mRNA

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STRING THEORY // INTERVIEW MARTIN JAGGI // BACTERIA VS PHAGES
SUPERPOWERS IN ANIMALS // DEEP SEA EXPLORATION // SPACE PLANTS

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EDITORIAL
LULU NOTSCHAELE

Dear reader,

What comes to mind when you think about science fiction?

Starships, laser guns, aliens taking over the world, or some scary virus sending countries into anarchy? Perhaps you imagine something a bit more realistic, like a society where people no longer communicate face to face, but would rather stay glued to their screens.

In light of recent events, the mRNA reporters were presented with an excellent opportunity to act out one of those scenarios. Instead of spending a weekend at the hub together, this very appropriately themed edition was put together in a never seen before way. Communicating screen to screen, we set out to test the limits of our current technology.

Each of us working from our own homes, we spent the weekend Skyping, WhatsApping, and making even more Google Drive folders than the usual already large amount. Using these resources to their fullest capacity, we were more efficient than ever before. A trade-off had been made. Reporters, unable to drink port together. The *gezelligheid* had been sacrificed. Was this the first step towards a future without the traditional beunweekends together in the hub?

In the previous edition, we talked about traditions. For the last edition of this lustrum year we have decided to steer our spaceship in an entirely different direction. Join us on a journey as we explore the mystery that is string theory, subject a screenplay written by an AI (in the spirit of efficiency, mRNA 5 might keep this possibility in mind next year?) to our scrutiny, look at freaky space-like plants, and bear witness to an epic battle between the bacteria and bacteriophages.

I am very proud of all the committee members for their hard work putting this edition together in spite of everything, and would like to give special thanks to Lukas van den Heuvel for helping us.

I have had a great time being a part of this committee, and wish the next generation all the best. Happy reading and don't forget to wash your hands ;)

A(n)t your service,

Lulu Notschaele
Editor-in-Chief of mRNA 4.5

FROM THE BOARD
ANNA HARTENDORP

Dear reader,

This is the second and, sadly, already the last edition of the mRNA of this academic year. I feel a bit nostalgic, so I would like to look back at some highlights from the last months. After a heavy period of exams in January, we crossed the sea with 40 people to Gran Canaria, went on a hitch-hike to Lille with LUCA, and installed Claire Wyman as our first honorary member! Besides that, the TU Delft and Erasmus Medical Centre decided to temporarily close their doors because of the coronavirus, which was something I had only seen happen in science fiction movies before.

Imagine that you lived in the 1400s and you would be able to make a prediction about what the world would look like in 600 years. Would you have thought that it would look like ours does today? Or else, what do you think the world will look like in 600 years? There is no real answer to this yet, as we simply can not know the future. What we do know is that science is moving rapidly, maybe faster than we can actually process. Some of the things we do on a daily basis nowadays were unthinkable 600 years ago. We genetically manipulate all sorts of organisms and we are able to fly to the moon. If you want to form an image of the future, you need imagination, creativity and fantasy. For example, the producers of the movie Jurassic Park were probably fantasizing about bringing back dinosaurs. And maybe, somewhere in the future, if we can stick to the 'if you can dream it, you can do it' mentality, we might actually be able to make science fiction movies come true. If we should want that, is another question.

In this mRNA, you will read a lot more about science fiction. The committee did an outstanding job once again, and I would like to thank them for all the effort they put into this edition. I wish you all a happy reading!

I have spoken.

Anna Hartendorp

SUPERPOWERS IN ANIMALS

SCI-FI

In movies, superheroes have the most spectacular superpowers: the ability to fly, turn invisible, see in the dark, and many more. Normal human beings, like us, can only dream of doing these things. Animals, however, are way ahead of us on that aspect. Keep on reading to find out how animals use their special superpowers.

Birds - Magnetoreception

Birds navigate using the magnetic field of the earth. This has been known for a long time, but only recently the protein that is responsible for this GPS-system was found: Cryptochrome 4. This protein also reacts to blue light and regulates the biological clock.

Birds are not the only animals with this ability: bacteria, fish, *Drosophila*, and some mammals like dogs and mice change their behaviour according to the magnetic field of the earth. Even humans have a protein that could theoretically react to magnetism, but it is still unknown whether humans can navigate using the earth's magnetic field. Maybe with enough practice, you could become the first!

Octopuses - Invisibility

There are octopuses that can blend into their surroundings almost perfectly. This process of blending in looks very fascinating and luckily the internet is full with videos of their transformation. Octopuses have cells in their skin filled with one out of three different pigments, usually yellow, red, or brown. They can make each pigment-filled cell bigger or smaller and thereby become the desired colour.

Source bird: vectorstock.com
Source octopus: shutterstock.com
Source bat: clipart-library.com

Also, they have muscles that can make their skin look either smooth or bumpy.

Researchers have recently found that the octopuses pick one object and imitate features of that one object, rather than trying to imitate their environment as a whole.

Dolphins & Bats - Echolocation

Bats and dolphins share a feature that neither of them could live without: the ability to detect their surroundings in total darkness. Bats make ultrasonic sounds that can not be heard by humans, and dolphins make clicking sounds. The animals can detect how much time there is between the making of the sounds and their reflection after having collided with an object. Bats do this using their ears and can detect the time separately for each ear. Dolphins pick up the echoes with their jaws and forehead. In bats and dolphins, 200 genes have independently evolved in the same way. This convergent evolution is the reason why such different animals have these similar features.

Humans can learn a lot from animals and this is no different when it concerns their superpowers: there are blind people who use echolocation to get around. Daniel Kish, one of the most famous human echolocators, explained in an interview with the BBC that he could even determine whether a fence was metal or wood, depending on the way the sound was reflected.

BACTERIA VS BACTERIOPHAGES

SCI-FI

There is a war that has been going for millions of years. The two opponents have gotten stronger and stronger, evolving together and causing a countless number of tiny casualties: we are talking about the battle between bacteria and bacteriophages, or phages for short. How come there is not a winner yet? What makes both of these fighters so strong?

Bacteria - Type: Defensive

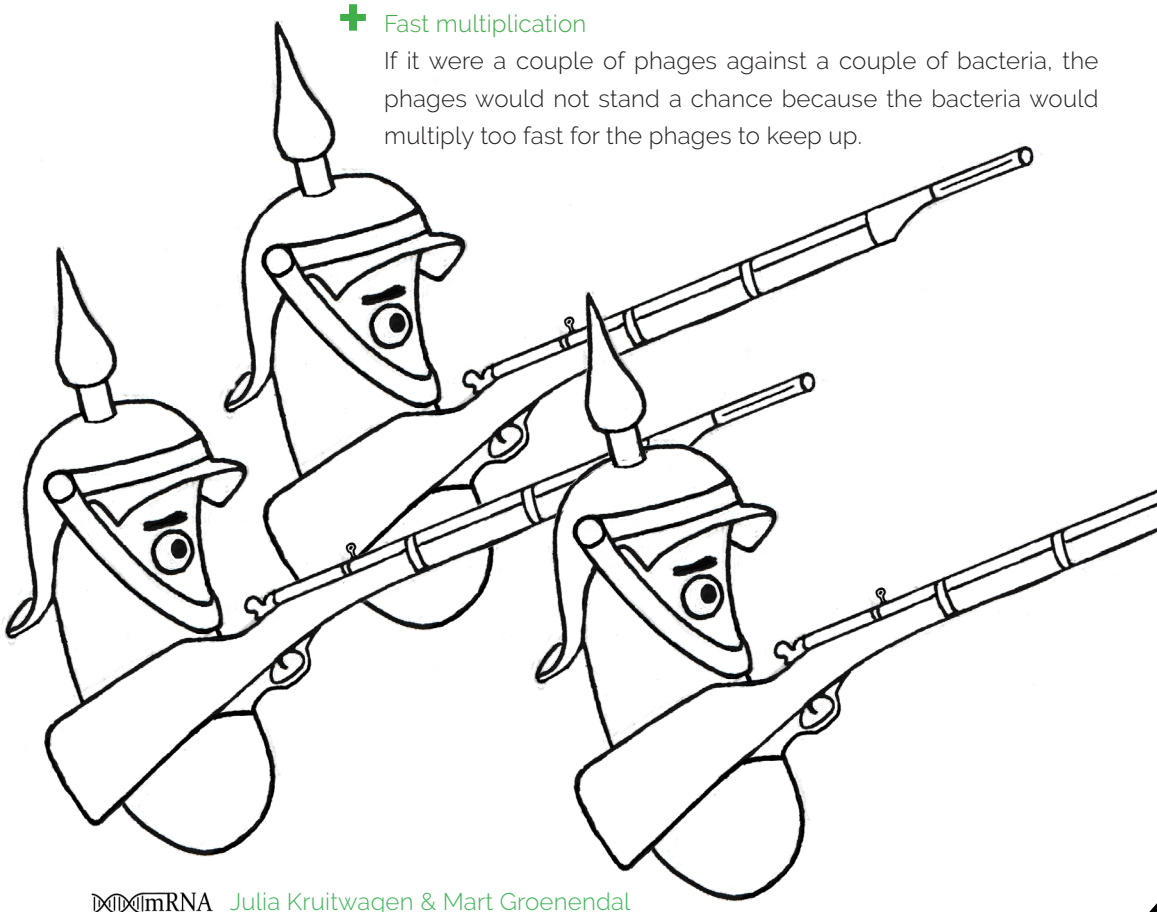
Strategy: Trying to keep the phages out. For example, bacteria can modify the receptors on their surface, so phages cannot recognise the bacteria. When it is too late and the phage has already entered a bacterium, the Abortive infection (Abi) systems promote cell death of this infected bacterium. The Abi systems depend on the fact that during an infection, the antitoxin encoding gene is suppressed. In normal, uninfected cells, antitoxins protect the cell from the activity of toxins. When this gene is suppressed, toxins are activated and the cell dies.

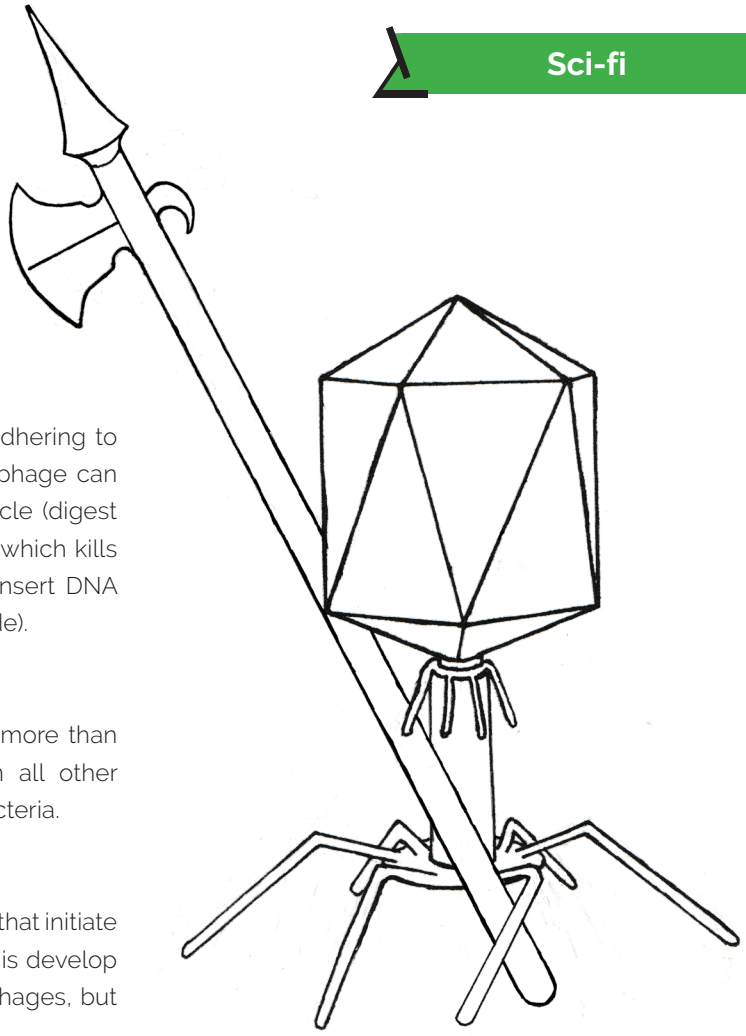
✚ Size

Most bacteria are between 0.2 and 2.0 micrometers in diameter, which is about ten times larger than bacteriophages. This means they must also be ten times more intimidating.

✚ Fast multiplication

If it were a couple of phages against a couple of bacteria, the phages would not stand a chance because the bacteria would multiply too fast for the phages to keep up.





Bacteriophages
Type: Offensive

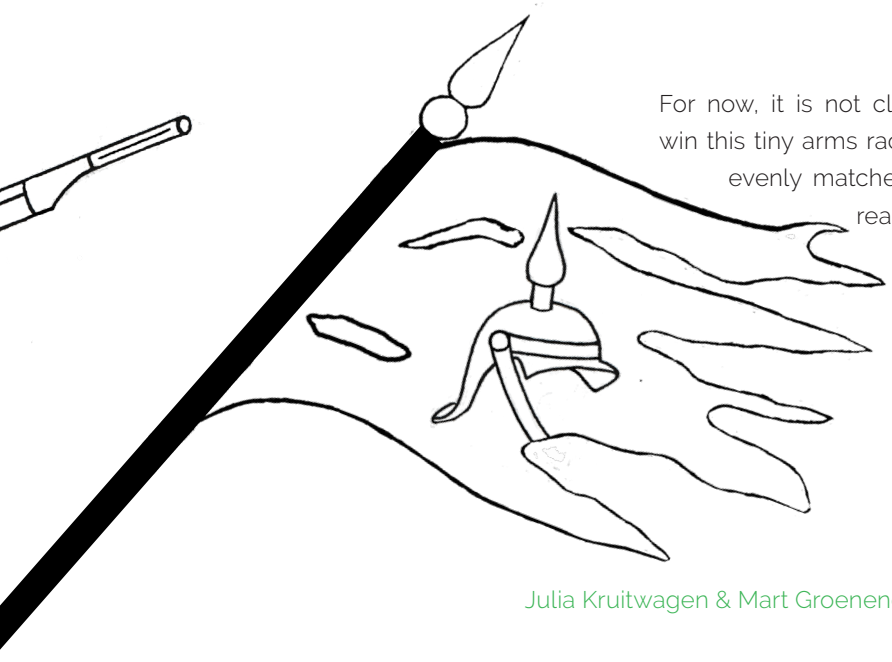
Strategy: Enter the bacterium by adhering to host-specific receptors. Now, the phage can choose to either enter the lytic cycle (digest host DNA and create new viruses, which kills the host) or the lysogenic cycle (insert DNA into host DNA and let the host divide).

+ Number

According to Wikipedia, there are more than 10^{31} phages on earth, more than all other organisms combined, including bacteria.

+ Attack

In this war, the phages are the ones that initiate the battles. All the bacteria can do is develop better strategies to keep out the phages, but they will never actually attack.



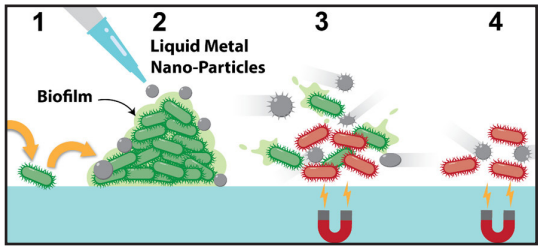
For now, it is not clear which side is going to win this tiny arms race. The two adversaries are evenly matched and neither of them are ready to give up the fight yet.

NEW WEAPON AND NEW LIFE

NANONEWS I

A New Weapon against Bacteria

Antibiotic resistance is becoming a serious problem. Therefore, an alternative type of treatment is needed. Researchers at the RMIT University might have found a new method of eliminating bacteria. Their method makes use of magnetic liquid metal nanoparticles. If nanoparticles are added to a bacterial biofilm and then exposed to a low-intensity magnetic field, the droplets will move and form sharp edges that will physically rupture the bacterial cells.



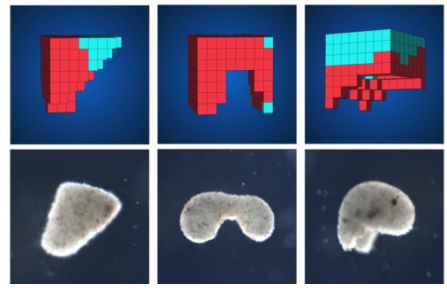
The efficiency of this method was tested on two different disease related biofilms. Both types of film could be successfully destroyed. The particles were also tested on eukaryotic cells, on which they did not impose any toxicity or damage. This was due to the difference in size and elasticity between bacteria and eukaryotic cells.

Now, the only remaining question is: do we from now on have to carry magnets around when being treated against a bacterial infection?

Elbourne, A. et al., 2020. Antibacterial Liquid Metals: Biofilm Treatment via Magnetic Activation. ACS Nano, 14(1), pp.802–817.

New Type of Life

If we had told Mary Shelley that her novel *Frankenstein* would one day become reality, would she have believed us? Researchers at the University of Vermont and Tufts took the first step by creating a new kind of lifeform which they call xenobots.



These xenobots are built up of embryonic cells, derived from the African clawed frog *Xenopus laevis*. The first step in making the xenobots is finding the best design. A special evolution-based algorithm that makes random combinations of epithelial and muscle cells, predicts how these cells will move, and then selects the best versions. These versions are then refined and optimized through implementing the algorithm again. The second step is building the bots by combining the embryonic epithelial and the muscle cells, as described in the blueprint. The result: a small blob composed of cells that are able to move, cooperate with one another, and repair, just as expected.

On the other side, let's hope that the researchers themselves will not be remembered as the xenobots, like what happened to Frankenstein, who was actually the scientist and not the monster.

Brown, J.E. 2020. Team Builds the First Living Robots. [Online]. [10 February 2020]. Available from: https://www.uvm.edu/uvm-news/news/team-builds-firstliving-robots

MARTIN JAGGI: MACHINE LEARNING

INTERVIEW

Professor Martin Jaggi is an assistant professor leading the Machine Learning and Optimization Laboratory at the École Polytechnique Fédérale de Lausanne, Switzerland. Via Skype we talked about machine learning, its relation to biology, its limitations, and its future.

First of all, what exactly *is* machine learning?
For me, machine learning (ML) is the collection of algorithms that learn from data. They are not directly written by humans in a rule-based way, but they change and are shaped by data. Many sciences are becoming more and more data-driven, which means people try to get scientific insights using data. Here, ML is a tool that can help.

When is ML better than other data analysis algorithms?
Sometimes, the distinction between ML and not-ML is not so clear. People often think that there is magic in ML methods, but there is not: they also include more standard approaches. The point is to get accurate insights from the data and to make accurate predictions. The quality of these predictions is often not so much influenced by whether you use a neural network or a linear regression, but much more by the quality of your data. The preparation of the data is the most important, as is the domain knowledge of the people working with the data.

What research are you conducting in your lab?
We are interested in training algorithms. First of all, we want to make them faster and more scalable to larger datasets. Data often comes from different sources, for example different hospitals. One way to combine data for training is to centralise everything, but there is a big privacy risk associated with this. To avoid these risks, we want to decentralise the training procedure: in our lab we train ML algorithms but keep the data where it is. The data remains local on the servers of the participating hospitals, but together they can train a ML model.

Can you give an example of how ML can violate privacy?
Privacy is a huge problem because there is much value in data, and often data is given away for free by the user. Everything you type on your phone, for example, is used by ML algorithms to make your keyboard better at predicting the next word. This information is, of course, very sensitive, so you might want a decentralised algorithm instead which trains the ML model on your phone without spreading your data. Another example is in medical applications: patient data is sensitive, so you want to keep it where it is.

Does the abundance of ML in our daily lives scare you?

ML has an increasing influence on our daily lives and people are often not aware of this. Examples are the keyboard in your phone, digital assistants, advertisements on the internet, translation services. All these applications are fueled by ML methods. Yes, sometimes this scares me a bit. Often we do not exactly know how companies use our data. This is a challenge for regulation; the European Union, for example, is thinking about how to encourage the use of fair and privacy-assuring algorithms.

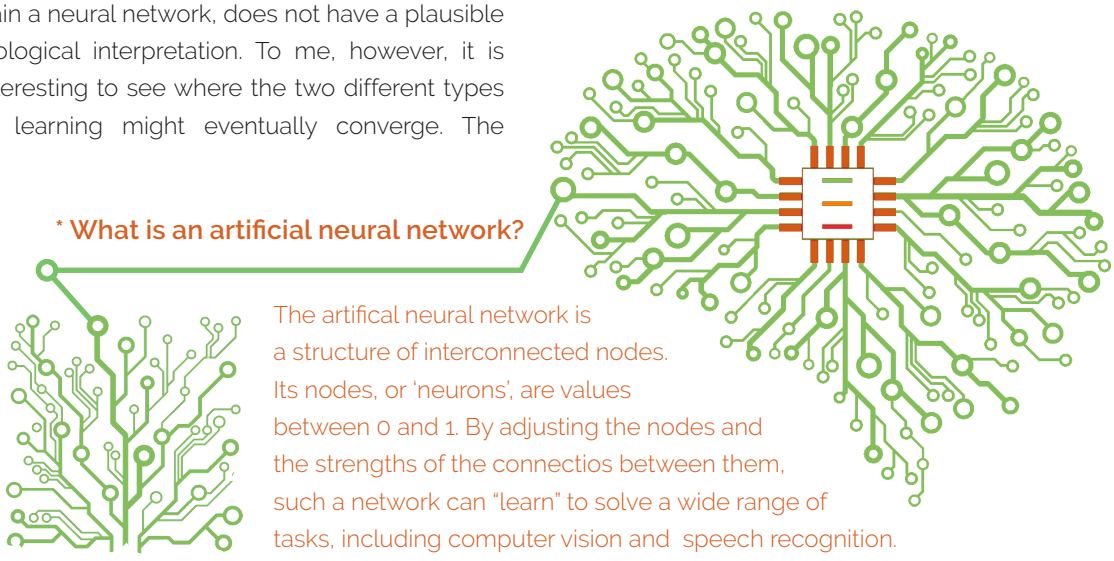
The 'artificial neural network' *, a popular ML model architecture, is said to be inspired by biology. What is the relation between human and machine learning?

<Laughs> This relation is a big debate. ML follows more of an engineering approach; computer scientists aim to make models work without bothering whether ML is necessarily similar to biological learning. There are fundamental differences between the two types: for example the "backpropagation" algorithm, which is used to train a neural network, does not have a plausible biological interpretation. To me, however, it is interesting to see where the two different types of learning might eventually converge. The two fields positively influence and inspire each other. ML schemes that practically work but are biologically not realistic can be improved by ideas from biological networks, so it can be fruitful to find connections between the two.

"To me, it is interesting to see where biological and machine learning might eventually converge"

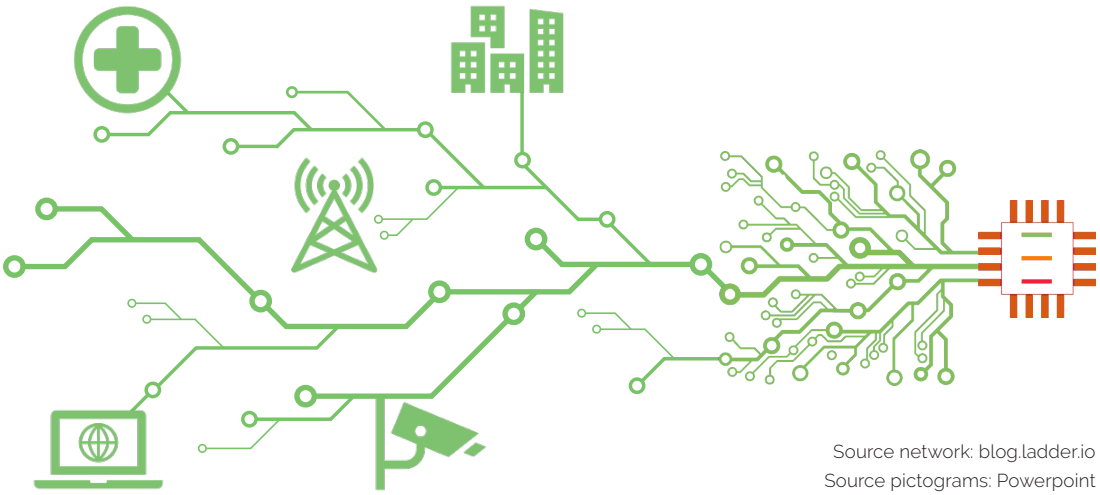
So you think biology can give new insights in ML?

Yes, I think this is an inspiring topic and there are groups at many universities working on this. Neuroscience can inspire the algorithms' design, for example to make training faster: ML algorithms are currently trained sequentially, whereas biological neural networks are always active and can train in parallel. Biology might teach us to have many computer units work together to increase training speed. There are, by the way, many applications of ML in biology, ranging from image analysis to signal processing to genomics.



*** What is an artificial neural network?**

The artifical neural network is a structure of interconnected nodes. Its nodes, or 'neurons', are values between 0 and 1. By adjusting the nodes and the strengths of the connectios between them, such a network can "learn" to solve a wide range of tasks, including computer vision and speech recognition.



Source network: blog.ladder.io
Source pictograms: Powerpoint

What are the biggest limitations of ML?
A lot of ML models are limited to one specific task, so there is little generalisability. Humans can transfer an ability they acquired doing one task to another, but computers mostly cannot. Also, computers currently learn with poor efficiency compared to humans because they need much more training examples. Other challenges are the privacy and fairness of ML models.

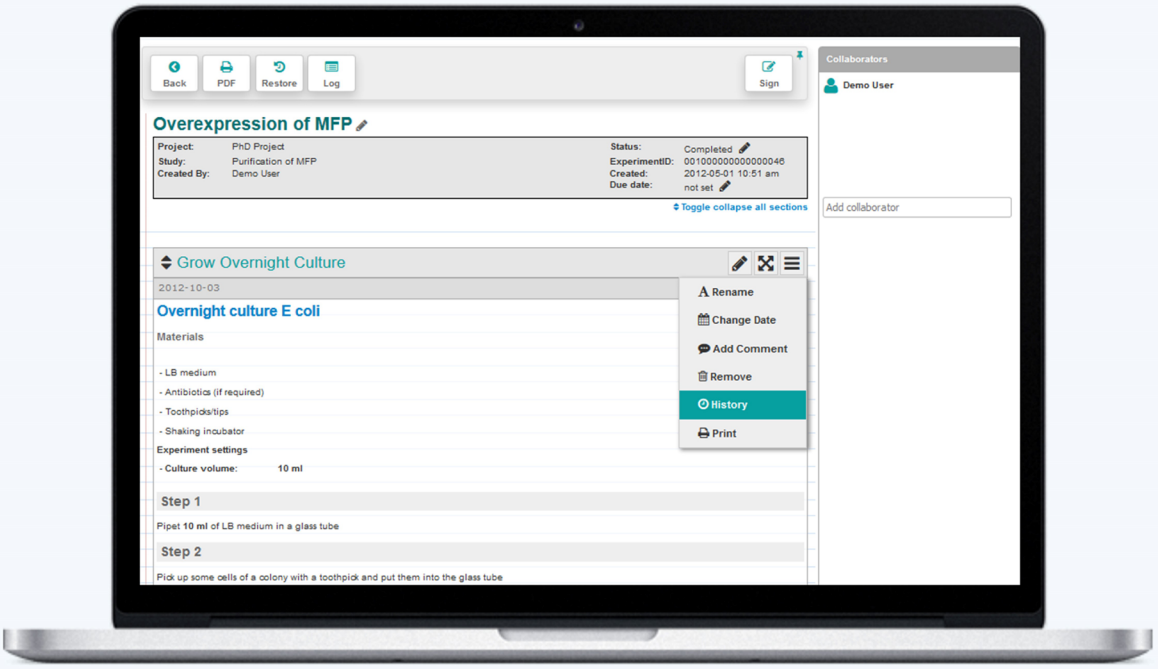
Where do you see ML in ten years?
ML is expected to surpass human accuracy on very specialised tasks, but I don't think we will soon achieve reliable transfer of 'knowledge' from one task to another.

What do you say to people who are worried that computers will surpass human intelligence?
This is an important philosophical question, but it is hard to formulate what we mean by 'intelligence'. To be a perfect translator from French to English is one thing, but I think human intelligence is much broader than one specific task. Still, it is an important question to which I do not have the answer. We should educate people about ML methods, the relevant mathematics and computer science background so we can make better informed social decisions.

However, people should also not forget many important near-term ethical issues in society, such as how ML systems can influence public opinion or how to achieve a better alignment of the utility, control and privacy of such systems. I think those problems are more important to solve in the next ten years.

"To be a perfect translator from French to English is one thing, but I think human intelligence is much broader than one specific task."

Do you have a message for the mRNA readers?
It is an exciting time with the current technological transformations, and as a student today you are in a unique position compared to your older colleagues with a more 'traditional' background concerning their studies. I think it can be rewarding for the future to be open to nontraditional and interdisciplinary applications which bridge techniques and ideas from different fields.



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MRNA FOR A LIVING
IN THE FIELD

This time for In the Field, mRNA went professional! Joined by our friends from dsDNA, we visited the redaction of the successful Dutch newspaper NRC. We will gladly share what we gathered from our visit in the next few paragraphs.

NRC is a serious newspaper, with serious news, written by people who do what they do with dedication. When we got there we found a surprisingly open workspace, with non-assigned desks and a relaxed environment. Even though people were working hard, it felt light and pleasant.

We were escorted to a conference room by our lovely tour guide, Marissa, where she answered our most pressing questions about how such a big newspaper keeps running smoothly. The mRNA is mostly focused on science, so imagine our glee when the editor of the science editorial office of NRC, Lucas Brouwers, gave us a run-down on how he runs his department. In short: it is a lot of work! First of all, there are so many articles published in various scientific journals every day that one can simply not keep up. Therefore, they have to sift through the most important ones, for example from major journals. Furthermore, the department has few people, only about ten, which is actually more than usual for a media science section. These few people must 'translate' the news into a format that people can digest and enjoy, while keeping the science as accurate as possible. Are we not lucky we publish for Nanobiology students?

After the conversation, we were given a comprehensive tour of the NRC office. We got to see the different departments and even got a peak of the editor-in-chief of the newspaper! Overall it was a very exciting experience that shed quite a bit of light on the current state of the media. The people at NRC were more than accommodating and very eager to answer our questions, making the day fun and informative for all of us.

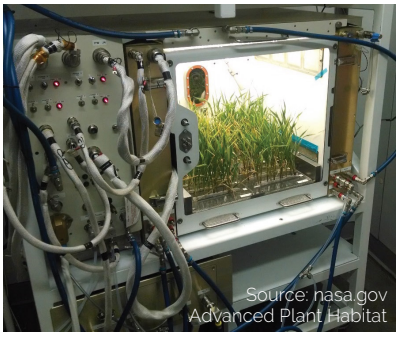
SPACE PLANTS

SCI-FI

We currently find ourselves in a new age of exploration as we explore space further and further. In our last age of exploration we encountered a problem as the journeys became longer: scurvy. Sailors contracted this disease due to a lack of fresh produce, causing vitamin C deficiency. As space journeys are becoming longer and sending shipments is getting more and more difficult, we have to investigate a new way of getting fresh produce to our space sailors and prevent them from getting vitamin deficiencies: agriculture in space.

Not only do plants provide the sailors with the required food and vitamins, they also produce oxygen from carbon dioxide and provide a refreshing environment. Furthermore, were it not for plants, our astronauts would only be accompanied by their colleagues, and the spaceship would be quite lifeless. Moreover, it is suggested that humans have a tendency, an urge, an instinct to look for nature and life, which is called the Biophilia hypothesis. Plants can help them with that by providing the space sailors with something to look after, to focus on, and to be with.

Plants have always had a place in our history of space exploration. It all started in 1946 when some seeds were launched into space. Among the first few were maize, rye, and cotton. In the '70s, tree seeds were flown in an orbit around the moon and afterwards planted on earth. Later, crops were grown in space stations and sent back to earth for further investigation.



Source: nasa.gov
Advanced Plant Habitat

These crops have been grown in special devices, most notably the Vegetable Production System (Veggie) and the Advanced Plant Habitat (APH). The main difference between the two is that the APH is more advanced; it monitors the plants better and they need less care from the astronauts. In these space gardens, plants grow on a "pillow" of porous clay, which makes sure the plants have a healthy balance of air and water around the roots. Since gravity is barely present, the plants use light to guide their growth.

Research into the symbiosis between plants and animals is also conducted. In 2018, a Chinese space mission launched a moon lander which contained a Lunar Micro Ecosystem. This was a cylinder with several plants (producers), yeast (decomposers), and fruit fly eggs (consumers). The researchers hoped that a symbiosis between them would be reached and thereby a biosphere would be created. Unfortunately, once on the moon, the module experienced a temperature drop and could not be heated properly causing the experiment to be terminated.

We have now looked at some of the plants that grow in space, but very space-like plants can also be found here on earth, I decided to go look for them!

For this article, I visited the Hortus Botanicus in Leiden, where I was guided by the "kaschef", Rogier van Vugt. It was a great experience!


Source: instagram.com/rogiervanvugt

Haworthia

This weird plant was clearly one of the favourites of the kaschef. The biggest part of this plant lies beneath the soil but its tips lie just above it. These tips are translucent and are made of a jelly-like substance, containing a crystal that diffracts the light in such a way that almost all sunlight reaches the chlorophyll in the green parts of the plant and can be used for photosynthesis. This is really amazing as the green parts of the plant lie beneath the soil (which makes it less visible to animals, thus less vulnerable) and would not get sunlight otherwise!

Hydnophytum

This cool plant is an epifyt, meaning that it naturally grows on other plants. In its big bulb it stores water, nutrients, and ants. These ants bring nutrients to the plant and protect the plant against animals that threaten it. In return, the plant provides them with a safe home, mutualism at its finest!

I would like to thank the Hortus Botanicus Leiden, and in particular Rogier van Vugt for guiding me through the Hortus.

Platycerium

This plant is truly a plant with green fingers: it makes its own compost! In nature, it hangs from a tree branch and it makes the compost by catching leaves, branches, flowers, insects, and everything else that falls from the branches above it. It does this with the brown leaves that you can see, which form a sort of bowl where the composting takes place. The compost then provides nutrients to the green fertile leaves, by which the plant spreads its genes.


Source Heidi: surethingpc.com


BACK


kohana
las palmas


Genesis


Credits to Fotosynthecie for the pictures!

WHAT IF...

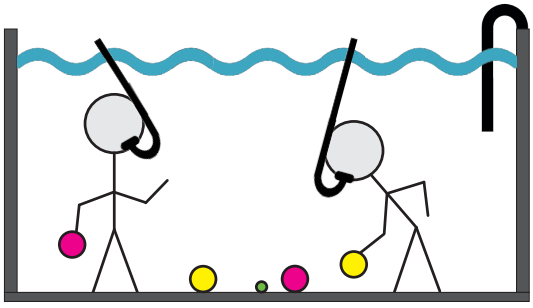
SCI-FI

What if people were not able to walk anymore, or what if we could travel with the speed of light? Inspired by Randall Munroe's book '*What If?*', we tried our best to answer two burning questions.

What if we did not have vocal cords?

Speech has always been a valuable asset to us humans. It allowed Churchill to activate Britain with his famous "We will fight them"-speech, and makes it possible for us to listen to the songs of Queen and, of course, S&S lectures (the effectiveness of the latter is still being debated).

By looking back in time even further, we can see that auditory communication has proven itself to be a more useful way of communication than, for example, sign language. The reason we can conclude this, is that humans were already capable of using sign language before speech, but speech has nevertheless developed to be our main method of communication.



It is interesting to wonder about how we would have developed without speech. Of course, we could communicate with each other in many ways: using facial expressions, hand gestures, or clicking with our tongue to produce some sort of morse code.

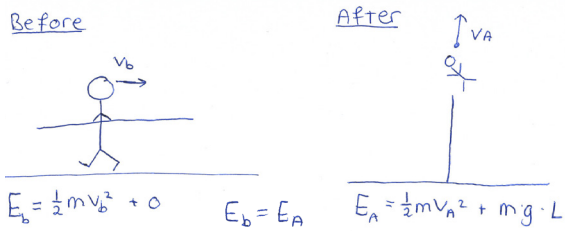
We believe that we would, in any case, have developed some sort of loud auditory communication through natural selection, useful to warn others about dangers and scare away animals, both of which would increase our chance of survival!

Maybe we would have evolved into a whispering species, as whispering does not require the use of the vocal cords. If we had, our lungs would probably be a lot bigger, as we would need a much greater lung capacity to blow out enough air to make our whispers louder than the ones we can produce now. These bigger lungs would also allow us to stay underwater for longer periods of time, which comes in very handy if you want to win in underwater pétanque (see image). We might also have evolved huge ears to hear the whispers better. How would all this affect our lives? We would lose a lot of heat through these huge ears, which is very nice during a hot summer, but during the winters our ears would be freezing off. Headphones would become huge. How would we fit those into our bags or around our necks? Would microphones still work with the increased air displacement, or would we hear a constant white noise during our analysis lectures?

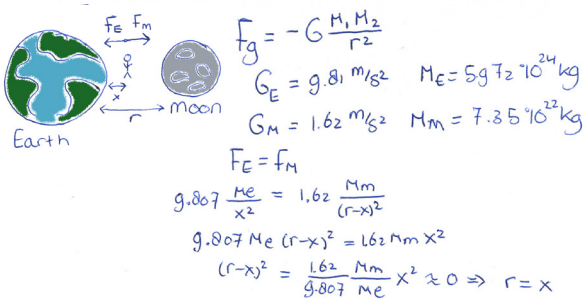
What if a person wanted to jump to the moon using a pole; how fast should they run?

To analyse this situation, we first need to make a few assumptions:

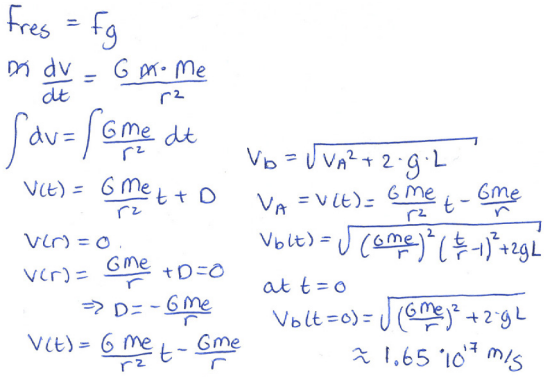
- We ignore the atmosphere around the earth and therefore air resistance.
- The pole that is used is a very strong pole with zero mass and length L=4.5 m.
- After the jump, the person who jumped will move vertically upwards.
- This person is not going to die while undertaking this exercise.



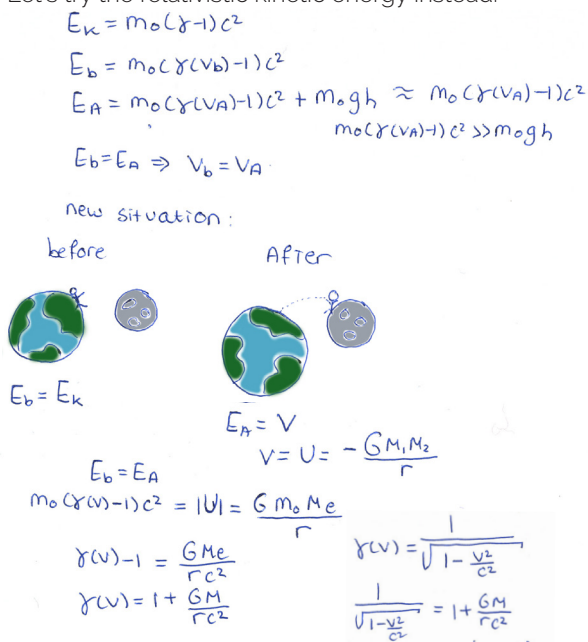
The situation can be visualised as followed:
How do we find the velocity after the jump?
First step: Determine the distance between the earth and the moon.
Since the moon follows an elliptical path around earth, we take the point at which the moon is closest to the earth, which is at r=355000 km according to wikipedia.
Second step: Determine at what distance the gravitational force of the moon is stronger than that of the earth.



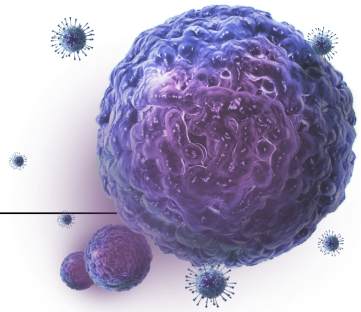
Third step: Apply Newton's second law to find the velocity of the person. We assume the boundary conditions v(r)=0 so that the person will not hit the moon.



The final velocity is approximately two times the speed of light. Obviously this will not work, but that is because we did not use special relativity. Let's try the relativistic kinetic energy instead.



The remaining question is: where can I buy a massless unbreakable pole?



T CELL THERAPY AND HIV VACCINES

NANONEWS II

New T Cell Senses Most Types of Cancer

Researchers at Cardiff University have had a major breakthrough in the fight against cancer. According to their study, recently published in Nature Immunology, they identified a T cell able to sense cancerous cells, while ignoring healthy cells.

T cell, or CAR T, therapy is not new, though it was proven to be of limited use. Furthermore, it must be tailored to each patient, as the antigens presented by the affected cells vary. However, according to the study, this new T cell interacts with the MR1 receptor, which is not patient- or cancer-specific. As a result, it has a lot of potential to detect and fight most types of cancer, without the cost of having to engineer new receptors every time.

Cardiff University hopes to have their new therapy in the human trial stage within the year. We are curious about new developments.

Drug Target Review. 2020. New T-Cell Therapy Could Provide Universal Cancer Treatment. [online] Available at: <https://www.drugtargetreview.com/news/55206/new-t-cell-therapy-could-provide-universal-cancer-treatment/> [Accessed 14 March 2020].

One Step Closer to an HIV Vaccine

In the past years, HIV/AIDS seems to have slipped under the radar. With the development of medication that keeps the disease under control or even prevents it from being contracted, the Western world seems to have neutralized the threat. It can be easy to forget, however, that most cases do not occur in the Western world, but in Subequatorial Africa.

In those areas, prevention is not easy. Furthermore, the stigma of AIDS and the high cost prevent people from seeking the treatment they need. As a result, deaths as a consequence of AIDS were up to 239/100000 people in 2007.

In response the HIV Vaccine Trials Network is currently working on clinical trials on two novel vaccine strains, in the hopes of combatting this epidemic, however this is not an easy task, considering the virus' complexity and mutation ability.

A previous effort of the international collaboration has shown a 30 percent effectiveness in a study conducted in Thailand. Dr. James Kublin, executive director, is hopeful that this new effort will have an even greater success.

seeker. 2019. The Search For An HIV Vaccine Might Soon Be Over. [online] Available at: <https://www.seeker.com/videos/health/the-search-for-an-hiv-vaccine-may-soon-be-over https://ourworldindata.org/hiv-aids> [Accessed 14 March 2020].

Source: scitecheuropa.eu
Source cell: focusedcollection.com

SUNSPRING

MRNA REVIEWS

A concept that occurs in many science-fiction movies is artificial intelligence (AI). Be it robots taking over the world or talking cars, people are fascinated by computers thinking for themselves. Rightfully so, because computers can do awesome stuff, and their abilities will only increase with time. But what if you would combine current artificial intelligence with these movies?

That is exactly what the makers of the short film *Sunspring* did. They fed a computer hundreds of sci-fi movie scripts, including those of *Star Trek*, *Men In Black*, *Jurassic Park*, and *Frankenstein*. The AI printed out a script for a short film of about six minutes, starring three characters.

During the whole film, it kind of feels like you are watching a French movie without subtitles. You hear some familiar words, but you never seem to understand a whole sentence, let alone the dialogue. Sentences have no correlation whatsoever. The only things that get repeated quite often are sentences like "I don't know what you're talking about", which is very accurate for this movie.

Without any children or rocks ever being mentioned before, the main character says "Nothing is going to be a thing, but I am the one who got on this rock with a child, and then I left the other two".

Right after, a telephone rings, and then a song plays. The lyrics of this song are also written by the AI, and this is a snippet of the beautiful, meaningful lyrics:

"I was a
Beautiful day
I was a taller talk that I was born
And I was
Ready to go"

Random stuff like that happens all the time in the movie. For example, a random black hole opens up in the ground or a character spits out an eyeball and then continues the conversation like nothing has happened.

At the end of the movie, the female character delivers a moving speech, save for the fact that it is completely incomprehensible. The more you try to make sense of it, the more your head hurts. All three of the actors deliver their lines with such seriousness, that it almost feels like a "real" movie. The seriousness only makes the random dialogue weirder.

Everything considered, it is definitely an interesting movie to watch. Not because it is good, it is absolute rubbish, but it is really cool to see what artificial intelligence "thinks" of science-fiction movies. Also, the effort that was put in the acting and the special effects is to be appreciated.

Source: imdb.com

Source: cmbo.nl

Source: thequint.com

DE DIKKE ALG: AN INTERVIEW WITH PETER MOOIJ

INTERVIEW

I first noticed Peter Mooij while I was watching a video of him very enthusiastically explaining his ideas on algae to an audience. After some googling I found out he had even written a book about them! We met in Zandvoort and talked about his current line of work, his love for algae, and making the world a better place.

In his PhD 'Lipid and sugar production by mixed cultures of microalgae' Peter tried to get algae to grow in a manner such that the maximum amount of oil could be produced. In 2017 he wrote a popular book; 'de Dikke Alg'. Here Peter describes why algae have played an essential role in the development of life on earth, but most importantly how these algae could save the earth. The informative storyline is accompanied by a storyline on Ritsert, a friend of Peter. Ritsert aims to build a motorcycle entirely from wood and other biobased materials. The goal is to make a wooden motorbike which can drive on algae oil, provided by Peter's algae.

Why did you decide to start writing?

During my PhD, by chance, I had some press attention. I rolled into science communication and became interested in reaching the wider public. At some point, Ritsert and I decided writing a book would be an interesting and valuable project to venture on. Especially doing something like this with a friend makes it a lot of fun!

Source: bol.com

What are you currently working on?

For three years I have been working at the AMS institute, mainly guiding research projects. Currently, we are making composite materials from wastewater. Composite materials consist of fibres held together by a glue, both taken from wastewater.

Wastewater is full of toilet paper, and toilet paper consists of cellulose fibres. So, we can obtain high-quality cellulose fibres from wastewater.
The bacteria that clean the wastewater are, in some wastewater treatment processes, forced to grow in spherical granules. The bacteria stick together in a granule by producing a sticky biopolymer called Kaumera.

By combining the bacterial glue Kaumera and cellulose fibres, we can create strong and stiff composites materials from wastewater.

"I now work with bacteria, which are less fun to work with, I must say. They are a sort of brownish colour, whereas algae are a nice green"

AMS
AMSTERDAM INSTITUTE FOR
ADVANCED METROPOLITAN SOLUTIONS

AMS is a public-private institution, which was founded in 2014 by Wageningen University & Research, Delft University of Technology and Massachusetts Institute of Technology.

With Amsterdam serving as playground, research can be tested and applied in a metropolitan area. The research portfolio revolves around applied technology in themes such as water, energy, waste, food, data and mobility, and integrating these themes to create an innovative, sustainable and just city.

About thirty to forty researchers are working on these themes. The institute also offers education, in the form of the masters' programme MADE (Metropolitan Analysis, Design and Engineering). This programme houses around 80 students and focuses on our cities and metropolitan regions.

Peter's tip:

When you induce a certain genetic mutation, allowing a target organism to obtain a certain trait, you have to make sure it is in some way beneficial to the organism.

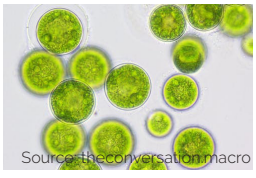
If the mutation has no added value, it will usually disappear from your population in seven to eight generations. This is fine for research, but if you want to find long term applications, you have to take the needs of your organism into account and fit your mutation to their needs as well as your own.

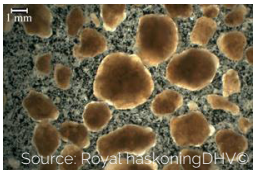
What made you turn away from your beloved algae?

I had been working on making algae as productive as possible for several years. Algae are very promising as an alternative to fossil fuels, as they can be grown in saltwater. However, the ease with which we can extract fossil fuels from the ground will prevent algae from being an economical solution. As long as governmental policies do not account for the carbon emissions in the use of fossil fuels, algae will be on the back foot. As the difficulties in realising algal fuel are mainly political and economic, I started looking for other research opportunities.

"When we have succeeded, I will look for other tricks nature has to offer"

I like to do research which contributes to a better, more sustainable society. Through my promoter I got in contact with AMS Institute and started working there. I now work with bacteria, which are less fun to work with, I must say. They are a sort of brownish colour, whereas algae are a nice green.


Source: theconversation.macro



Source: RoyalHaskoningDHV©

At AMS Institute I learned a lot about transforming research into societal applications.
The goal for the next years is to create a high-value composite building material for the city by using urban wastewater, and subsequently see which other urban waste streams we can upcycle using all the opportunities nature offers. When we have succeeded, I will look for other tricks nature has to offer.

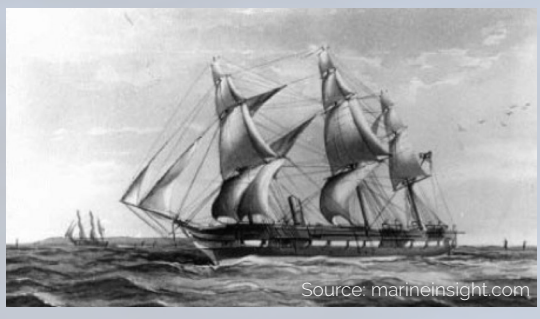
DEEP SEA EXPLORATION

SCI-FI

In many ways, deep sea exploration is not unlike space exploration, although the deep sea is definitely not as popular as space. However, it just might be more uncharted, exciting, and challenging to explore. Life in the seas is booming, evolution is all around, and we are at the forefront of exploration. But just what are the challenges that we face? What would we find if we were to venture down far below?

Water is a very avid light absorber. At a depth of just 200 meters below sea level, the amount of sunlight becomes insufficient to perform photosynthesis; the twilight zone starts. All colours of light, except for deep blue, are absorbed. At roughly 1000 meters, also this blue light vanishes into thin air. Night falls in the ocean. Venturing this deep poses many challenges. Due to the absence of photosynthesis there are very little nutrients present. Organisms have to survive at high pressure, which increases by 1 atmosphere every 10 meters. Temperatures fluctuate from -1 to 4 degrees Celsius. [1]

Up until the 19th century, it was common belief that the deep sea was a lifeless wasteland. The first steps in flipping this viewpoint were taken by the crew of the HMS Challenger through a series of discoveries made from 1873 to 1876. Using trawls and dredges, and supplied by a stock of 291 km of Italian hemp, a whole new world of biodiversity was discovered. By chance, the crew of the Challenger came across the deepest point on earth, later named the Challenger Deep, at roughly 11.000 meters below sea level. [2]

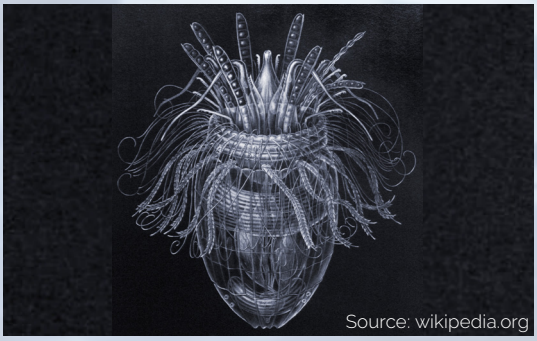


Source: marineinsight.com

The next step was to have humans visit the depth themselves. The first manned vessel to reach the Challenger Deep was the Bathyscaphe Triëste. A large tank filled with gasoline allowed for a free dive, providing the needed buoyancy. This tank was accompanied by a small pressure sphere for the crew. In 1959, a series of deep dives in the Mariana Trench were performed. On the 5th of October, after cracking one of the outer plexiglas windows during descent, the bottom was reached. [3]

In modern deep sea exploration, little exploration is done by manned vehicles. The predominant techniques are either ROVs (remotely operated vehicles) or AUVs (autonomous underwater vehicles). Together with technologies such as echo-sounding instruments, seismographs, thermo- and pressure meters, and high resolution cameras the majority of the ocean floor has been mapped and many astounding discoveries have been made. [4]

Source: oceannews.com


Source: wikipedia.org

Loriciferans are the first known multicellular organisms living continuously without oxygen. They were discovered in 2010 in oxygen-depleted waters in the mediterranean sea. [7]


Source: sciencemag.org

Most fish and vertebrates have one or two RH1 genes, which encode for retinal proteins, used to detect dim light. Silver spinyfin were found to have 38. To them the faint bioluminescence in the deep dark sea might seem as bright as a full moon and starry night. [8]

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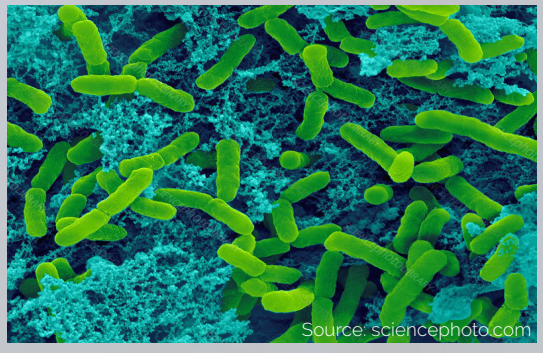
8.Pennisi, E. (2019, May). In the deep, dark, ocean fish have evolved superpowered vision. sciencemag.org/news/2019/05/deep-dark-ocean-fish-have-evolved-superpowered-vision

Most of the nutrients in the deep sea come falling down in the form of marine snow. Marine snow consists of the remains of dead animals and plants living near the sea surface. [5]


Source: news.algaeworld.org

These bacteria use the geothermal radiation that is emitted by hydrothermal vents on the seabed to perform photosynthesis [6]

In many ways, deep sea exploration is not unlike space exploration. We know less about what is in our waters than about the surface of the moon. With extreme conditions, abundance of life, and many challenges to overcome, the deep sea offers a playground for new and exciting research. I can recommend the BBC series 'Blue Planet', for a more in depth representation of our waters, to everyone!


Source: sciencephoto.com

STRING THEORY

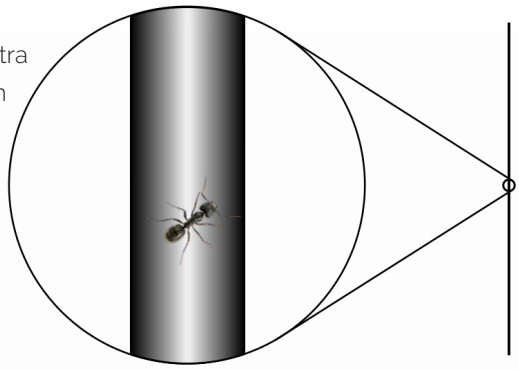
SCI-FI

In our ordinary daily life we describe the world around us using the laws of physics. All the different forces can be explained through two basic principles: general relativity (GR) and quantum mechanics (QM). QM explains electromagnetic forces, weak forces (responsible for radioactive decay) and strong forces (responsible for nuclear interaction), while GR explains gravity. These theories work independently, but combining them has been impossible so far. GR is an ordered and predictable theory while QM is chaotic and unpredictable. So how can we build our theory of everything to describe how space and time started?

One of the proposed theories is the string theory. According to this theory, all existing particles are not composed of matter but of vibrating strings of energy. These strings all vibrate with specific frequencies, and combinations of vibrating strings form different particles. If we would compare the vibrating strings to a piano, playing a C and a G would form an electron, while playing an A and an F would form a proton.

The first version of string theory was introduced in '70s, but in this version there were many mathematical inconsistencies, called anomalies. However, in the next decade John Schwarz and Michael Green came together to solve these mathematical inconsistencies in the string theory. After a great effort, they proved that their version of the string theory has space-time supersymmetry, which implies that a particle from one group has a partner from another group. For example; particles with half integer spins (fermions) have a partner with a full integer spin (bosons).

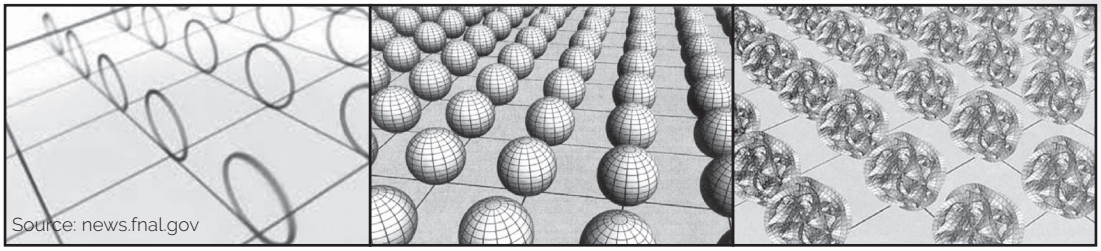
For this theory to work, string theorists needed extra space for strings to vibrate in: higher dimensions. In 1919, mathematician Theodor Kaluza proposed that electromagnetic waves are ripples in a fifth dimension, just like gravity is ripples in time and space.



Source: nl.wikipedia.org

To explain his idea, Kaluza introduced an additional hidden space dimension in the space-time continuum that we observe. This can be visualized as a thin rod; from far away a rod seems to be a line (1D-perspective), but when you take a closer look you can see that small animals, such as ants like Heidi, could walk along the rod and around it (2D-perspective).

To allow the string theory to work, not one, but five higher dimensions are needed to explain all the different vibrating modes. When accepting this very unintuitive principle of higher dimensions, all forces can be explained using strings.



Source: news.fnal.gov

Why are we still learning about Bohr's model if this sounds so plausible? Well, one of the major drawbacks of string theory is the lack of experimental evidence. Since the higher dimensions can not be observed by us, we could never measure these vibrating strings. Another interesting side effect of the string theory is the existence of five different versions. All of them include strings and higher dimensions, but in some versions the strings are open-ended strands and other versions require 26 higher dimensions. So which version describes our universe correctly? Also, if we live in one version of the string theory, does that mean that there are parallel universes with different rules?

That sounds like music to my ears, or could it just be the strings in my ear that are vibrating?

QuiremSpheres®

TRANSLATING CUTTING EDGE SCIENCE TOWARDS REAL WORLD APPLICATIONS - QUIREM

Have you ever wondered working for a scale-up company that is in early phase of commercializing an innovative therapy for the battle against cancer?

Quirem Medical develops and commercializes radioactive microspheres based on the isotope Holmium-166 for Selective Internal Radiation Therapy (SIRT) of liver cancer. The safe and effective treatment option originated from the UMC Utrecht in The Netherlands and has gone a long way to get from an idea to a marketable product.

With SIRT, patients suffering from liver cancer are treated by infusing the liver with millions of radioactive microspheres. By injecting in the hepatic artery and because of the preferential blood flow from that artery towards liver tumour(s) the microspheres accumulate in and around the liver tumour(s). The tumour cells are then killed by the locally delivered radiation dose. In this way, a relative high radiation dose is delivered to the tumour(s) while the healthy liver tissue receives a much lower dose. Holmium-166 microspheres are next-generation microspheres that can be visualized and quantified outside the human body to improve patient selection, therapy planning and treatment verification of the SIRT procedure.

Meet Maurice Vink, graduate student Science and Business Management and Junior Product Manager at Quirem Medical. He started as an intern at Quirem Medical to learn how scientific developments are translated to valuable products for patients with liver cancer. We asked Maurice a few questions about his experience at Quirem Medical.

What did you do and learn during your internship at Quirem Medical?

The internship opportunity at Quirem Medical was exactly what I was looking for. I had to deep-dive into the science behind the product to subsequently participate in various product optimization projects. This means that I had to ensure that product developments were sound from a scientific, regulatory, customer and business perspective. This enabled me to understand the complete process from the initial product design towards its implementation in clinical practice.

Why did you choose to work for a scale-up company?

The scale-up environment is a work environment where I was really looking for as it requires you to work on different disciplines at the same time. It regularly occurs that on the one day, I am attending a clinical case in the hospital and on the next day I am investigating a completely new business opportunity for our product.

How would you describe your function as Jr. Product Manager?

As product manager, you are responsible for driving business opportunities and creating new products & solutions from idea to market. This obliges you to interact directly with Research & Development, Regulatory Affairs, Project Management and Product Specialists in the field.

What should be your background to become a Jr. Product Manager?

I have a master's degree in Life Sciences and Business Management, but this was my first working experience within a scale-up medical device company. Previous work and internship experience emphasized my scientific competences, analytical mind-set and self-supporting attitude. However, the most important part is to have a positive attitude and have a real interest in translating science into real word applications.

Are you interested in performing an internship or to start working on the interface of science and business? Please visit us on www.quirem.com or send your motivation to hr@quirem.com.

Source: wallpaperplay.com

ROBERT HOOKE IN OUTER SPACE

SCI-FI

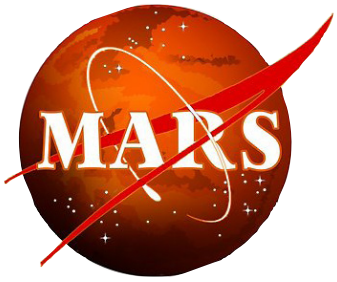
For this segment, let us take a look at a day in the life of Robert Hooke, a newly arrived PhD student at the Mars Research Colony.

Robert J. Hooke @robbyjh - 8h35m
Landed on Mars after six months. All my respect to the captain of the Santa Maria for dealing with us for so long. I don't envy his job. I missed you, sweet gravity! #MarsResearchColony #SmoothLanding
25 70

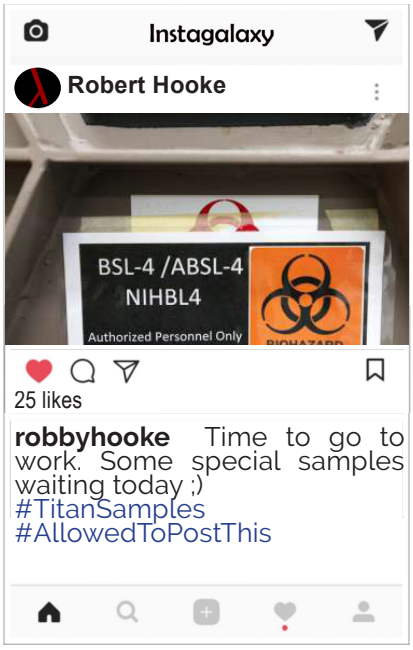
Robert J. Hooke @robbyjh - 6h
Meeting my supervisor today! That is if I can find the mess hall. Why does everything look the same in this colony?
#MarsResearchColony #Lost #Help
2 15

Robert J. Hooke @robbyjh - 8h35m
Never skip decontamination day! Seriously...Don't!
#MarsResearchColony #Clean #Not4Drinking
5 30

Robert J. Hooke @robbyjh - 15m
Home sweet home! Have we established if interplanatery jetlag is a thing yet?
#jetlag #bed #Mars #2tired4hashtags
10 35



Source: redbubble.com



JUST ANOTHER ADVENTURE AT THE FARM

RANDI

>> rng ('shuffle');
>> randi(nr_leden)
ans = 13 %Anna Daamen

Try to imagine: you're about to leave to have drinks at the pub with your friends when all of a sudden you see your father rushing towards you, saying he needs help because a cow is giving birth. Or you were about to put on a nice dress for Christmas but instead you have to put on overalls so you can help your brother prepare a cow for surgery. You might not be familiar with these kinds of situations. To me, they're just another adventure on the farm.

My name is Anna Daamen and I'm a Nanobiology master student. Before moving to Delft, I lived on a farm with my parents, brother, and sister. I grew up there and have very fond memories of the place. I still go back quite often to help out my father. I started helping him on the farm as soon as I could walk and put on boots. Of course, the little calves were my favourite.

When I was about four years old, I loved every single calf. However, my dad couldn't keep them all so every time I saw the truck of the cattle dealer I cried my eyes out. "Why do they have to leave, can't they all stay here?", I asked my dad.

He replied: "We have boy and girl calves. The boys don't give any milk. We can only keep calves that give us milk when they grow big." I was sad, but I understood.

"I started helping him on the farm as soon as I could walk and put on boots."

So from that point on, every time a new calf was born, I asked my dad if it was a boy or a girl. I remembered which ones were boy calves, and I didn't cuddle as much with them so I wouldn't get too attached. But then one month, we had so many girl calves that my father simply wasn't able to keep them all. He didn't have the space. So he sold one.

I was furious, that was not the deal! My father tried to explain but I was too disappointed. I was four years old though, so after a nap I forgot we had even had a fight. Today, I understand way more about life on a farm and the tough decisions my father has to make. And when I'm at home, I pet every single calf because they are just too cute to resist!

The **Dutch Biotechnology Association (NBV)** is the professional association for all professionals in the field of applied Life Sciences. A valuable network with over 800 members from different disciplines; from the business sector to education. The NBV aims to stimulate professional activities and corporate social responsibility. Knowledge exchange and networking are the main factors. Become a member and join our activities: https://nbv.kncv.nl/en/

Activities

- March 19, 2020 (Berkel en Rodenrijs): **View into the green kitchen** Green Biotech symposium at the company Kopper Biological Systems. Koppert Biological Systems offers sustainable solutions for the agriculture and horticulture.

- Sunday June 28, 2020 (Maastricht): **NBC-20 Beyond Borders** Netherlands Biotechnology Congress (NBC-20) is a yearly conference with scientists representing Dutch Biotech industry and academia. Be inspired during the parallel sessions or by the keynote speakers: Mark Post (Mosa Meat & Maastricht University), Frances Arnold (Nobel Laureate 2018, Caltech) and John van der Oost (Wageningen University & Research).

- Sunday June 28 – Wednesday July 1, 2020 (Maastricht): **ECB2020** Together with the European Federation of Biotechnology (EFB), the International Union of Pure and Applied Chemistry (IUPAC), the Asian Federation of Biotechnology (AFOB) we organize the 2020 **European Congress on Biotechnology (ECB2020)**. More information on the website: https://www.ecb2020.com/

Nederlandse Biotechnologie Vereniging