but that does not matter if people do not want to make it a reality. It is all really complex.

Do you notice that a lot? The resistance against genetic manipulation, for example in funding?
Yes and no. Of course there still are big groups in society that really have a problem with genetic manipulation of food especially. I do not think you can convince some of these real die hard groups. Maybe you can convince other people who are less straight that you have a really good idea and the only way to make it happen is by genetic modification. Of course it is not only about genetic modification. We are also looking at the biodiversity in nature, and some things that we want can also be done by normal modern plant breeding. However, it might take about 30 to 40 years to reach the end result, whereas if you would use modern biotechnology modification, you would be there in 5 to 10 years. So it is also about the pressure; how fast should you act, and can you convince society that you should take the shortcut? There are various paths to improvement of photosynthesis, but at the end

Researcher during measurment of gas-exchange of stomata

of the day society should decide whether or not some things are acceptable.

On the other hand, we also surely notice an increased attention to environment-related problems. Agreements are being made, and Europe is really determined to do something about the climate. The United Nations have these so-called 'sustainable development' goals with which they want to save the climate, the oceans and so on. Lately, there is also more and more attention to biology and to solutions based on biology and ecology, so you see a lot of potential.

The Biosolar Cell program ended after seven years because there was no money anymore. Now, we are very busy trying to develop follow-up programs. Leiden is following up on the part on artificial photosynthesis, and one of my tasks in Wageningen is to start new programs on the part of natural photosynthesis, especially in plants. Meanwhile, we have set up an international consortium of about 50 universities in Europe, which is supported by 10 to 20 companies and other important stakeholders such as the Gates Foundation, but also supported by society as much as possible. Our goal is to write roadmaps on how we should develop these plants in the coming 3 to 4 years.

Is there something else you would like to share with, or say to, the Nanobiology students reading this article?

As said, the 21st century will be the century of Biology as only biology will be able to resolve some of the great challenges (food, climate) of our time. So there will be ample opportunities for biology students to contribute to solutions, for instance towards improving our environment. The key will be to have an open mind and to see opportunities where Mother Nature has found far better solutions than us human beings. As an example, our entire food production is dependent on fertiliser (ammonium) that we produce at the expense of massive amounts of fossil energy in the Harber-Bosch process. This industrial process requires a pressure of 100 atmospheres and a temperature of 500 ° C. In nature, however, the exact same reaction is carried out by bacteria at 1 atmosphere and at room temperature! So if we would understand this biological process *and* would be able to apply it on an industrial scale, than we would make an enormous positive impact on the environment. So keep your eyes open, spot opportunities, and dare to be ambitious!

INTERVIEW WITH TANJA HILKHUIJSEN

INSIDE PEOPLE'S FRIDGE

This time, we interview Tanja Hilkhuijsen, our fantastic study counsellor. Will her fridge be ordered like she is or wild and exotic?

There are four containers of soy yoghurt in your fridge, is there a specific reason for this?
My boyfriend and I always have soy yoghurt with oatmeal and fruit for breakfast. We definitely use those four containers for one week. We try to start off the day healthy by eating all our fruits already. Then, whenever I eat more fruits during the day; that is something like a bonus.

Did you hide the Grolsch beer on purpose behind the soy yoghurt?
Haha, of course! No, we usually have more beer in the fridge. Usually, we also have a bottle of wine, but we prefer to drink red wine and that does not have to be put in the fridge. But in general I drink a lot of water and tea. My favourite type of tea is green tea. We have a fixed place for every item, so the yoghurts are always on top together with the beers. The vegetables are mostly in the drawers. Now, we have a lot of space; in our previous house, we had a very small fridge. That was such a mess! Whenever you opened the door there would be something falling out.

Do you notice a difference in taste between you and your boyfriend? Does that lead to debates about your fridge?
Hm, not really actually. My boyfriend drinks more beer than I do. We both try to eat healthy, so we try to eat meat or fish only once a week. We also eat a lot of vegetables and only have snacks in the weekends. Sometimes, that does not work. For example, when friends are coming over. He does really have a very explicit taste, like seaweed for example. We usually also have a jar with herring from Ikea. I find those disgusting, but he really likes them. In general, our tastes are similar, I think.

Talking about explicit taste; I also see a lot of Asian food items. Have you ever considered starting a second life in Asia?
Years and years ago, I once talked with my previous boyfriend about moving to Asia for some time, but now I am settled here. I just bought a new house with my current boyfriend. However, my brother does actually live in Hong Kong. Two years ago, I visited him when he was getting married. He is having a baby really soon, so we are planning on visiting him again around October. I am very much looking forward to that as I really like the Asian cuisine. My mom generally cooked very traditionally. I like Asian food because it is quite light and healthy as well, but I do not know where this taste comes from.

Do your like green vegetables in particular?
Because you see a lot of green vegetables here? Well, I think maybe most vegetables are green haha. But no, not necessarily. I do not really have a favourite kind of vegetable. We eat a lot of courgette, broccoli, and paksoy for example, but it also depends on what is at a discount.

What item do you always have in your fridge apart from soy yoghurt?
I think I always have eggs, butter, and sparkling water. We go to the supermarket once a week, then we buy all our food for the whole week. We have this huge list of different dishes we are going to make throughout the week. Before and as a student, I went to the supermarket every day, but that is really not efficient, and I also think that you spend more money that way. Now, there are a lot of items from *Albert Heijn*. That is kind of funny because the house where we now live is not really near an *Albert Heijn* supermarket. In general, we go to *Lidl* first, and we buy the items that *Lidl* does not have at *Plus*. Maybe we went to *Albert Heijn* after going to the gym, that could be possible.

I also saw four different kinds of cheese. What is your favourite kind of cheese?
I like strong cheese, such as goat cheese and older cheeses. I could put the goat cheese in a salad with lentils and beetroots. You also see halloumi, which is a sheep cheese I usually bake in slices and put on a bun. It is really nice!

You already told us about not eating a lot of meat because it is healthier. Do you also keep the environment in mind when doing groceries?
Not necessarily, but I do hate it when there is a lot of plastic wrapped around a product. For example, sometimes a cucumber is wrapped in plastic. Although I would still buy it, I have to say. Also, sometimes I go to an Asian supermarket where they have these dried seaweed snacks, but all snacks are put in plastic separately, and all those little pieces are also put in plastic. I really hate that as well, but I have to admit that is does not keep me from buying it. Maybe I could ignore those products in order to help to environment. Although when I buy apples in the supermarket, I do not put them in a plastic bag.

I recently saw this documentary about 'your green footprint' where some girls were interviewed who always bring their own tupperware boxes to take away restaurants. I think this is really smart, but I also think that for a lot of people, including myself, there is a certain obstacle there that you have to overcome because bringing your own box does still feel a bit embarrassing, maybe a bit like a hippie even.

ARTIFICIAL REPLICATION, NANOPARTICLES, AND MEAT

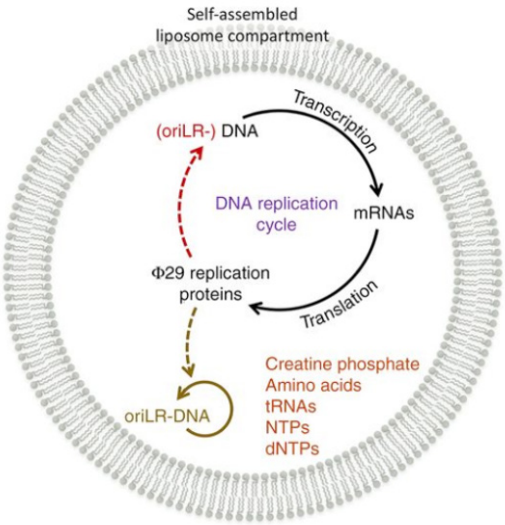
NANONEWS

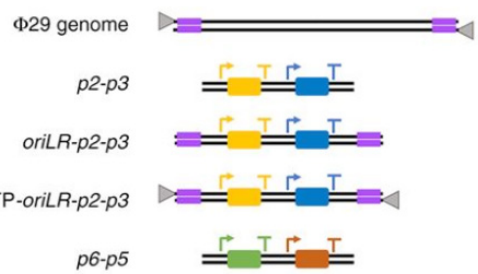
Artificial Replication

A large step has been taken in the challenge to synthesise a minimal cell from scratch. This cell should consist of the very basic proteins, genes, and molecular pathways as present in most organisms. Of course, a living cell is able to replicate and divide its DNA. This means that the aforementioned biomolecules should also be contained in the artificial cell and should be able to carry out replication. While researchers have already been able to couple replication to gene expression, they have not yet succeeded in mimicking actual replication. Van Nies et al. have aimed to do this by using the bacteriophage Φ29 DNA replication mechanism. Multiple ways to use the molecules from Φ29 to replicate a circular genome have previously failed. In contrast, this group wanted to amplify a linear genome, which is more easily accessible, using only the terminal, single-stranded and double-stranded DNA binding proteins, and DNA polymerase.

First, they made a DNA strand coding for the Φ29 replication proteins. Then, they searched for the conditions under which these proteins amplify the genome. The researchers found that the synthesised protein p5 enhances the amplification of double stranded DNA. This protein, together with p6, improves the efficiency of replication by a large factor. To check whether the experiment really succeeded, they used the newly synthesised strand for translation. This gave the expected result. Although they accomplished to imitate replication from scratch, there are still a few limitations. For example, tRNA inhibits the polymerisation of the proteins Φ29. Also, it is fairly hard to produce a large amount of proteins. However, this can still be seen as a important step in this challenge.

Van Nies et al. Self-replication of DNA by its encoded proteins in liposome-based synthetic cells. *Nature*, 2018, article 1583, DOI:10.1038/s41467-018-03926-1

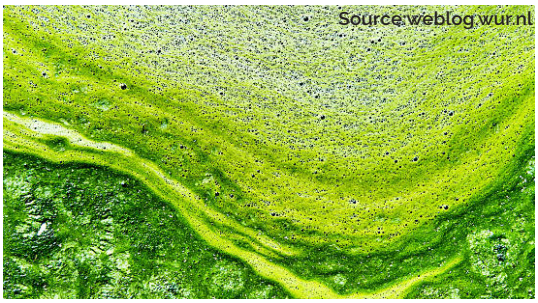




The Impact of the Smallest: When Nanotechnology Meets Ecology.

Sometimes, the remedy is worse than the disease. If you do not agree, ask Louise Stevenson, postdoctoral scholar at University of California.

Currently, nanoparticles are used to remove or degrade toxic chemicals in the environment. In particular, one called FeSSi (sulfurised nano-zero-valent iron) removes the cadmium from water. However, when the nanoparticle takes in the metal, it becomes increasingly more toxic. Luckily, Louise and a team of scientists have found that organic matter, in this case a byproduct of photosynthesis from algae, reduces that toxicity allowing the nanoparticle to remediate up to four times as much cadmium.



The current standards for use of the nanoparticle are based on data from the particle itself, unbound to the contaminant, which could highly underestimate its actual risks of toxicity. Their work elucidates this problem via an ecological model that can describe the dynamics of the concentrations and their impact on the system.

"We are developing new technology faster than we can predict its environmental impact," Stevenson notes. "That makes it very important to design experiments that are ecologically and environmentally relevant, but also to get at dynamics that can be extrapolated to other systems."

Louise M. Stevenson, Adeyemi S. Adeleye, Yiming Su, Yalei Zhang, Arturo A. Keller, and Roger M. Nisbet. (2017). Remediation of Cadmium Toxicity by Sulfidized Nano-Iron: The Importance of Organic Material. *ACS Nano* 2017 11 (10), 10558-10567. DOI: 10.1021/acsnano.7b05970

Cultured Tissue "Meats" Legislation

Take a few muscle stem cells, culture them in a lab, and you get a delicious, animal friendly, environment friendly piece of meat, right? Well, that depends on what you would call "meat". Instead of replacing meat with plant-based imitations, scientists have successfully cultured meat from stem cells taken from livestock. Lawmakers in the U.S. are currently debating whether the Department of Agriculture (USDA) should be in charge of overseeing the manufacturing and labeling of cultured meat. They are responsible for the quality-assurance of meat, poultry, and egg products. Some experts are unsure about the expertise of the USDA on cultured meat since this process is entirely different from the feedlots and slaughterhouses that they are used to.

The debate is also relevant in other countries. The European Union recently declared cultured meat should be treated as "novel food' and thus able to be marketed if it is safe and equal to meat obtained from livestock.

Servick, K. (2018). US lawmakers float plan to regulate cultured meat.

APPLIKON BIOTECHNOLOGY

CAREER - SPONSORED ARTICLE

Applikon Biotechnology is a world leader in developing and supplying advanced bioreactor systems from laboratory-scale, to pilot-, to production scale. Our mission is to provide reliable solutions for the bioprocess market that will enable an improved quality of life. We support industrial microbiology and the pharmaceutical industry in their upstream process by implementing scalable platforms from initial screening through development to full-scale production. By minimising scale-up risks and shortening the time-to-market for our customers, we contribute to the improvement of Life Sciences, and that is our passion!

Expertise

Applikon Biotechnology is known for bringing new technologies to the market. We continuously improve and launch new bioreactor systems as well as process analytics and software tools. These new technologies offer advantages in process efficiency and thus costs. In particular, our small scale designs that offer a complete solution for results generation make us unique in the mini and micro bioreactor range.

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Our focus is on supplying the best product offering for our customers now and in the long-term future. Our portfolio ranges from very small miniBioreactors to large volume cultivation systems. Whether used for laboratory applications, good manufacturing practices, or the full scale-up process from lab to production, we have the right solution.

MiniBio, Source: Applikon

A Selection of Our Flagships

micro-Matrix | 24 bioreactors in a convenient microtiter format

The unique micro-Matrix offers total control over 24 independent bioreactors in a simple microtiter plate footprint. Each of the 24 bioreactors on a plate offers independent controls. The micro-Matrix is a true scale down of small scale bioreactors. The bioreactor square well cassette design is based upon our popular SBS-format microtiter plates that maximize mixing, optimize gas transfer, and seamlessly integrate into lab automation protocols.

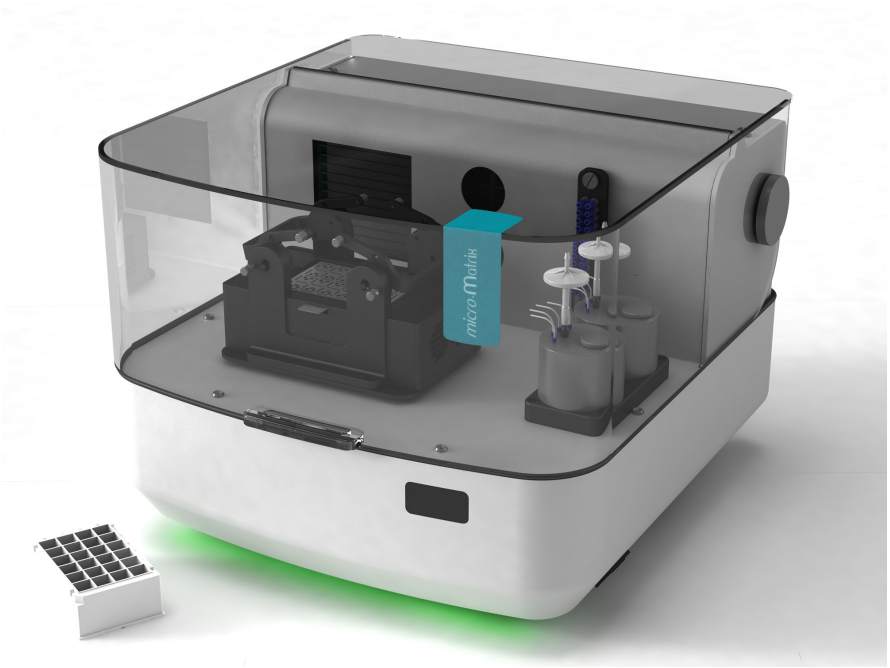
miniBio | Parallel scale-down systems built to your configuration

The miniBio is a true scale down of the classic laboratory scale bioreactor. It has the same flexibility as the laboratory scale bioreactors and can be customised to fit the demands of any process. The small volume reduces media costs and maximises bench space.

Lucullus PIMS, Source: Applikon

Lucullus PIMS | One integrated software solution for the whole bioprocess workflow

Lucullus Process Information Management System offers a new dimension in upstream bioprocess data management. Lucullus integrates multiple functionalities which save the scientists time since all data is stored in one central Oracle© database. No more need for data export and import between different solutions, Lucullus integrates all functions needed for complete data management of your upstream process.

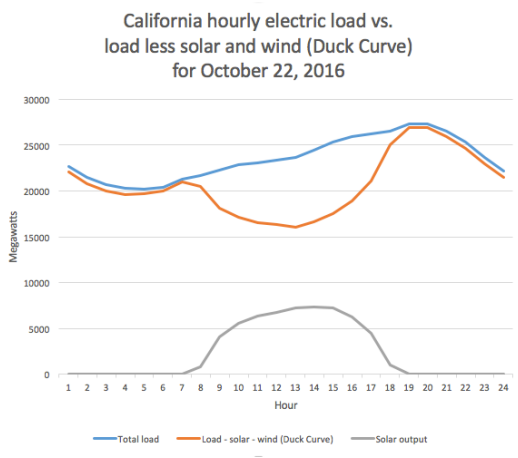


micro-Matrix, Source: Applikon

MAJOR ADVANCEMENT IN RENEWABLE ENERGY

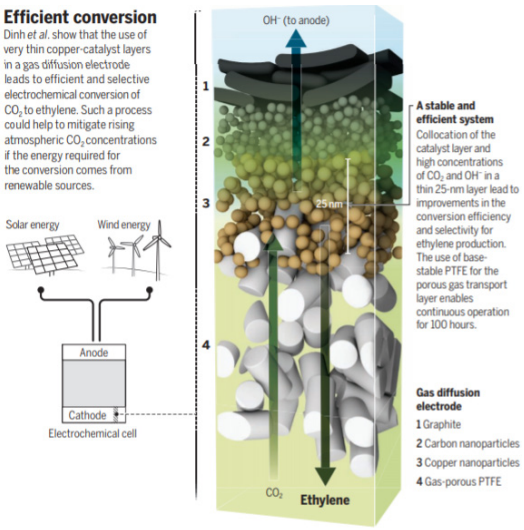
NANONEWS

Renewable energy is the future of electricity. It seems to be the only form of energy production that is sustainable besides nuclear energy. Before this type of energy can be used as the primary resource for electricity, some major problems need to be solved. For example: it is not environmentally friendly to produce solar panels, and windmills often break down. Even if all these complications would be resolved, the biggest challenge remains: storing the excess energy efficiently.



It might sound counterintuitive, but energy storage is the hardest problem to deal with. One of multiple reasons is that most renewable energy is generated during the day while most of it is needed in the evening. Another obstacle is a concept known as the duck curve. When the sun sets, a substantial portion of energy that comes from renewable sources abruptly disappears, requiring enormous amounts of additional energy to suddenly be generated. This results in a duck shaped curve and puts huge stress on the grid, which in turn requires less preferable electricity factories, such as coal, to produce more.

These complications could all be solved with efficient batteries that are commercially viable, which is exactly what Cao-Thang Dinh *et al.* developed [1]. The battery uses CO2 and water to make polymers that can be used as fuel which can be conveniently stored. It uses a complicated series of catalysts that are pH controlled and powered by a potential difference. This system can reach an efficiency of up to 80% and can convert CO2 reasonably fast. If this battery can be mass produced then the forecast for renewable energy is all sunshine and rainbows.



Dinh, C., Burdyny, T., Kibria, M. G., Seifitokaldani, A., Gabardo, C. M., Arquer, F. P., . . . Sargent, E. H. (2018). CO2electroreduction to ethylene via hydroxide-mediated copper catalysis at an abrupt interface. *Science*, 360(6390), 783-787. doi:10.1126/science.aas9100

PHOTOCONTEST WINNER: JULIA WENINK

INTERVIEW

Hooke's first ever photo contest was won by Julia Wenink. She is a first year's Nanobiology student and has won a disposable camera. This is the story behind the picture, which is shown on the next page.

Could you tell us a little bit more about the picture?

The picture was made in a ski resort called the Kaunertaler Glacier in Austria. Every year my dad and I go skiing there. During our ski holiday, we always go a little bit crazy: we usually wake up at 6:30 so we can be the first ones standing on the ski piste. This picture was actually taken on the last day of our holidays this year. It was a beautiful day that day, and super cold; I believe it was -20˚C. We took the first gondola up to the highest point of the mountain, where you have a stunning view of all the other mountains. Then, when the morning sun glows over the mountains, you are given the perfect opportunity for a photo.

Did you take this shot spontaneously or were you specifically looking for objects to photograph?

At the peak of the mountain, I went to the cliff to take a picture of the view. To prevent people from falling, the workers at the ski station spanned a cord along the edge of the cliff. While I was taking pictures, I saw that the cord was covered in ice crystals. You could really see the structure of all the individual crystals, and I thought that it was very cool because you never realise that snow and ice are made of all these small crystals. So, I tried to focus on the ice crystals instead of the mountains in the backgrounds, which gave me a nice nano-macro perspective.

Do you have a specific goal in mind for your prize: the disposable camera?

I think I am going to save the disposable camera for a special occasion. A disposable camera might come in handy for the IntroN weekend!

Regarding the theme of this edition, in what way do you think that you could contribute to the environment?

I think it is important that we try to be aware of how our habits affect the environment. If we could change small habits that will at the end be the most effective solution. I made the conscious choice to stop eating meat around a year ago. I also try to minimise my food waste as much as possible. But I have to say that there are many things that I can still improve on. For example I am not really good at separating waste, which is very important as well. Besides that, I should also cycle more to Rotterdam instead of taking public transport. So, there is still enough to improve, but, as my mother always says, take one little step at a time.

MASTERS OUTSIDE TU DELFT AND ERASMUS MC

EDUCATION

Following a master's programme in Delft or Rotterdam might seem to be the most practical or even the only option after finishing your bachelor's degree. However, there are many more suitable programmes distributed across our beautiful country. Have a look at these examples and fly away from these two safe and comfortable cities.

Molecular and Cellular Life Sciences

Where? Utrecht University

If it is your goal to develop medicines and vaccines, you might want to look at this master's programme. In the courses, you will mainly look at the way molecules induce diseases, and this will be combined with two large research projects where you could use the knowledge you have gained from *Bioinformatics*. Especially the tracks *Biophysics and Molecular Imaging* and the more programming-based track called *Computational Biology* resemble the combination of biology with the technical courses similar to our Bachelor's degree.

Universiteit Utrecht

Forensic Science

Where? University of Amsterdam

One remarkable master's programme that wants to have students from the technical and biological fields is Forensic Science. While this might look contradicting to a DUT student for a social sciences based programme, the technical students are wanted for their analytical skills and biologists for their analysis methods of tracing DNA. In the courses, you will learn to interpret crime scenes, and you will look at reasoning of criminalistics. Furthermore, you will learn principles and techniques to analyse the traces found at a crime scene by researchers and experts from the forensic institute or police force. At the end, you will combine all your knowledge in a simulated case, where you will collect data, analyse it, and draw your own conclusions as a true detective.

UNIVERSITY OF AMSTERDAM

Biotechnology

Where? Wageningen University and Research

Just like the master's degree Molecular and Cellular Life Sciences this programme has a track that deals with the development of vaccines. Here, you will look at immunotechnology, molecular biology, virology, and the ways to use this for the development and production of drugs. However, if you are inspired to focus more on the environment due to this edition, you might want to have a look at the track called 'Environmental and biobased technology'. Their department has achieved making PET bottles out of biobased materials obtained from plants, and they want to use microalgae as a new fuel. To design the techniques to accomplish this, you are needed.

Artificial Intelligence

Where? Maastricht University

Do you want to learn more about data mining, machine learning, and autonomous intelligent systems? Then this master's degree will be a good option for you. Apart from the courses, you will have many projects. You might make an intelligent agent that can play complex games independently or make a team of robots communicating and fulfilling a task together. However, you might want to take into account that you might need to follow extra courses to bridge the gap between NB and AI. In this programme you are free to choose your specialisation; you might thus study sensor networks for medical applications, trading software, or robotic space exploration. Anyhow, you will become an expert in this challenging field with a lot of impact on today's society.

Molecular Mechanisms of Disease

Where? Radboud University

This master's programme is the only one discussed that is mainly based on research instead of courses. The few courses you take are grouped in three themes: 'Infection, Immunity and Regenerative Medicine', 'Metabolism, Transport and Motion', and 'Cell Growth and Differentiation'. Here, you will discuss the failures of systems in these categories and the diseases they come with. Furthermore, you will have research trainings and lots of possibilities to take part in current research groups in multiple fields. As it is required to do the internship abroad, most graduates will continue their career outside of the Netherlands.

DOWNSIZING

MRNA REVIEWS

The mRNA was searching for creative approaches to make a positive contribution to the environment. During this search, we came across the movie Downsizing. Alexander Payne's 2017-movie is set in a near future where scientists have discovered the solution to "mankind's single greatest long-term threat": overpopulation. The technical procedure called "becoming small" reduces the size of human beings to about twelve centimetres.

Although it is introduced as a way to save the Earth from overpopulation and waste accumulation, it is sold as a life improvement plan because small things are cheaper. The currency exchange rate is enormous; a mere $150,000 will translate to a relative $12.5 million in "small world."

This seemingly neat concept unfortunately lacks a good execution. It is as if they wrote several different storylines to choose from, and somebody said "I like them all." The movie begins well until the plot starts going into multiple, seemingly random and mostly disappointing directions. It is a shame that Payne did not choose one of these storylines and stuck with it.

Source: AD.nl

Another missed opportunity to make a more interesting storyline is the protagonist. Paul Safranek (Matt Damon) is introduced as a nondescript everyman, much like Willy Loman in Arthur Miller's Death of a Salesman, but, unlike Loman, who gets more interesting as the story progresses, Safranek never succeeds to evoke a sense of sympathy from the audience. Despite the many ups and downs, Safranek surprisingly manages to remain rather uninteresting and shallow. Even when he has his moment of liberation, playing a native African drum in his last rays of sunlight on a Norwegian mountain, surrounded by people who are either humanity's last hope or a misguided doomsday cult (we have lost count of the storylines by now), it is a struggle to really care for Safranek.

What is more is that the science behind the process of "becoming small" might have been interesting for us nanobiologists. However it would only lead to more directionlessness of the plot. An interesting fact that we could not leave out, though, is that reducing Matt Damon from 177 cm to 12 cm would require the disappearance of 7.6*10^18 joules, equivalent to 180 ten megaton bombs. Shrinking 27 people at the same time in one room, you would expect to see some damage.

All these things aside, the movie is not that bad. It is just a shame that they missed out on these opportunities, because it could have been so much better.

THEM DARN HIPPIES

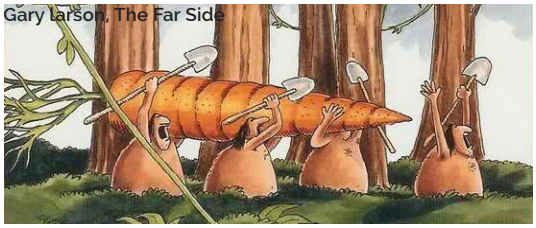
HISTORY

Let's get real; anyone who is not a vegetarian is egocentric. Alright, maybe that is a little blunt to say, but we did wonder why some people become herbivores and others do not. To answer this question, we decided to look into the history of vegetarianism and hopefully learn from the ancient hippies.

Around 500 BC when voluntary vegetarianism first appeared, vegetarianism was strongly associated with religion. Buddhists in India adopted a vegetarian diet as killing living things was forbidden by their doctrines. Meanwhile in Greece, followers of Pythagoras had a strong belief in reincarnation, and they vehemently opposed practicing violent professions as well as eating meat. However, a large part of society was not vegetarian as it was simply not part of their beliefs. If you think you are original by making jokes about vegetarians, you are about 2,500 years too late. Greek comedy playwrights would make fun of vegetarians during their plays. This might have been partly due to the fact that the non-vegetarians felt uneasy because vegetarians seemed to suggest, and still do, that their lifestyle was "superior" to non-vegetarians.

This did not change with the arrival of Christianity, although the motivation to become vegetarian did. Most early Christians thought of vegetarianism as ungodly because it was an insult to God to not eat what He had provided. This disapproval of a vegetarian diet was probably also related to the ideology that most vegetarian sects adhered. They usually spoke out against the church, treated women as equals, and allowed homosexuals to visit their churches. Horrendous, is it not?

Although Pythagoras died in 500 BC, he did inspire a group of academics to form the Vegetarian Society in England in the mid-1800s. This group had attracted 4,000 members by the end of the century. Furthermore, a lot of working-class Brits were vegetarian; not by choice, but because they often could not afford meat.



From the beginning of the 20th century, the motivations to become vegetarian underwent a change. Not only ethical and nutritional concerns, but also environmental and economic motivations were reason enough to stop eating meat. By advocating for nonviolence against animals, Mahatma Gandhi surely contributed to the popularity of vegetarianism in Western cultures as well. An important milestone in the history of vegetarianism was the opening of what would later turn out as the first successful vegetarian restaurant: *Cranks* in London, in 1961.

All in all, although the motivation to not eat meat kept changing, you could say that vegetarianism in any age has to do with living according to your ideology and ideas. It has never been the easiest choice, but people still try their best to do the right thing regardless of what others think. Whether this is a good or a bad thing, is up to you. However, we do believe that thinking about your ideology and living up to it is admirable.

Boyle, J.E. (2007). Becoming Vegetarian: An Analysis of the Vegetarian Career Using an Integrated Model of Deviance.

GIANLUCA KEMPS
INTER-MRNA-TIONAL

"Humankind has been telling stories forever and will be telling stories forever"
Jim Crace, English author.

In the Nano family, Dutch and internationals coexist in a cultural symbiosis which, to our belief, is mutually beneficial for both parts. Learning their stories is learning about the world, but also about ourselves; it puts us into a global perspective where a variety of views and ideas come into place challenging what was previously established.

In the spirit of diving into our international students' stories we asked Gianluca Kemps, a first-year student from Italy for an interview.

Born in Rome, Gianluca lived there his entire childhood. In high school, he followed the scientific track, which included a lot of mathematics, biology, and chemistry. Fascinated by what he calls "the cool stuff," he looked outside of Italy to pursue this further. That is when he got in touch with Delft, Rotterdam, and Nanobiology.

"First, there was a period when I kept coming and going back to Italy. At some point after Christmas, I saw that I wanted to learn some Dutch and to know more about where I was going to live. So when I came back to the Netherlands, I took an intensive Dutch course at the TU Delft. Afterwards I worked in a restaurant to train my Dutch."

Having an Italian mother and a Dutch father, Gianluca has a double citizenship. This was a big help for the application and "*all the government issues that you face when you move to the Netherlands.*" Gianluca has lived in the Netherlands for one and a half year by now.

We asked him about the stereotypical differences between Italy and the Netherlands. He replied that he found most of the stereotypes to be true, however, he thinks they lack some depth when taken out of context.

"For instance, cheese: it is true that the Dutch eat it with everything. The Netherlands is famous for its cheese, and since there is no big lunch here like in Italy, everybody eats it on their sandwiches for lunch instead."

"A funny thing I have noticed is that abroad everybody considers Heineken the most Dutch beer, even though since I moved here I think I have drunk Heineken only a couple of times."

Discussing cultural habits, he confessed that there are some things he still has not gotten used to. "*Dinner time for example. I cannot eat at half past six, which is supposed to be the dinner time here in the Netherlands. Therefore, I always have dinner at 9, 9:30.*"

He admits there are some Dutch things that he cannot live without anymore. Hagelslag, the chocolate sprinkles Dutch people put on their bread, is a pleasant addition to his diet: *"I eat it almost everyday now."*

We asked him about his struggles. At the moment, he is still learning the Dutch language. *"I especially struggle with the grammar. It is a language where sometimes it seems as if there is no logic in the way you order the words in a sentence."*

We inquired him about the little things that other students may not realise about international students: *"The language of course. It is natural for two fellow students from the same country to talk in the language they know; it is just the easiest way to communicate for them."*

His personal experience with Nanobiology has been positive up to this date. He always appreciates when local students help the internationals and make him feel at home. *"Especially in the beginning of the year. An international is lost because he is starting something new, and he does not know where to go."*

We asked him for advice he would give to the international community. He replied frankly: *"Do not have big expectations."* When you take the step of becoming an international student: *"It is important to value everything instead of being critical towards things and complaining all the time."*

Asking him about what he missed most from Italy, Gianluca told us: *"At first I thought I was going to miss the nice temperatures a lot throughout the year, but since today is a nice day, my mood is nice as well. There are still nice days in the Netherlands that I can enjoy."*

Considering himself a stereotypical Italian, Gianluca loves his traditional cuisine. His favourite dish: *"Pasta carbonara, typical in Rome. Since I am a student I normally do not have much time to cook, and carbonara does not take long at all, so I have made it many times, and I have perfectioned my recipe."*

His favourite Dutch dish is not really a nutritious dish: he really enjoys the deep fried cuisine (bitterballen, kroketten…) together with a nice cold beer.

To end our interview, we asked him about changes in his lifestyle that could help the environment. He replied that he would not become vegan. Instead, he would adopt changes such as using more public transport, reducing the consumption of meat, or supporting local food markets:
"It is not only the transport of people that pollutes, but also the transport of things. I actually really like going on Thursday mornings to get some fresh local food at the main square from Delft."

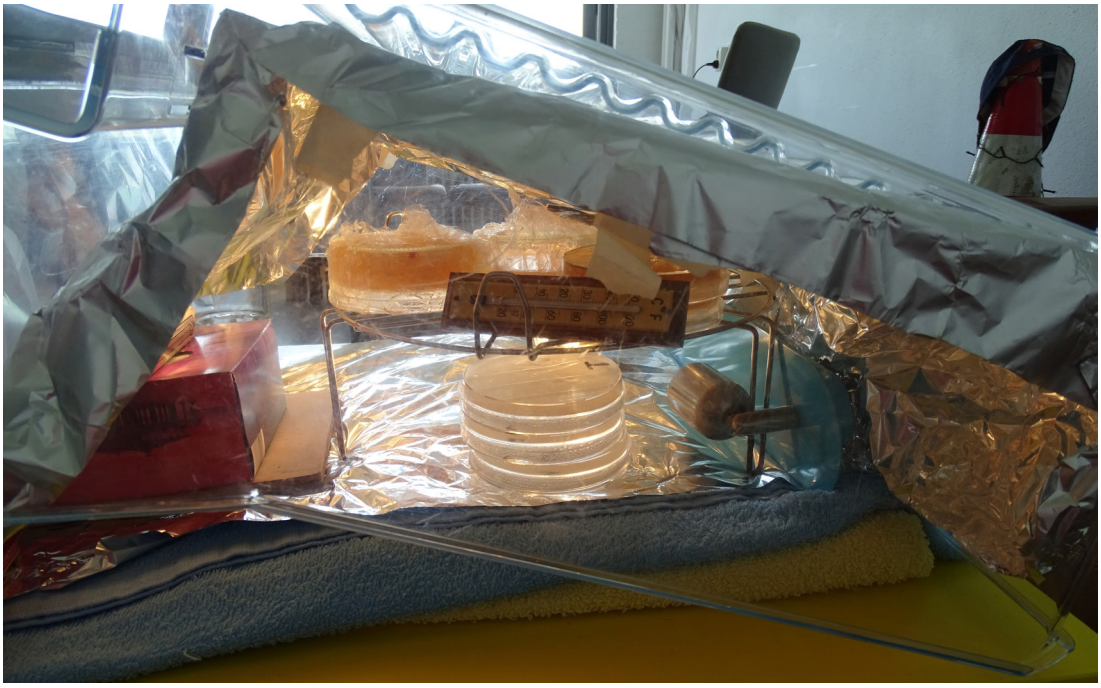
DIY INCUBATOR - CONTINUED

IN THE FIELD

Remember the article from the previous edition where we explained how to build your own incubator using only products that you probably have at home? Remember courses such as *Biomolecular Dynamics*, *Biophysics* and *Labcourse*? Remember the rush of adrenaline you felt when you saw the first Petri dish filled with bacteria that you plated?
This edition, we decided to let it all come together by growing cells in our very own home-made incubator. If you do not remember how to build the incubator, scan the QR code!

For the best result, use:

- DIY incubator
- Thermometer
- A form of elevation to let in cool air (box of napkins and three sets of playing cards)
- Petri dishes (provided by Hogeschool Rotterdam)
- Swallow Globe Brand Agar powder (*Vanka-Kawat*)
- Tap water, boiled
- Granulated sugar (*Belbake*)
- Beef broth (*Maggi*)
- Cotton swabs (*Albert Heijn*)
- Source(s) of bacteria/fungi (phone screen, doorknob, etc.)

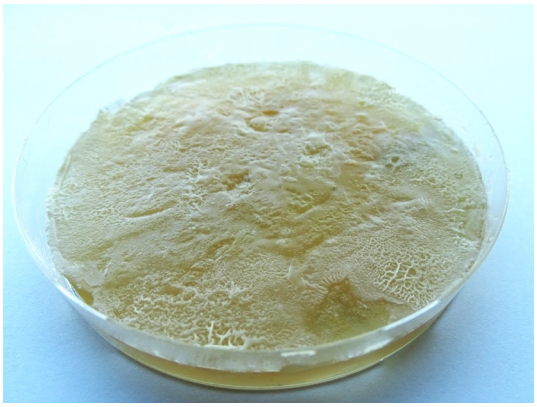


Instructions

1. Think about what you want to achieve. If you are happy with any type of bacterial growth, it is not important to prepare the Petri dishes in a sterile way. However, if you have specific desires regarding what type of bacteria you want to grow, it is very important to continuously work sterile.
2. Prepare the agar. Do this by boiling 0.5L of water and pouring it in a bowl. Next, add one packet of agar powder, two tablespoons of sugar and half a broth cube. Stir until well mixed. Pour into the smaller half of the Petri dish until it is filled about halfway up. Let the agar dry at room temperature without putting the lid on the Petri dish. By doing this, you risk the chance of bacteria from the air falling on the agar. If you want to prevent this, you could try making a hot air umbrella with your kitchen stove.
3. Prepare the incubator. Do this according to the article from the previous edition. Make sure that the temperature inside the incubator is stable around 37 °C. In case it becomes too warm, use elevation such as a napkin box to lift up the incubator in order to let cool air in.
4. Once the agar has hardened, place the bacteria on the agar. Start by swiping the cotton swab on the object that you are interested in. Next, gently brush the cotton swab on the agar, just like you learned in *Labcourse 1*. Be careful, and try not to damage the agar.
5. Place the Petri dishes inside the incubator. It is important to inspect them often to make sure that the temperature is still correct and that the agar is not drying out.

Results

The first try was not quite successful. Because we did not add broth to the agar, there was no sign of bacterial growth. For the second round, we added broth to the agar. This time the results were definitely satisfactory. In the Petri dishes, there are clear structures of bacterial colonies and fungi.



Picture to the left: bacteria obtained from a phone screen. Picture above: bacteria obtained from a dish cloth.

E. COLI JEANS AND RUBIK'S CUBES

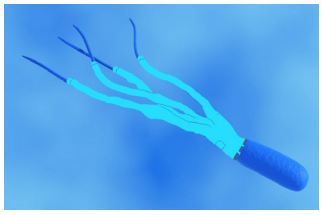
MRQNA

How would an E. coli wear pants? One-legged trousers? Please include a sketch.
Emma and Brian

Dear Emma and Brian,

After sleepless nights of reflecting upon your question, a relentless doubt kept swarming in our heads blinding our reasoning and nearly bringing us to the verge of madness. It is fact that one-legged trousers are a contradictio in terminis, an aberration against the essence of pants. The Oxford dictionary of English defines trousers as: "An outer garment covering the body from the waist to the ankles, with a separate part for each leg". Thus, in essence, a pair of trousers implies the existence of multiple legs, hence "for each leg". Considering that these Gram-negative, facultatively anaerobic, rod-shaped, coliform bacteria possess motile flagella and that flagella are the closest things to legs in a bacterium, we would have to conclude that E. coli strains would wear multiple-legged trousers like in the picture below.

Kind regards,
mRNA



Dear mRNA,
Can people who are colour-blind solve a Rubik's cube?

Kind regards,
Stefan Loonen

Dear Stefan,

In order to answer your question we will first discuss the definition of colour blindness. Colour blindness is a colour vision deficiency in which a person's perception of colours deviates from what most people observe. The most common cause of colour blindness is a mutation on the X chromosome that influences the development of certain photoreceptor cells in the retina. Actual colour blindness, meaning an inability to see any colour, is actually extremely rare.

Colour blind people could in principle solve a Rubik's cube if there would be enough light to distinguish the colours. Actually, Mats Valk, who holds the second fastest record time ever for solving a 3x3 cube, is said to be partially colour blind. Because of this, his cube has slightly different, more distinguishable colours. There are also special Rubik's cube variants for which the solution does not depend on colour. For example, the Shengshou Mirror Cube has to be solved by matching the right shapes in order to obtain a cube. In conclusion, we think the answer to your question is 'yes'. However, is everything not already solved when you do not see a problem?

Lots of love,
mRNA

aliexpress.com

HOW TO BE AND STAY A SJAARSCH

RANDI

>> rng ('shuffle');
>> randi(nr_leden)
ans = 42 %Daniël Landré

Let me introduce myself, I am Daniël Landré, fourth year student. But I am probably better known as: Oude Lul, Vierdesjaarsch, or Eternal Sjaarsch.

Daniël Landré (left) as first year sjaarsch

You are probably wondering: "Why would I want to stay a sjaarsch?" Well, your first year is the year in which you learn and develop yourself the most. You meet a lot of new people, and you get exposed to all kinds of new opportunities. Therefore, the longer you stay a sjaarsch the more you learn.

"The longer you stay a sjaarsch the more you learn."

You may wonder: "how do you stay a sjaarsch after your first year is over?" I decided to join the powerlifting association IJzersterk in my third year, so I became a sjaarsch there, and I joined D.S.R.V. Laga in my fourth year (again becoming a sjaarsch). However, simply joining associations is not enough to stay a sjaarsch, you have to retain a certain sense of naivety, wonder, and youthfulness. It is generally believed that staying a sjaarsch will delay the onset of a very common trait of aging: "burger worden".

"Being a sjaarsch will delay becoming a burger"

I will elaborate more on the positive effect that staying a sjaarsch has had on me. By joining IJzersterk, I discovered that I love to exercise regularly and that this is what I look for in an association. I then discovered that I love rowing and the culture surrounding it by joining Laga, where I now train six times a week. I would never have discovered this if I would have been too

Daniël Landré as fourth year sjaarsch

stubborn to allow myself to be a sjaarsch again. Being a student means that you will be exposed to a lot of new opportunities.

"Do not be scared to be a sjaarsch again"

My advice to you is to stay eager to learn and to take advantage of opportunities when they arise. Do not be scared to be a sjaarsch again because then you will be exposed to the most opportunities.
May the sjaarsch be with you.

Best,

Landré

SUMMER EDITION

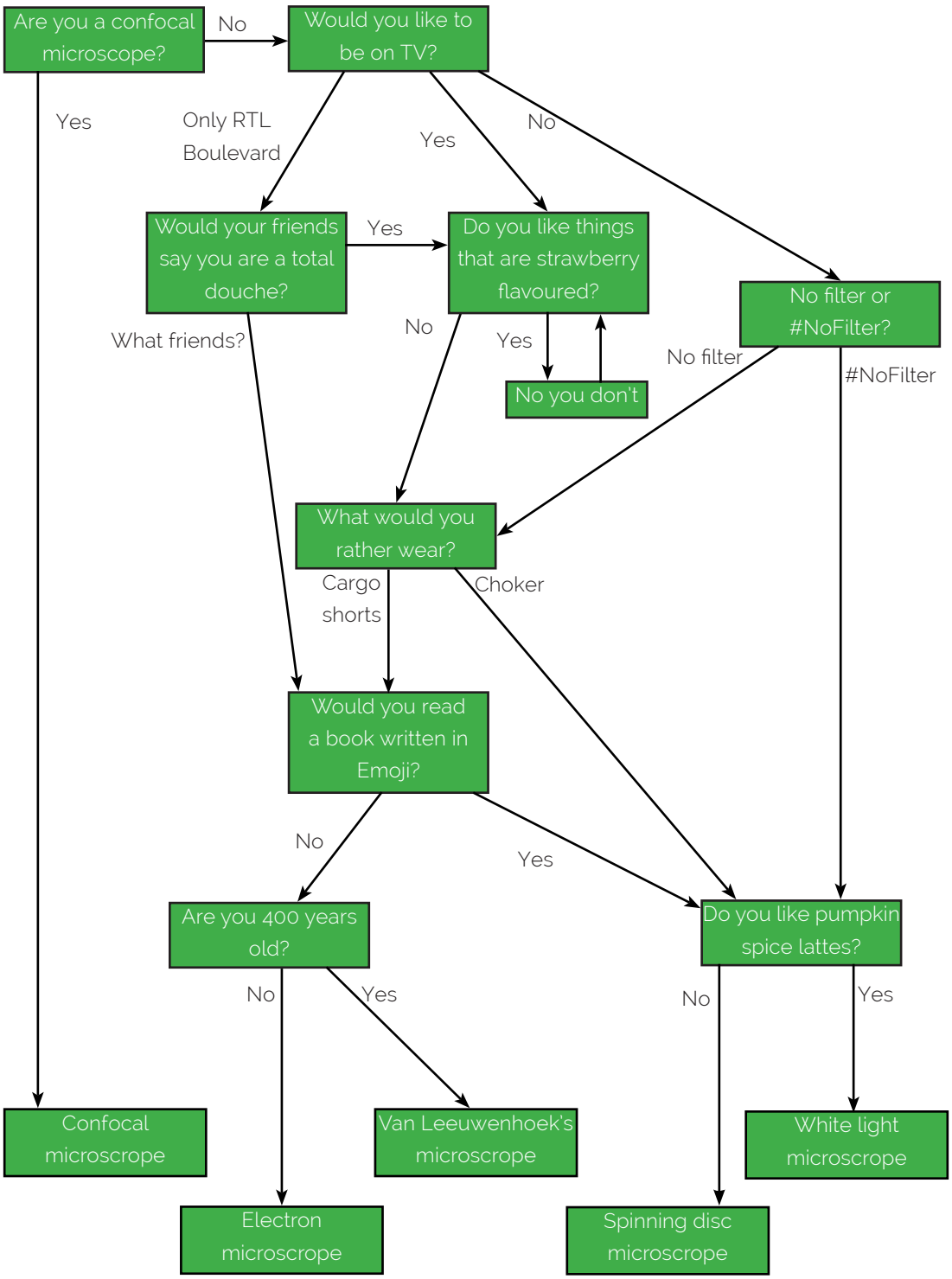
PUZZLES

When you have finally finished your last exams, and you have plenty of time to do absolutely nothing, it is time to sit on your balcony and enjoy the sun shining on the pond with lovely ducks in it. Now that you are fully relaxed, crack your brain on these puzzles, and send us your results to show off your brilliance. The solutions to all following puzzles will be posted online in August.

As a tradition, six geniuses come together after the holidays to notify each other of their new inventions. This year, all of them have been especially successful, and they enjoy bragging about their achievements. Last summer, this meeting had been very useful, since they made a pact to all do one good deed for the environment.

Can you find out what each scientist invented, what good dead they did last year, and from which chair they are talking?

- The genius who only works without any light on sits on chair 1.
- The inventor of the MRI, Professor Brown, is really frustrated by the stories of trees that the person opposite planted.
- Dr. Jones does not know all the specifics of the prism.
- The person who invented the prism did not downsize himself.
- Doctor Smith sits on chair two.
- The number of the inventor of the optical tweezer is two less than the number of Cooper, PhD. which are both not equal to three.
- One of the doctors sitting on chair six cloned a human being.
- Dr. Harris reuses his pipettes, but likes the story of how one of the other scientists does research only by programming.
- Clockwise seen the inventor of the tunneling microscope who contributes his conferences by skype follows directly after Dr. Wright.
- The last person studies nanopores.


Are you a confocal microscope?
No
Would you like to be on TV?
Yes
Only RTL Boulevard
Yes
No
Would your friends say you are a total douche?
Yes
Do you like things that are strawberry flavoured?
No filter or #NoFilter?
What friends?
No
Yes
No filter
#NoFilter
No you don't
What would you rather wear?
Cargo shorts
Choker
Would you read a book written in Emoji?
No
Yes
Are you 400 years old?
Do you like pumpkin spice lattes?
No
Yes
No
Yes
Confocal microscrope
Van Leeuwenhoek's microscrope
White light microscrope
Electron microscrope
Spinning disc microscrope

Puzzle

"A calculus student's dream" (Submitted by Dr. Fokko van de Bult)

When grading calculus/analysis exams I often encounter applications of non-existant rules of calculations. This brought me to think of the following problems. Suppose f and g are continuously differentiable functions from $\mathrm{R} \to \mathrm{R}$:

1. Show that if $(f+g)^2 = f^2 + g^2$, then $[f * g]' = f' * g'$.
2. Writing F for an anti-derivative of f, and G for an anti-derivative of g, find all almost never zero functions (to be precise $f(x) = 0$ and $g(x) = 0$ both have at most one solution) such that both $[f * g]' = f' * g'$ and that $F * G$ is an anti-derivative of $f * g$.

Best regards, Fokko.

Who's the murderer?

Bad news! During the last day of the Beunweekend, we discovered that our beloved QQ Danilo has been murdered. Being the only ones in the building, it must have been one of us who did it. Below are two pictures; one of the crime scene, and one of us working during the Beunweekend. Can you find out who did it, how, and why? Submit your solution to mrna-hooke@tudelft.nl and have a chance to be featured in the next mRNA.

UPCOMING ACTIVITIES

HOOKE AGENDA

First year exams

Linear Algebra	03/07
Physical Biology of the Cell	04/07
Analysis 3	05/07
Biomolecular Programming	06/07

Second year exams

Journal Club	02/07
Computational Science	03/07
Bioinformatics	04/07
Optics and Microscopy	05/07 Retake
Evolution	05/07 Retake
Image Analysis	06/07

Third year exams

Optics	02/07 Retake
Current Topics: Protein Structure.	03/07
Current Topics: Primer on High Speed Simul.	04/07
Current Topics: Systems Neurobiology	05/07
Current Topics: Genomics and Proteomics	05/07
Quantum Mechanics	06/07 Retake

Master's exams

Protein Quality Control Mechanisms	03/07
Stem Cells	04/07
Biological Networks	05/07 Retake

End of the Year BBQ	06/07
Resits in August	13-16/08
IntroN	17-19/08